April 28, 2025

Illinois Pollution Control Board
60 E. Van Buren St, Ste 630
Chicago, IL, 60605

Submitted Via Email to Clerk Don Brown (Don.Brown@Illinois.gov)

Re: Proposed Clean Car and Truck Standards (R-2024-17)

Dear Members of the Board:

I am writing to support the adoption of all three regulations before you – the Advanced Clean Cars 2 Regulation, the Advanced Clean Trucks Regulation (ACT), and the Heavy-Duty Low NOx Omnibus Regulation. My focus for these comments is ACT, which has received some misplaced industry opposition even though it is both achievable for Illinois and clearly in the public interest. I am the former Deputy Executive Officer and Assistant Chief Counsel of the California Air Resources Board (CARB) and oversaw these same regulatory programs which are now before your consideration. Though I am speaking for myself as an independent consultant, I draw upon my nearly twenty years of environmental program design experience, including on all three rules for this comment. I respectfully urge you to join other leading states and adopt these rules.

In this letter, I hope to provide you with resources for your ongoing consideration; as you will see, the evidence strongly supports adoption. I've organized my comments by topic.

I. Availability and Pricing of Heavy-Duty Zero Emission Vehicles

The zero emission truck (ZET) market is rapidly maturing, with the bulk of sales in the U.S. in states that have already adopted ACT. If Illinois adopted the rule, it could expect significant sales increases, with resulting pollution declines. Critically, the world market as a whole is moving towards ZETs – meaning that jurisdictions that align policies to support efficient, electric, supply chains early will have a long-term advantage in logistics. As a major freight hub, Illinois has, in my view, a significant interest in beginning to move its systems towards the emerging global standard – and shedding long-term exposure to long-term diesel fuel costs.

Multiple analysts expect the long-term fuel and maintenance savings associated with zero emissions trucks to fully counterbalance their currently higher upfront costs within the decade. McKinsey projects this "total cost of ownership" (TCO) parity between 2026 and 2030. The federal National Renewable Energy Laboratory has reached similar conclusions, with lighter vehicles (like vans) reaching TCO parity or better shortly, and long-haul trucks following thereafter. The International Council on Clean Transportation (ICCT), a well-regarded expert group, projects cost parity or better by 2030. The ZEV Transition Council has helpfully compiled a long-list of expert studies, all of which generally accord. CALSTART, a multi-industry-group consortium, unsurprisingly documents considerable commercial interest, with over 17,000 ZETs already in the market as of 2023 – a steep year over year increase that has continued, with a proliferating variety of models and makes available in all vehicle classes covered by ACT.

The market has, in fact, advanced even more quickly than my former team anticipated in initial regulatory documents (I append both their initial and final analyses, along with their market and economic analyses). Indeed, manufacturers had sold 60% *more* ZETs than were needed for compliance with ACT in California over a year early. When CARB recently passed the more ambitious Advanced Clean Fleets regulation, it had good reason to be even more bullish on the path forward, as the regulatory documents demonstrate (again, I append both initial and final analyses, including an economic analysis showing very large benefits from ZETs). Staff also compiled a list of 155 different ZETs available at that time (appended); the number has grown since. U.S. EPA has also finalized a federal program that, even if modified as it may be by the current administration, is now in force and will further grow the market.

Notably, the global market is even more advanced than the U.S. market. ZET sales are racing ahead in China and India and the European Union is also seeing steady sales growth. New heavy-duty market entrants, including Windrose and Tesla are advancing the state of the art, while major trucking firms, including Daimler and Volvo, have announced their long-term commitment to a ZET-based future. Further, California's Clean Truck Partnership deal secured manufacturer commitments to continue making and selling ACT compliant vehicles regardless of federal and state regulatory changes, so the U.S. market is well assured to continue.

I will note one wrinkle. A few ACT states have recently adopted various forms of enforcement discretion in response to industry pressure as firms seek a slightly longer transition – but generally only for the largest truck classes, and for a few initial years. These flexibilities are limited, and all of these states have maintained ACT on the books as a critical medium-term direction of travel for their regulatory programs. In my view, these dynamics can largely be attributed to unfortunate pricing decisions by a few large firms who have opted to raise ZET prices in the near-term, likely to fund their long-term transitions.

These price increases are local and transient, can be addressed by state market oversight (e.g. Massachusetts recently provided some regulatory flexibility *only* if firms discontinued these tactics), and are also subject to oversight by state antitrust and unfair business practice authorities if they violate any relevant law. No wonder that governors implementing ACT responded to letters sent by environmental advocates by confirming they would stay the course. These issues will be resolved well before ACT could go into effect in Illinois, and the broad trend towards TCO parity globally – and the race by manufacturers to sell ZETs, along with ongoing multi-state oversight – will erase any current pricing variability. Neither these issues, nor the usual state-level implementation back-and-forth warrant a pause on adoption in Illinois, where years will pass before the rules take effect.

Should the Board have any remaining concerns, it also has mechanisms to address them in due course. ACT already has extensive banking and trading provisions, among other flexibilities, to support implementation. And it can also help ground a larger policy ecosystem that will increasingly take off under its own momentum as firms crowd into the space in response to regulatory certainty.

I know - as a former California official – that opponents often insist that no other state is California, but the truth is that the many other states implementing these rules have shown a clear path forward. Although I of course encourage Illinois to explore complementary policies, from indirect source rules to encourage warehouse electrification to incentive and feebate programs to support businesses, those policies are just that; complementary. The ACT program can operate well on its own, and gather further policy support over time as needed, as states across the country with a wide range of policy mixes demonstrate. The Northeastern states have long implemented these programs are rapidly moving forward and seeing their markets mature. And they are not alone: For instance, just as is proposed in the petition before you, Oregon recently adopted early action credits to manufacturers to ease the transition. This approach is tried and true: Colorado used a similar advance crediting approach to prepare its market to transition to electric cars; a few years later, its zero emission car sales have now topped California's. Illinois has ample time, ample flexibility, and ample tools to benefit from the global shift towards ZETs – and to lead it.

I reviewed opponents's comments alleging that Illinois's role as a freight hub, with bordering states, somehow obviates this analysis. That point appears to me to be entirely rhetorical. Most fleets in a given state operate *in that state* because most trucking trips are local – and serve local clients. As to long-haul trips, I can report that California, too, is a major freight hub, and does not border only ACT-adopting states. The practical reality is that ACT operates, nonetheless, to secure very substantial in-state benefits, from pollution reductions to new jobs, while the remaining trucks registered elsewhere simply continue about their business. Our federal system allows – and encourages – the states to solve problems where they can, while continuing to support our larger multi-state freight system.

Illinois has always been a crucial state to the shipping and logistics industries. If it takes advantage of this growing international market, now, by adopting ACT, it will ensure that its firms benefit, first, from the ZET TCO savings, and from attention by the large truck manufacturing companies, which focus sales efforts in ACT states. This is a chance to capture significant benefits, and to create a midwest market for the growing zero emission vehicle manufacturing industry, which may well wish to locate in Illinois to be near to new customers, along with a chance to secure a large share of the hundreds of thousands of jobs being created to construct and improve associated infrastructure. It will also, of course, save lives and realize over a billion dollars in avoided public health costs, per a recent analysis by the nonpartisan public health experts at the Clean Air Task Force.

Markets respond to regulation and this is a market ripe for change. Illinois can help shape that rapid shift to electrification to the benefit of its residents by adopting this rule, and can be assured of long-term cost savings and a growing ZET market.

II. Infrastructure Challenges are Opportunities in Disguise

Let me make an observation on one more common argument that industry lobbyists have raised in this proceeding, too – that EV infrastructure provision must be entirely solved before ACT can be adopted. The short answer is that Illinois does not, in fact, need to build everything, everywhere, all at once, as a thoughtful ICCT analysis demonstrates – indeed, a substantially greater amount of electrification than is initially required can be supported with a very focused set of investments along just 0.06% of U.S. roads. An independent CALSTART report confirms as much. Trucking activity is concentrated along a limited number of routes, meaning that focusing on key freight hubs and corridors is a highly effective strategy. The federal government adopted and extended these analyses with a recent federal infrastructure strategy that shows how this phased approach can readily meet electrification goals (summary slides lay out the case and detailed technical appendices include Illinois portions of that network that will be needed).

This is a very do-able task, especially with the leadtime Illinois will have and the growing waves of private investment entering this space in addition to public funds. Notably, ZET batteries can also serve to help balance renewable energy on the grid, and so actually help fund network expansion by acting as "virtual power plants" that can provide valuable grid services. So, the infrastructure challenge, in fact, is a major opportunity to integrate transportation electrification with Illinois's clean power goals. The two efforts mutually reinforce each other.

More generally, let me observe that this is not, in fact, a chicken-and-egg problem. Because of the phased nature of infrastructure needs, ACT implementation does *not* require a full build-out before it starts. On the contrary: adopting ACT provides investors in infrastructure, including utilities and truck companies, the certainty they need to build the network. The *first* step is setting the regulatory direction, followed by ongoing infrastructure efforts that are then supported by a growing ecosystem of investors.

III. A Word on Federal Government Activity

It is not lost on me that these programs are likely to come under federal attack – legally spurious though such potential federal administration efforts are likely to be. But this is a reason to proceed, not to pause. Twice now, despite the threat of legal uncertainty, vehicle companies have come to the table to *contractually* agree with the states to continue progress (a recent published article of mine describes this history). First in the light-duty-vehicle Framework Agreements during the first Trump Administration, and then in the truck partnership I noted above a few years ago, manufacturers have recognized their long term interest in a more certain path to electrification. I expect the same pattern to recur now, as manufacturers have invested billions into their zero emission vehicle production plans, and will not be able (or desire) to reverse course in light of growing global competition.

But it is states that have *adopted* these rules that benefit most directly from these deals, because it is those states that have the long-term leverage to bring companies to the table. The

Section 177 states are able to protect their publics from federal rollbacks by forging their own deals with companies – which view them as stable, reliable, market places for zero emission vehicles, and are willing to engage in long-term compliance relationships. If Illinois adopts the rules, it will join this group. If it does not, it will remain at the mercy of federal regulators, who seem entirely ready to attempt to deny it the benefits of electrification. Rule adoption is the right move to manage federal uncertainty – it allows Illinois to shape its own fate.

IV. Conclusion

One of the opposing commenters likened adopting ACT to hopping on a moving train. In fact, the real risk here is being left at the station. As the global economy accelerates towards a ZET-based future, Illinois can best protect its air, its economy, and its critical role in the U.S. logistics system by adopting ACT (and the companion rules being considered) to ensure its participation as a full partner in the electrification shift already underway. I respectfully urge you to approve the rules.

Sincerely,

/s/ Craig Holt Segall

Craig Holt Segall

McKinsey & Company

Logistics

Can zero-emission trucks become viable–and what will it take to boost adoption?

March 3, 2025 | Article

By Dilip Bhattacharjee and Moritz Rittstieg
with Cross Pagano and Saral Chauhan

The total cost of ownership for zero-emission trucks remains significantly higher than for internal combustion engine ones. Closing this gap could boost the transition to zero-emission truck fleets.

DOWNLOADS

Article (10 pages)

Trucking is a significant source of emissions. Given that transportation is the second-largest source of greenhouse gas emissions in the United States, with medium- and heavy-duty trucks accounting for about a quarter of these, transitioning fleets to zero-emission vehicles (ZEVs) has emerged as an urgent priority.[1] McKinsey's recent survey of more than 200 US trucking fleets found that while two-thirds are committed to decarbonization and over half are piloting ZEVs, fewer than 10 percent see a viable path to scaling the use of ZEVs.[2] Adoption currently sits at a few thousand units per year, and even with decarbonization targets, there is uncertainty around scalable and timely zero-emission truck adoption.[3]

Fleet operators aiming to make the ZEV switch share a persistent underlying challenge: The total cost of ownership (TCO) for ZEVs remains significantly higher than that of internal combustion engine (ICE) vehicles. The TCO gap ranges between 30 and 50 percent compared to ICE vehicles running on diesel.[4]

Other barriers to scaling are multifaceted; for instance, available ZEV models, though improving, often struggle with uptime rate, while charging and depot infrastructure remains underdeveloped.[5] Operational complexity further complicates the equation.[6]

Closing the TCO gap could be essential to unlocking ZEV adoption at scale. Even with the significant structural challenges, there are many opportunities for fleet operators, OEMs, and ecosystem partners to act now, collectively, and pave the path to a zero-emissions future at TCO parity. This article explores three areas for potential action:

1. **Truck OEMs** could take steps to incrementally reduce product costs and deliver their offerings in the US market at scale—which, in turn, could unlock opportunities to compete effectively with their global counterparts.

2. **Fleet operators** can consider evolving their ZEV adoption approach from plug-and-play to operations tailored toward optimizing the unique capabilities ZEV assets can deliver compared to ICE vehicles.

3. **Service providers,** beyond OEMs and fleet operators, play an important role in reinforcing an ecosystem that supports zero-emission truck adoption at scale. This may include supplying the

required charging or fuel infrastructure along freight corridors and developing innovative financing offerings.

Sizing the TCO gap

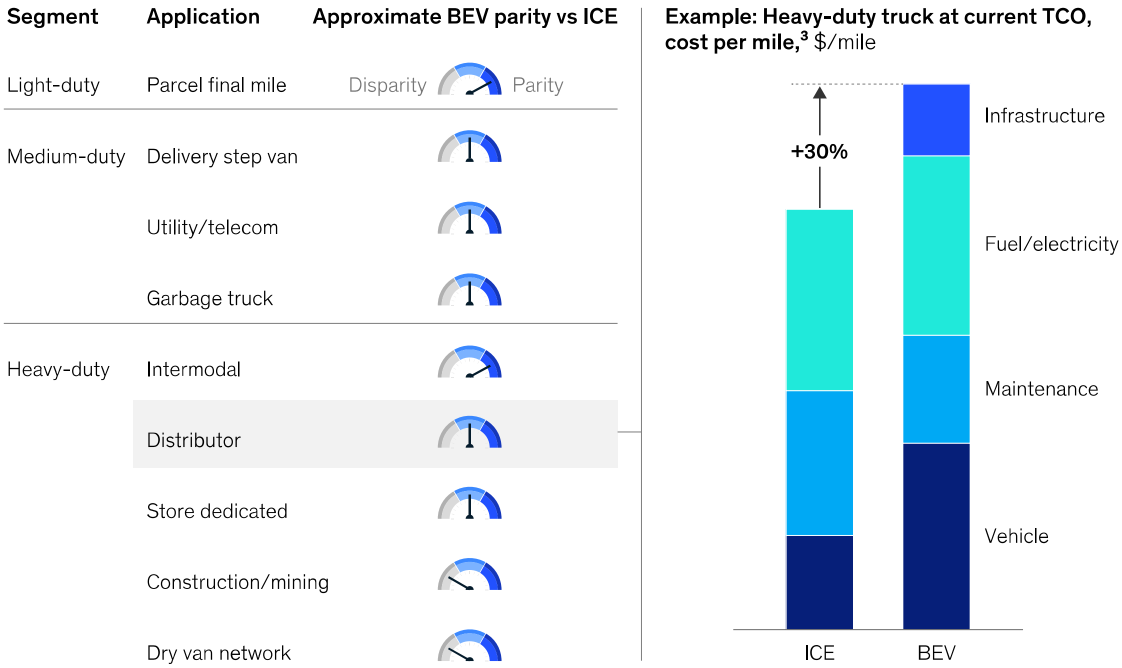
Achieving TCO parity is a pivotal enabler for the ZEV transition, but most fleets struggle to achieve it today. TCO parity exists for light vehicles like vans, but for heavy-duty trucking, TCO is 50 percent higher in many cases.[7] The hurdles to TCO parity differ across truck archetypes and use cases.

For example, local distributors run routes that, on the surface, seem perfect for electrification—low daily mileage, predictable routes, light payloads, and vehicles that return to the same depot each night. However, these operators don't turn the vehicles frequently enough to amortize the higher zero-emission truck costs. To recoup the up-front ZEV costs and approach TCO parity, local distributors may need to increase utilization and raise daily mileage (Exhibit 1).

Exhibit 1

Battery electric vehicles are uneconomical on total cost of ownership for most truck applications.

Total cost of ownership (TCO) parity by application, BEV[1] vs ICE[2] truck



[1]Battery electric vehicle.
[2]Internal combustion engine.
[3]Excluding driver. TCO numbers are indicative, and can be highly fleet-dependent and location-dependent.
Source: McKinsey Fleet Decarbonization Tool

McKinsey & Company

Conversely, long-haul full truckload (FTL) networks have multishift operations with high utilization at over 500 miles per day. Yet, their schedules are less predictable, and the time available to charge is limited. FTL fleets' high payload density also requires large batteries or hydrogen tanks supported by infrastructure built out across freight corridors. Reliance on public fast-charging stations—often during peak electricity rate periods—adds unpredictability and erases much of the variable cost advantages of battery electric vehicle (BEV) trucks compared to ICE trucks. Beyond lower up-front vehicle costs, a path to parity may require FTL fleets to tailor schedules to allow for charging in off-peak times and to form partnerships to develop electrified freight corridors and reduce on-route charging costs.

Truck OEMs: Step change cost reductions for at-scale economics

For fleet operators aiming for TCO parity, the up-front vehicle price tag is a recurring obstacle.[8] In the United States today, BEV trucks can cost between 50 and 250 percent more than ICE alternatives.[9] While there could be opportunities for savings outside of the asset—fuel and maintenance, for example—these are less predictable. Trucking fleet owners are having to reckon with higher up-front asset costs against the uncertain anticipation of lower operational costs and residual value of ZEV assets in the future.

To make the initial outlays more palatable for fleet owners and maintain their own profitability, OEMs can look for opportunities to make a step-change reduction in BEV costs by improving strategic design, technology, and operational excellence. Systematic cost reduction pathways could take into account battery pack sourcing and design, manufacturing and engineering process improvements, economies of scale, and warranty and support reduction. If such measures are implemented, McKinsey's bottom-up modeling suggests an up-front cost reduction of approximately $150,000, which is in line with cost reduction in light vehicles or passenger cars (Exhibit 2). To illustrate, US OEMs could consider exploring cost-saving opportunities in the following four areas.

Battery pack sourcing and design. This area holds significant potential for price improvement. Three interventions could lead to cost savings of up to $60,000.[10] First, in-sourcing or near-sourcing battery cell production has the potential to reduce cell costs. In the United States, local cell production and pack assembly can bring eligibility for battery tax credits of $45 per kilowatt-hour (kWh) in total.[11] Second, selecting cell chemistries for cost by moving from high-cost nickel manganese cobalt (NMC) to cheaper lithium iron phosphate (LFP) cells could also result in savings.[12] Third, implementing cell pack design improvements, such as adopting a cell-to-body architecture approach and designs that incorporate manufacturing efficiency, could add incremental value. These approaches are gaining ground in the passenger car space and by Chinese OEMs.[13]

Manufacturing and engineering improvements. Engineering optimization in areas such as e-powertrain production and manufacturing efficiency could realize up to $30,000 in cost savings. Streamlining processes through innovative manufacturing techniques and automation could drive down production and energy costs.

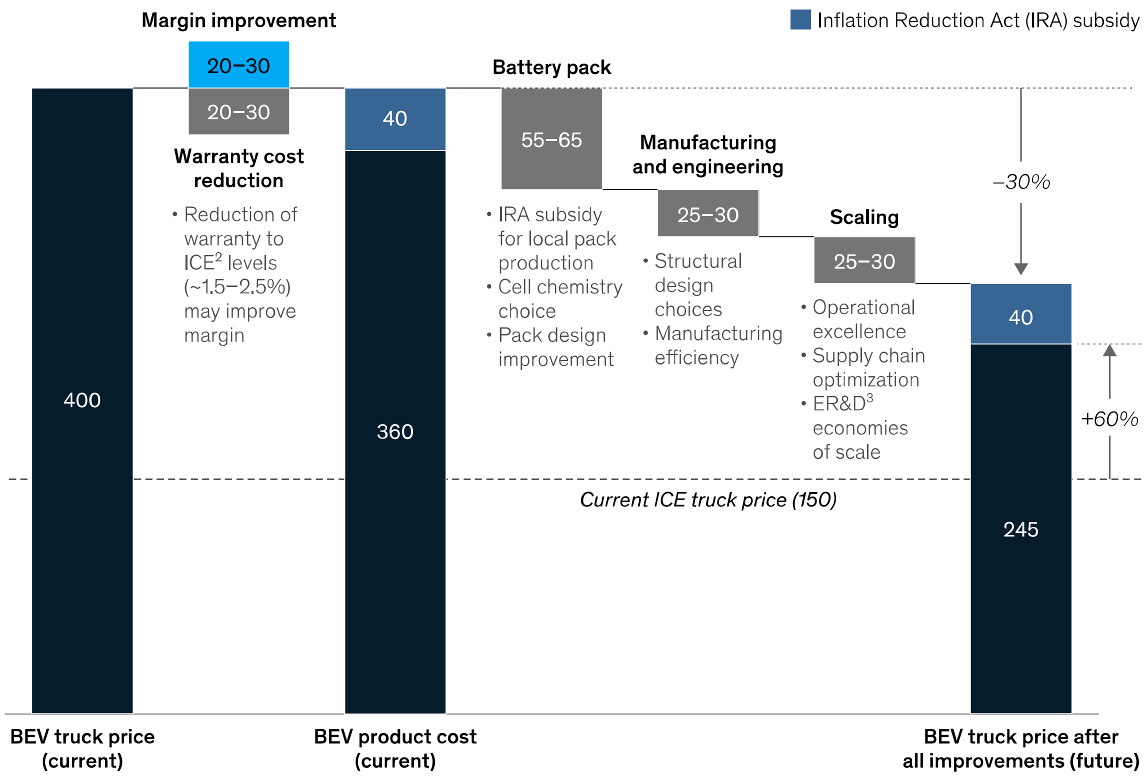
Scale benefits in production. Increasing production from fewer than 100 vehicles a year to thousands could introduce up to $30,000 in savings. The potential could be realized through operational excellence, economies of scale with suppliers, and platform-specific development costs such as engineering and research and development.

Warranty and support reduction. Warranty accrual rates could come down as BEV products reach a steady state, maturing from prototype-like models to higher-reliability designs. EV-specific OEMs report warranty accrual rates from 5 to 10 percent of revenue, compared to 1.5 to 2.5 percent for traditional truck OEMs.[14] McKinsey analysis indicates that by matching historical ICE warranty accrual levels, OEMs could reclaim $20,000 to $30,000 of their margin.

Exhibit 2

Battery electric vehicle asset costs could potentially be reduced by more than 30 percent, helping close the total-cost-of-ownership gap.

Estimated improvements in BEV[1] truck prices (illustrative), $ thousand



Note: Figures may not sum, because of rounding.
[1]Battery electric vehicle.
[2]Internal combustion engine.
[3]Engineering and research and development.
Source: McKinsey Battery Insights; McKinsey Center for Future Mobility

McKinsey & Company

Looking to Chinese OEMs as a reference, US truck OEMs have an opportunity to continue innovating in operational efficiency and product cost. Today, for example, Chinese OEMs have access to Chinese-made LFP cells, spending approximately 25 percent less on battery cells than US truck OEMs that mostly rely on NMC batteries.[15]

Chinese OEMs are also adopting vertical integration, which has improved efficiency and reduced production costs. Incumbent OEMs in the US truck market could take the opportunity to drive product cost improvements and maintain relevance as new providers enter the market.

Fleet operators: Breaking with the current plug-and-play logic

In parallel to OEMs reducing up-front vehicle costs, fleet operators also have a critical role to play in shifting the TCO balance. In most truck applications, a plug-and-play model—trading ICE for BEV without altering operations—is not enough to reach TCO parity. To commit to this transition, fleets may need to dig deep into their operations model and optimize for zero-emission powertrains. While the solutions look different within each application, a core set of optimization enablers can apply across fleets.

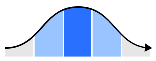
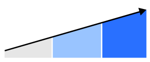
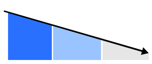
McKinsey identified 24 parameters that impact TCO across different fleet operating models. Fleets can directly influence 13 of these (Exhibit 3). The remaining 11 are external market parameters that fleets could monitor but cannot control, such as electricity prices at fleet depots and public charging locations, ambient temperature, diesel and gas prices, and subsidies.

Exhibit 3

Among the 13 parameters that fleets can influence, there are positive, negative, and 'sweet-spot' relationships with total cost of ownership.

Impact on BEV[1] total cost of ownership (TCO) savings vs ICE,[2] by parameter

Least optimal — Most optimal

Impact on TCO savings	Parameters under fleet's ability to influence	Explanation of impact
"Sweet spot" 	(1) Length of haul or single hop	Mileage near EV maximum range drives utilization, while limiting public charging need
	(2) Daily driving distance	High mileage drives vehicle utilization, though countered by higher-cost fast charging required
	(3) Stop/dwell time duration	Long dwell time allows for lower-cost charging options (slower), though limits vehicle utilization
	(4) Number of shifts	High mileage drives vehicle utilization, though countered by higher-cost fast charging required
Positive impact 	(5) Holding period	Longer holding period drives down per-mile asset cost
	(6) Dwell time in off-peak hours	Lower energy cost in off-peak hours
	(7) Route predictability	High predictability enables scheduled charging during optimal hours, reducing charging cost
	(8) Route fit for regen braking	Routes with more stops and/or hilly terrain increase battery electric vehicle efficiency
Negative impact 	(9) Payload density	Increased payload, reduced vehicle energy efficiency
	(10) Auxiliary load	Increased auxiliary load, reduced vehicle energy efficiency
	(11) Number of vehicles at depot	Many vehicles at a single depot increases grid upgrade costs and demand charges at depot
	(12) Charger power rating	High power rating increases energy cost through charging infrastructure and demand charges
	(13) Public charging usage	Expensive public charging increases energy cost

[1]Battery electric vehicle.
[2]Internal combustion engine.
Source: McKinsey Center for Future Mobility

McKinsey & Company

Some of the 13 parameters have a purely positive/negative relationship, where maximizing or minimizing variables has the most substantial impact on TCO. For example, maximizing the vehicle's dwell time during off-peak periods allows for using slower, less expensive chargers in conjunction with lower electricity rates. Similarly, minimizing the number of trucks at a given site can help reduce peak-demand charges and overage fees, reduce the additional capital expenditure required for EV charging infrastructure at the site, and lower total energy costs.

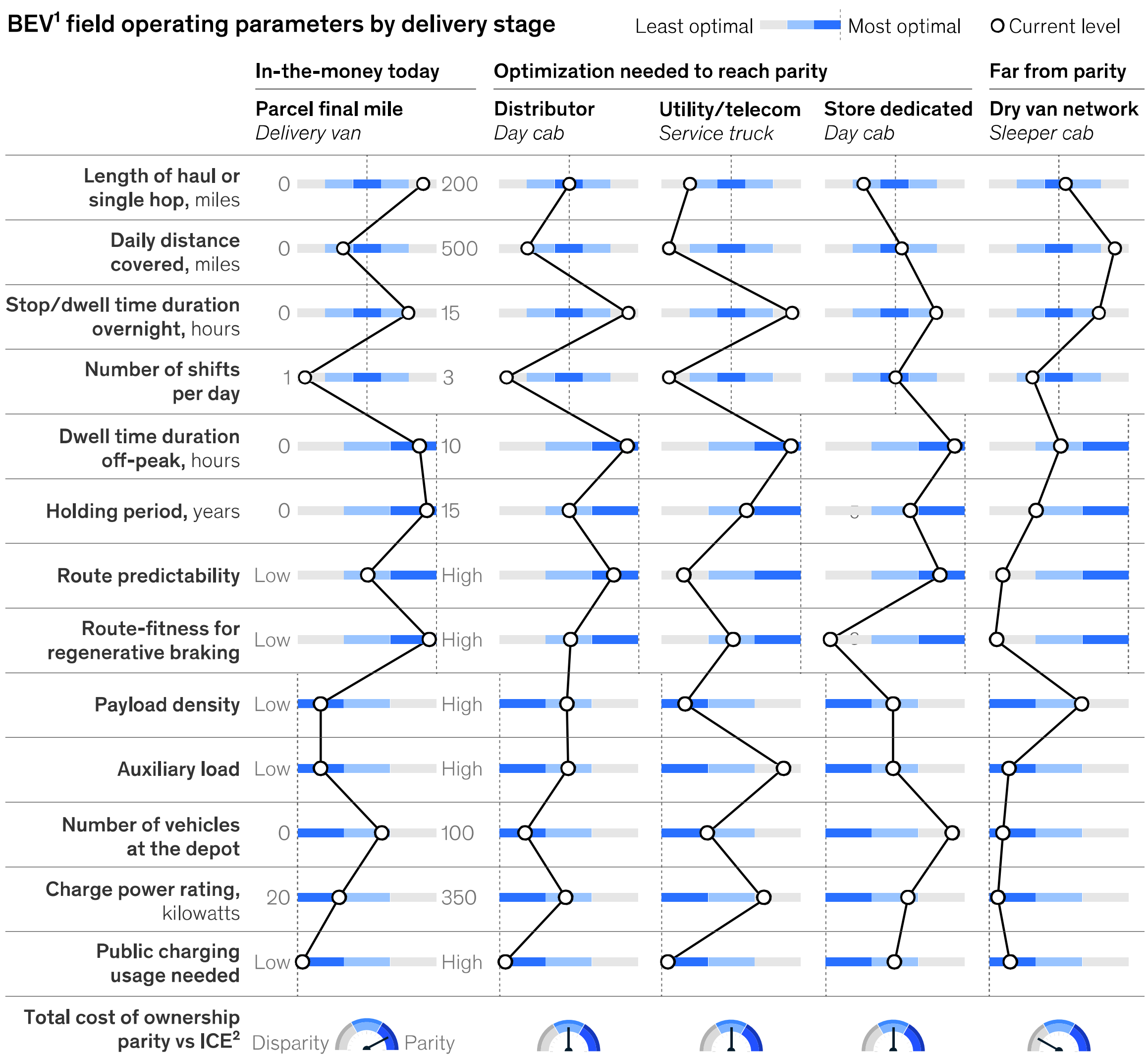
Some operating parameters can be optimized to a specific value or range—a “sweet spot.” When considering the daily driving distance, too few miles result in insufficient utilization. On the other end of the scale, too many daily miles lead to increasingly inefficient charging schedules, requiring the use of pricier fast-charging facilities.

To prepare for the ZEV transition, fleet operators may need to challenge the way they run their ICE truck operations today. Depending on the fleet archetype and baseline TCO parity gap, this could go as deep as re-architecting their network to reduce the length of haul or adding additional shifts to increase utilization. For example, last-mile parcel delivery vehicles are able to achieve TCO parity today; their fleets’ operating parameters are well suited for EVs with moderate daily mileage and long off-peak charging periods and are ideal for regenerative braking during city trips.

Dry van long-haul networks, on the other hand, have a more challenging road to TCO parity. These fleets have less route predictability, haul heavier than average payloads, and don’t have access to an established network of charging stations across major highways (Exhibit 4). The opportunity lies in the vast set of use cases between these two extremes, where fleet owners willing to challenge their existing operating regimes could potentially gain a competitive advantage and accelerate their path to TCO parity.

Exhibit 4

For applications nearing total cost of ownership parity, optimizing fleet operating parameters could close the gap.



[1]Battery electric vehicle.
[2]Internal combustion engine.
Source: McKinsey Center for Future Mobility

McKinsey & Company

Distributor heavy-duty trucking (HDT) fleets nearing TCO parity could reduce TCO by 5 to 25 percent by moving toward the sweet spot in their operations. This would require adjusting parameters alongside other interdependencies. Increasing the daily mileage—moving from one to two driving shifts, doubling the daily driving distance per vehicle—could increase asset utilization if balanced against other interdependencies, such as potential increases in demand charges and grid upgrade costs required for higher-speed charging.

Ecosystems and alliances can support solutions at scale

While fleets and OEMs are the primary stakeholders in the transition to ZEVs, they cannot solve it in isolation—it will take an extended ecosystem of industry stakeholders to support the shift. As has historically been the case with major technology disruptions, a whole new set of business models and participants will likely emerge, where cooperation among existing stakeholders will be critical. While the complete set of solutions cannot be predicted, two ecosystem factors stand out as key enablers to the zero-emission transition: Electrified fleet corridors and fleet ownership innovation.

Realizing electrified fleet corridors

Electrified fleet corridors with reliable on-route charging and fueling options may encourage faster EV adoption, particularly for longer-distance hauls.[16] However, the current US public charging infrastructure situation presents a chicken-and-egg scenario: Most fleets have neither the scale nor budget to justify deploying their own on-route charging infrastructure. Meanwhile, existing public charging infrastructure demands high prices—two to three times higher than depot charging—to make up for the low utilization provided by the small BEV trucking fleet on the road today.[17]

In one possible solution, a consortium comprising US truck fleets and a charging solution provider—potentially with an infrastructure investor—could collaborate, each contributing a key missing piece of the long-haul fleet electrification puzzle. Fleets participating in the consortium could guarantee a minimum utilization of the on-route chargers, between 5 and 10 percent, for instance, while gaining access to competitively priced $/kWh charging rates and guaranteed charger uptime. Simultaneously, the charging solution provider could benefit from a predictable ROI through the pooled utilization of chargers by the participating fleets. An infrastructure investor could underwrite the investment in fast chargers, grid upgrades, and ancillary infrastructure like battery energy storage systems (BESS) and microgrids at the on-route charging locations, thereby easing some of the capital burden on the fleets and the charging provider. Lastly, a system orchestrator could plan the deployment of infrastructure along the freight routes most commonly used by the participant fleets, tailoring the plan to align with each fleet's daily operating patterns.

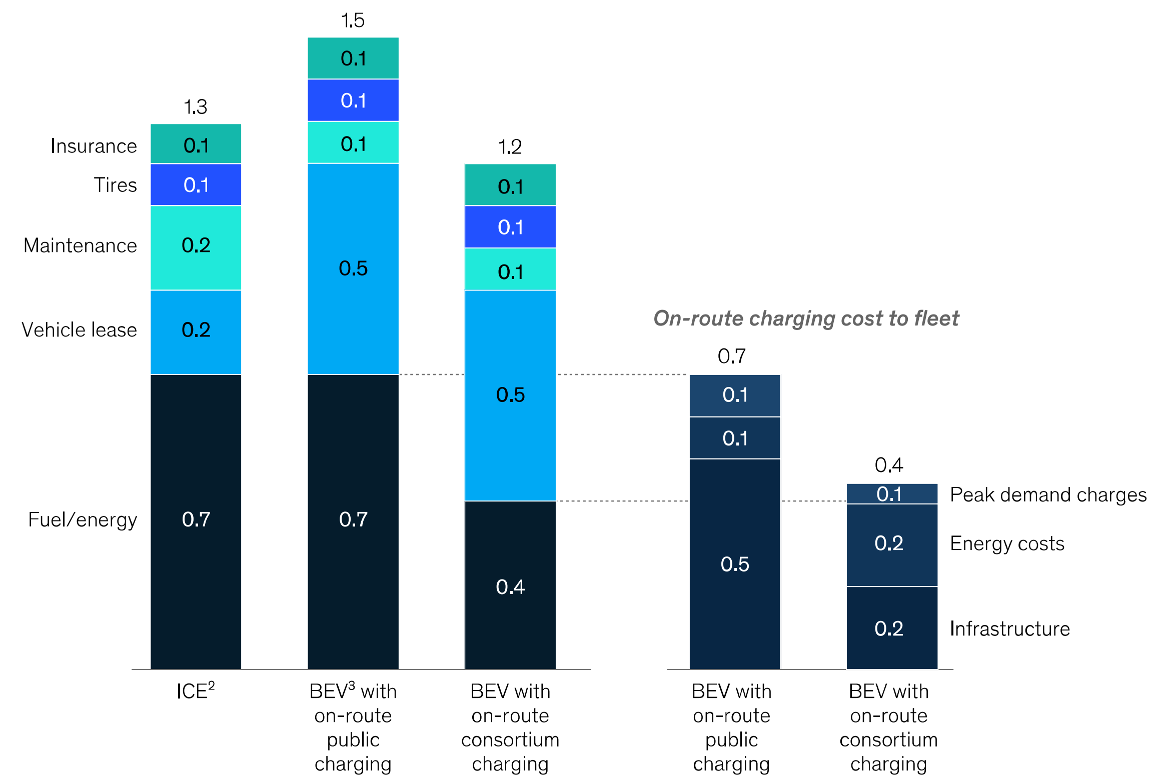
This collaborative approach enables the deployment of optimal charging infrastructure in a cost-effective manner, potentially allowing for mutual economic and operational benefits for all stakeholders involved. Our analysis indicates that the consortium model of on-route charging could lead to a 15 to 20 percent TCO reduction for HDT electric fleets (Exhibit 5). To illustrate the potential impact: In a scenario where public charging has not been optimized, TCO parity is estimated to be attainable from the early 2030s, whereas a consortium approach could accelerate TCO parity to around the year 2026—with further upside if daily driving distances are higher than 125,000 miles per year or approximately 400 miles per day.

Exhibit 5

A consortium model could reduce zero-emission truck total cost of ownership by 15 to 20 percent in the near term.

Illustrative example: 15 trucks charged per day at one location

Total cost of ownership (TCO) per high-density truck, 2026,[1] $/mile



	BEV with on-route public charging	BEV with on-route consortium charging
Number of chargers needed	~7–8	~1–2
Charger utilization, %	~8–10	~40–45
Peak power draw, megawatts	~3.0	~0.6

Note: Figures may not sum, because of rounding.
[1]Excluding driver.
[2]Internal combustion engine.
[3]Battery electric vehicle.
Source: McKinsey Fleet Decarbonization Tool

McKinsey & Company

Generating innovative financing solutions

Beyond the comparatively high vehicle costs, ZEV operations require capital expenditure-intensive infrastructure for charging and, often, grid upgrades to draw enough energy from the power supply. Hardware alone can cost up to a few hundred thousand dollars per charger, while grid upgrades can cost a couple of million dollars per depot.[18]

While this is challenging for fleets with capital expenditure constraints, there are opportunities to tap into the funding earmarked for energy transition and green investments. The top ten core-plus infrastructure energy transition funds collectively hold an estimated $50 billion in available capital for green investing.[19] Fleet operations could present an attractive investment opportunity due to their predictable business models; operational needs could be calculated with precision well in advance of committing to the investment. While residual vehicle value carries some risk, the sway it has over the overall investment case is minimal, and collaborating with the OEM could help mitigate this concern.

Innovative financing is particularly relevant for electrifying third-party logistics (3PL) or for-hire fleets. Notably, 3PL fleets account for about 86 percent of the total US truck ton-miles traveled.[20] Few companies operate without significant reliance on these services, making the electrification of 3PL fleets an important step toward achieving Scope 3 targets for the companies that use them. A potential approach to accelerate 3PL ZEV adoption could involve a collaborative effort by investors, OEMs, fleets, and 3PLs to “buy out” diesel truck ownership and replace it with a lease-like model for ZEVs, paired with guarantees for routes and a sufficient price level.

An OEM-led version of that model could be truck-as-a-service (TaaS), through which OEMs can support fleets that may not have the necessary capabilities to face the transition. This type of solution could provide charging, insurance, and maintenance services for electric medium-duty trucks—reducing up-front costs and operational risk to fleets. Following a similar approach, there are opportunities for existing and new participants to reinvent the vehicle ownership structure.

Achieving cost parity with ICE trucks could be the catalyst that begins mass ZEV adoption in the United States. The path ahead is visible, but the journey may require a final push to clear various structural hurdles and close the TCO gap. A concerted effort by fleet operators, OEMs, and ecosystem players could activate new levels of collaboration across the industry, unlock opportunities for global competitiveness, and inspire novel business models that support shared decarbonization ambitions.

How relevant and useful is this article for you?

☆☆☆☆☆

1. "Sources of greenhouse gas emissions," United States Environmental Protection Agency (EPA), accessed January 16, 2025; "Fast facts on transportation greenhouse gas emissions," EPA, accessed June 18, 2024.
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4. McKinsey's Fleet Decarbonization Optimizer Tool (2024), based on real-world EV fleet plans and deployments.
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7. "Charged logistics: The cost of electric vehicle conversion for U.S. commercial fleets," Ryder, May 2024.
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Study Examines Cost Competitiveness of Zero-Emission Trucks

Tech Progress, Supportive Policies, and Infrastructure Investments Drive Down Costs and Spur Technology Adoption

April 3, 2024 | By Julia Thomas | Contact media relations

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A recent NREL study explored how the total cost of driving for medium- and heavy-duty vehicles could evolve over time under different scenarios. *Photo from iStock*

Medium- and heavy-duty vehicles (MHDVs) account for just 5% of vehicles on the road in the United States, yet they are responsible for 21% of transportation-related greenhouse gas emissions. Reducing MHDV emissions is vital to mitigating the effects of climate change and improving air quality. Zero-emission vehicles (ZEVs)—such as battery electric vehicles (EVs) and hydrogen fuel cell electric vehicles (FCEVs)—offer a solution.

While projecting future technology adoption is complex and many factors influence consumer decisions, economics play a key role in choosing technologies for commercial vehicle applications. A recent study by the National Renewable Energy Laboratory (NREL) explored how the total cost of driving for zero-emission and diesel MHDVs could evolve over time under different scenarios, from the present day to 2050.

"With continued improvements in vehicles and fuels, ZEVs are rapidly becoming commercially viable, potentially reaching total cost of driving parity or better compared to diesel vehicles by 2035 in all market segments," said NREL's Catherine Ledna, a decision support analyst who led the study.

A full transition to ZEV sales by 2035 would result in a 65% reduction in emissions by 2050 compared to 2019. Incentives such as the zero-emission MHDV purchase tax credits made possible via the 2022 Inflation Reduction Act (IRA) further accelerate total cost of driving competitiveness and spur emissions reductions up to 70%.

The results of NREL's study are detailed in a recent *iScience* journal article—"Assessing Total Cost of Driving Competitiveness of Zero-Emission Trucks"—by Ledna and NREL's Matteo Muratori, Arthur Yip, Paige Jadun, and Christopher Hoehne as well as Kara Podkaminer from the U.S. Department of Energy.

Paving the Way for Zero-Emission MHDVs

The path to zero-emission MHDVs is supported by various proposed and existing actions, including policies ranging from increased air quality and greenhouse gas emissions standards to tax credits for ZEV purchases as well as investments in research and development for ZEV technologies and infrastructure deployments. For example, the IRA includes tax credits of up to $40,000 for qualifying clean vehicle purchases, including EVs and FCEVs, as well as incentives for charging and refueling infrastructure. More recently, the U.S. Environmental Protection Agency has proposed more stringent greenhouse gas emission rules for model years 2027 to 2032 MHDVs.

TEMPO: The Right Modeling Tool for the Job

At the heart of the study was NREL's Transportation Energy & Mobility Pathway Options (TEMPO^{TM}) Model, the laboratory's flagship sector-wide transportation energy systems model. The research team used TEMPO to estimate how the total cost of driving of MHDVs could evolve under a range of scenarios comprising technology cost and progress, fuel costs, and policies, while also considering new vehicle purchases, stock turnover, vehicle activity, energy consumption, and greenhouse gas emissions.

"While recent studies have evaluated the economic competitiveness and technical feasibility of zero-emission MHDVs in one or more specific market segments, our study was unique in its consideration of total cost of driving competitiveness, adoption, energy consumption, and fleet turnover across *all* MHDV applications," Ledna added.

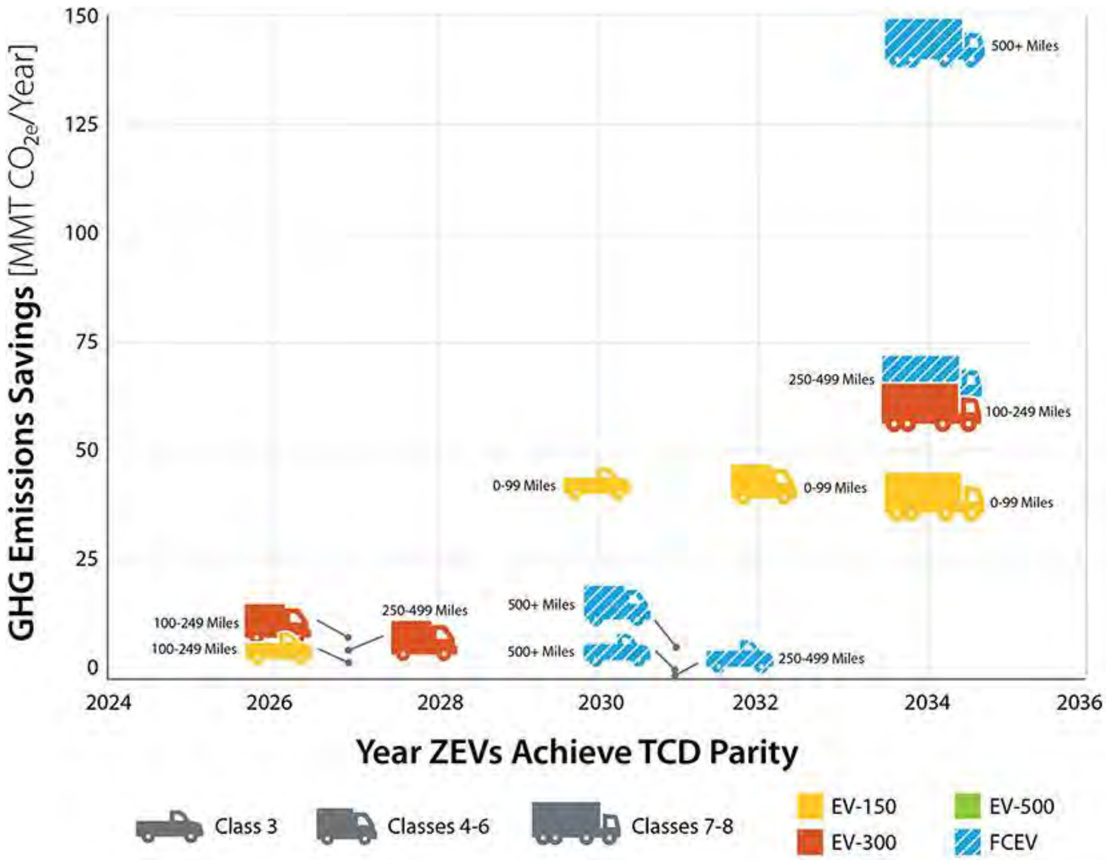
NREL's analysis captured differences in vehicle use and energy consumption across diverse MHDV market segments, which have distinctive technical and economic requirements resulting in differences in the cost competitiveness of ZEV technologies. Case in point: The nation's MHDV fleet encompasses vehicles ranging from 10,000 pounds to more than 33,000 pounds and driving distances of less than 10,000 miles per year to greater than 200,000.

Spotlight on Technology Progress and Incentives

Today, ZEVs comprise a small share of existing MHDVs and face near-term barriers such as high purchase costs, limited charging or refueling infrastructure, and logistical challenges for fleet conversions.

"Thanks to recent technology progress and investments in clean vehicles, EVs have already become a viable solution for some use-cases," said NREL's Muratori, a senior transportation and energy systems engineer. "It will take some years for ZEVs to reach cost-competitiveness with diesel across all segments and applications, but we are on the right path and EV technology has progressed more rapidly than expected during the last decade."

According to the NREL study, the time horizon in which ZEVs become competitive with diesel vehicles on a total cost of driving basis varies according to vehicle class and market segment. The combination of capital costs, operational costs, and vehicle miles traveled generally determines when a ZEV technology achieves parity. For all vehicle applications, at least one ZEV technology achieves parity with diesel before 2035.



Total cost of driving (TCD) parity and greenhouse gas (GHG) emissions savings potential by MHDV class and market segment. (EV labels refer to EV range in miles. Mileage labels indicate the primary traveling distance of a given market segment.) *Figure by Fred Zietz, NREL*

This study shows that by 2032 (and in many cases before then), ZEVs achieve total cost of driving parity with diesel vehicles in light-medium (Class 3) and medium-duty (Class 4–6) trucks, driven by declines in battery costs. By 2035, shorter-range EVs with 150 to 300 miles of electric range reach parity in short-haul and regional market segments, which have lower daily vehicle miles traveled and a reduced need for larger, more expensive batteries. Heavy trucks (Classes 7–8) and trucks that drive longer distances (500-plus-mile shipment distance) achieve parity after 2030.

IRA Incentives Accelerate Technology Adoption and Emissions Savings

With IRA vehicle purchase tax credits, ZEVs—particularly EVs—achieve total cost of driving parity with diesel vehicles on substantially earlier time frames.

Most light-medium vehicles achieve total cost of driving parity by 2026, which could result in an additional 700,000 light-medium vehicles sold, 48 billion vehicle miles traveled by ZEVs, and carbon dioxide tailpipe emissions savings of 33 million metric tons between 2023 and 2032. Meanwhile, most medium vehicles achieve total cost of driving parity by 2023 or 2024, resulting in an additional 1.1 million vehicles sold, 81 billion vehicle miles traveled by ZEVs, and carbon dioxide tailpipe emissions savings of 73 million metric tons. For heavy vehicles, short-haul market segments achieve parity between 2027 and 2030 (versus 2034 without incentives). Heavy regional and long-haul market segments continue to achieve parity in 2034, with FCEVs remaining the most cost competitive on a total cost of driving basis.

"IRA incentives greatly accelerate the time at which ZEVs reach total cost of driving parity, enabling market uptake in the near term," Muratori said. "By 2050, a rapid transition to ZEVs results in substantial greenhouse gas emissions reductions—65% relative to 2019 levels without incentives and 70% with IRA vehicle purchase tax credits."

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WHITE PAPER

APRIL 2023

TOTAL COST OF OWNERSHIP OF ALTERNATIVE POWERTRAIN TECHNOLOGIES FOR CLASS 8 LONG-HAUL TRUCKS IN THE UNITED STATES

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EXECUTIVE SUMMARY

Heavy-duty vehicles (HDVs) in the United States were responsible for more than a quarter of the transport sector's greenhouse gas (GHG) emissions in 2020. To regulate the sector's GHG emissions, the U.S. Environmental Protection Agency has implemented emission standards. The most recent update, Phase 2, extends from model years 2021 to 2027. The stringency of the standards was based on the improvement potential of HDVs powered by combustion engines. Zero-emission (ZE) HDVs, which have no tailpipe GHG or pollutant emissions, were not considered in the technology pathways underpinning the standards due to their lack of maturity when the standards were adopted in 2016.

Understanding that ZE HDVs are essential for decarbonizing the sector, some truck manufacturers in North America have announced plans to produce ZE trucks and buses at scale. The upcoming Phase 3 GHG standards for HDVs, proposed in early 2023, present an opportunity to review the stringency of the standards and consider the role ZE HDVs will play in deeply decarbonizing the HDV sector in the United States.

Despite their environmental benefits, the widespread adoption of ZE HDVs will only occur if it also leads to economic benefits. To shed light on their financial viability, this paper evaluates the total cost of ownership (TCO) of four different truck technologies: diesel, battery electric, hydrogen fuel-cell, and hydrogen combustion powertrains. We focus on Class 8 tractor-trailers operating in long-haul assuming a first ownership period of five years.

The study assesses the techno-economic performance at the U.S. state and national levels in the 2022–2040 timeframe. For the state analysis, seven representative states—California, Georgia, Illinois, New York, Florida, Texas, and Washington—were chosen due to their geographic coverage over the U.S. mainland, long-haul trucking activity in every geographic region, and differences in energy costs. At the national level, the analysis captures uncertainties in technology cost and representative variations in energy prices that a vehicle might face in cross-state operation.

We arrive at the following main findings:

By 2030, the total cost of ownership of battery electric long-haul trucks will likely be lower than that of their diesel counterparts in all representative states considered in this analysis. Despite their higher upfront price, battery electric trucks have substantially lower operational expenses than the other trucks studied, as shown in Figure ES1. This is driven by the higher energy efficiency of battery electric powertrains and their lower maintenance costs.

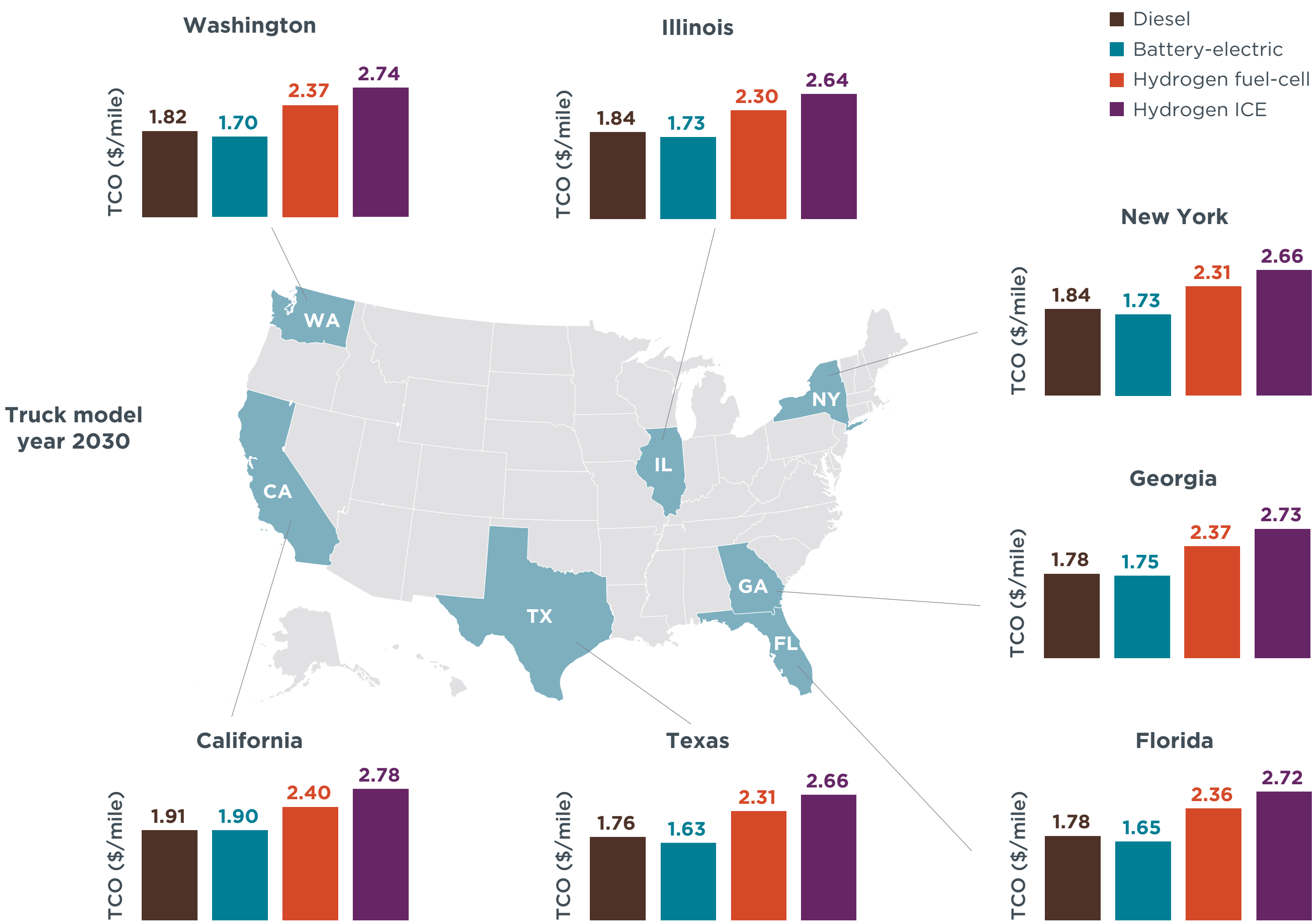

Figure ES1. State-specific total cost of ownership for different model year 2030 truck technologies.

For very high daily mileages, battery electric trucks can still achieve a better total cost of ownership than their diesel counterparts. As a truck's average daily mileage or mileage variability—defined as the percentage difference between the maximum and the average daily mileage—increases, larger batteries are needed to ensure the truck's daily energy needs are covered during average use and on the most demanding days. The larger batteries required increase the upfront price of battery electric trucks. Conversely, higher average daily mileage improves the operational costs of battery electric trucks compared to their diesel counterparts. Overall, battery electric trucks are expected to record a better TCO for average mileages as high as 750 miles per day, provided that the day-to-day milage variability is low (Figure ES2).

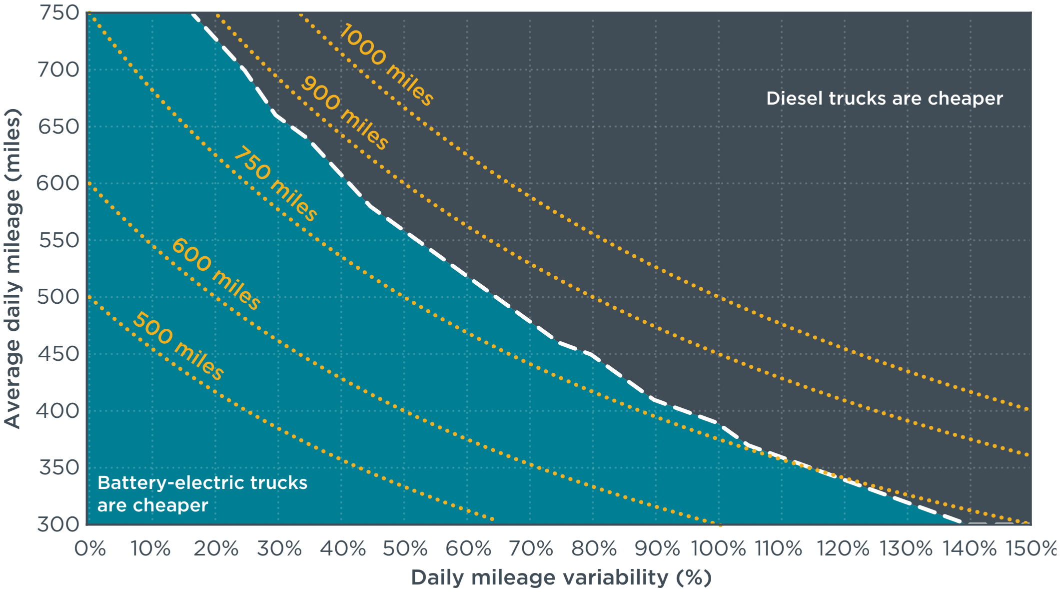

Figure ES2. Impact of daily mileage and mileage variability on the TCO of model year 2040 battery electric and diesel trucks. Daily mileage variability defined as the ratio of maximum to average daily mileage.

Battery electric trucks have a lower total cost of ownership than hydrogen-powered trucks for long-haul applications, even when accounting for tax credits in the Inflation Reduction Act. Lower fuel costs make battery electric trucks the most cost-effective zero-emission technology. With estimated charging costs ranging between $0.15/kWh and $0.30/kWh, green hydrogen fuel prices would need to be in the range of $3.00/kg to $6.50/kg for hydrogen fuel-cell trucks to reach TCO parity with battery electric trucks during the next decade. Hydrogen internal combustion engine trucks will require green hydrogen fuel prices as low was $2.00/kg to reach TCO parity with battery electric trucks by 2030; This is much lower than the estimated green hydrogen price in 2030 ($9.00/kg to $11.00/kg) and 2040 ($8.00/kg to $10.00/kg) with the tax subsidies included in the Inflation Reduction Act, as shown in Figure ES3.

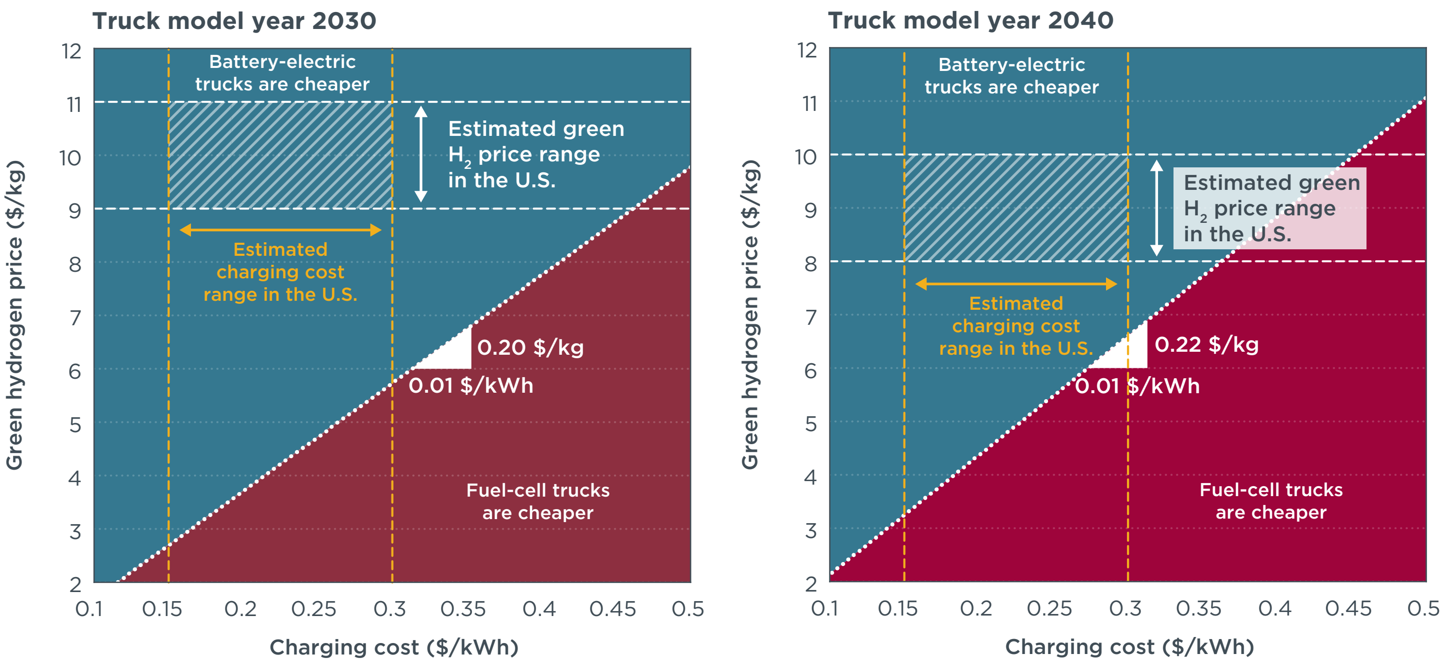

Figure ES3. Total cost of ownership parity sensitivity to charging costs and hydrogen fuel prices for several truck model years. The dashed area in the figure reflects the estimated charging costs and green hydrogen prices, including infrastructure deployment cost. The small triangles in the figure represent the line slope

The analysis presented in this study shows that zero-emission trucks can ensure a cost-effective transition away from fossil diesel, providing a substantial reduction in GHG emissions. Battery electric trucks operating in long-haul are likely to achieve a lower TCO than diesel trucks before the end of this decade in all states considered in this analysis.

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LIST OF ACRONYMS

DMC	Direct manufacturing cost
GHG	Greenhouse gas
HDV	Heavy-duty vehicle
ICE	Internal combustion engine
ICM	Indirect cost multipliers
MPGe	Miles per gallon diesel equivalent
MSRP	Manufacturer suggested retail price
TCO	Total cost of ownership
VMT	Vehicle miles traveled
ZE	Zero emission

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INTRODUCTION

Heavy-duty vehicles (HDVs) are among the most significant sources of greenhouse gas (GHG) emissions in the United States. In 2020, HDVs were responsible for more than 27% of the total U.S. transport sector GHG emissions (U.S. Environmental Protection Agency, 2022a). While GHG emissions for most transport means recorded a decline over the past 30 years, the average HDV GHG emissions per vehicle increased by 83% in 2020 relative to 1990 levels and by 5% relative to 2005 levels, mainly driven by the increase in freight activity and a negligible improvement in vehicle fuel economy (U.S. Environmental Protection Agency, 2022a).

Greenhouse gas emissions from heavy-duty vehicles have historically been regulated at the federal level by increasingly stringent standards set by the U.S. Environmental Protection Agency. Last updated in 2016, the current Phase 2 GHG standards for HDVs were predicated on projected improvements in the efficiency of conventional internal combustion engine vehicles. While zero-emission (ZE) HDVs were not considered in setting the stringency of the rule, they were incentivized with super credits intended to support the nascent market. Zero-emission HDVs are defined as vehicles that have no tailpipe GHG or pollutant emissions. In the context of this study, this includes battery electric and hydrogen fuel-cell electric vehicles.

Zero-emission vehicles have a significant role in deeply decarbonizing the HDV sector in the United States, given the limited remaining GHG emission reduction potential for internal combustion engine (ICE) vehicles (Buysse, Sharp, & Delgado, 2021). Since the Phase 2 rulemaking, several states led by California have moved to require the deployment of ZE HDVs. The most notable is California's Advanced Clean Trucks rule, which requires manufacturers to sell an increasing percentage of ZE HDVs, starting at 5% in model year (MY) 2024 and increasing to 40% by 2035 (Buysse & Sharpe, 2020). In addition, several truck manufacturers in North America have announced plans to increase their production of new ZE truck models (Buysse, 2022; International Council on Clean Transportation, 2022). This includes 100% zero-emission sales commitments from major manufacturers like Daimler Trucks (Daimler Truck AG, 2023), Volvo Trucks (Volvo Trucks, 2022), and Navistar (McDaniel, 2022) by or before 2040. Nonetheless, the capital investment needed to transition to these technologies may hinder their wide deployment.

In this report, we evaluate the economic viability of several HDV truck technologies by estimating their total cost of ownership (TCO) over the most important use case in the United States: Class 8 tractor-trailers operating in the long-haul. This class is the most challenging HDV segment to decarbonize, given the trucks' high daily mileage and payloads. We compare four powertrain technologies: diesel, battery electric, hydrogen fuel-cell, and hydrogen internal combustion engine (ICE). The study looks at the TCO from the perspective of the first ownership period, assuming a holding period of five years. The TCO is quantified using detailed assumptions regarding current and future technology potential and costs.

METHODS AND DATA SOURCES

USE CASE DEFINITION

This paper studies the total cost of ownership of diesel, battery electric, hydrogen fuel-cell, and hydrogen internal combustion engine heavy trucks focusing on Class 8 long-haul high-roof sleeper cab trucks operating in the United States. The use case of interest considers a 500-mile average daily mileage. The annual vehicle miles traveled (VMT) curve is shown in Figure 1 as a function of the truck age based on information from MOVES3 (U.S. Environmental Protection Agency, 2022b).

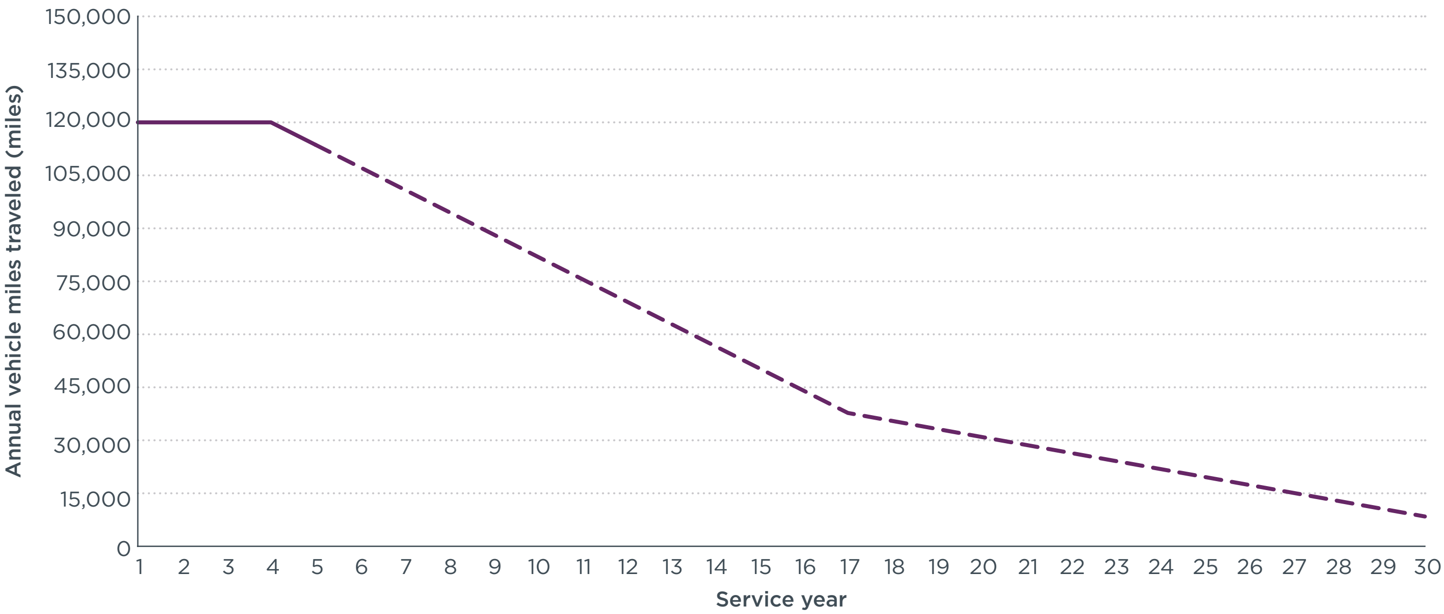

Figure 1. Long-haul truck annual mileage as a function of service years.

This TCO analysis is conducted at the state and national levels, considering state-specific and national-average energy and fuel cost data, respectively. For the state-specific analysis, the study focuses on California, Texas, Washington, Florida, Illinois, Georgia, and New York. These states are chosen based on the following criteria:

1. Ensuring comprehensive geographic coverage over the U.S. mainland.
2. Focusing on states with the highest long-haul trucking activity in every geographic region based on data available from Federal Highway Administration (2018).
3. Ensuring a comprehensive coverage of commercial electricity rates in the United States based on data from U.S. Energy Information Administration (2022a) to reflect charging costs variation among states.

At the national level, we conduct a stochastic Monte Carlo approach considering data from all 50 states, mainly on diesel fuel, hydrogen fuel, and electricity costs, in addition to data reflecting the uncertainties in technology costs, where the main TCO inputs are modeled as probability density functions with predefined ranges of uncertainties.

FUEL CONSUMPTION MODELING AND ENERGY STORAGE SIZING

The fuel consumption of each truck technology is estimated through a multi-physical modeling approach using a commercial simulation tool (Simcenter Amesim, 2022). The models simulate the vehicle's longitudinal dynamics and the physical behavior of the main powertrain components, considering the vehicle road load parameters and technical specifications. More details about the development of the diesel, battery electric, and hydrogen fuel-cell powertrain models can be found in Basma, Beys, and Rodríguez (2021) and Basma and Rodríguez (2022). Regarding the hydrogen ICE powertrain modeling, the main difference relative to the diesel powertrain lies in the engine modeling. We model the hydrogen ICE as a spark-ignited engine in lean combustion mode. The hydrogen fuel specific heating value is 120 MJ/kg, and the air-fuel stoichiometric ratio is 34. Table 1 summarizes the common road load parameters and powertrain specifications among all technologies, and Table 2 summarizes the technology-specific powertrain components. The current technology parameters correspond to an average truck in 2022, while future technology parameters reflect the technology potential that can be achieved in 2035.

Table 1. Common road load parameters and powertrain specification for current (2022) and future (2035) technologies.

Parameter	Current value (2022)	Future value (2035)
Aerodynamic drag area	5.68 m^2 [a)]	4.4 m^2 [b)]
Rolling resistance coefficient	6.15 kg/t [a)]	4.1 kg/t [b)]
Wheel radius	0.49 m	0.49 m
Wheel inertia	22.5 kgm^2	22.5 kgm^2
Gear efficiency [c)]	98.5%	99.1%
Final drive efficiency [c)]	97%	98%
Trailer weight	13,500 lbs [a)]	10,850 lbs [b)]

a) U.S. EPA & U.S. DOT (2016)
b) Buysse et al. (2021)
c) Basma, Beys, et al. (2021)

Table 2. Technology-specific powertrain parameters for current (2022) and future (2035) powertrain technologies.

Parameter	Diesel		Battery electric		Fuel cell		H_2 ICE	
	Current	Future	Current	Future	Current	Future	Current	Future
Power unit [a)]	339 kW (445 HP)							
Battery size	-		1 MWh	740 kWh	70 kWh		-	
Fuel cell power	-		-		210 kW		-	
H_2 tank size	-		-		62 kg	40 kg	76 kg	52 kg
Peak break thermal efficiency	46%	55% [b)]	-		-		44%	50% [c)]
Peak fuel cell efficiency	-		-		60%	67%	-	
Gearbox (gear ratios)	10-speed (12.8, 9.25, 6.76, 4.9, 3.8, 2.61, 1.89, 1.38, 1, 0.73)		2-speed [5,1]		2-speed [5,1]		10-speed (12.8, 9.25, 6.76, 4.9, 3.8, 2.61, 1.89, 1.38, 1, 0.73)	
Final drive ratio	3.31		2		2		3.31	

a) Electric motor or engine rated power.
b) Buysse et al. (2021)
c) Loszka et al. (2022)

The battery in a battery electric truck is sized to meet a specific daily mileage. For this use case, the required daily mileage is 500 miles. We assume that the truck drivers stop for a 30-minute break every 190 miles (Phadke et al., 2021), which can be used to recharge the battery at a rate of 350 kW today and 1 MW as of 2027. The battery size is then estimated given the truck's electric energy consumption, charging power during the day, and required daily mileage. We also assume that the battery size will be, at most, 1 MWh due to payload and volume capacity constraints. When a larger battery is required, we assume that the drivers stop more frequently for charging, which will increase labor costs, as will be discussed later in the total cost of ownership modeling section. We also assume that the battery will be sized to provide at least 300 miles on a single charge. Table A1 in the appendix summarizes the battery sizing approach.

All powertrain models are simulated under the National Renewable Energy Laboratory long-haul cycle (National Renewable Energy Laboratory, 2023), and at a reference payload of 38,000 lb as defined in the U.S. Environmental Protection Agency's regulatory impact analysis of 2016 (U.S. Environmental Protection Agency & U.S. Department of Transportation, 2016). For battery electric trucks, the choice of battery size will significantly impact the fuel economy and maximum payload capacity, given the battery weight. On the other hand, the battery size depends on the truck's fuel economy, total vehicle weight, and driving mileage design point. In this case, an iterative approach is considered to size the battery and determine the truck's energy efficiency and maximum payload capacity.

Figure 2 summarizes the fuel economy of the simulated trucks for current and future vehicle technologies, expressed in miles per gallon diesel equivalent (MPGe). Battery electric is the most energy-efficient technology recording the highest fuel economy of around 13 MPGe for current vehicle technologies. This is almost twice as much as the diesel truck's fuel economy. Hydrogen fuel-cell trucks record an approximate 10% improvement in fuel economy relative to their diesel counterparts for current vehicle technologies. Hydrogen ICE trucks register the lowest fuel economy at 6 MPGe, almost 10% lower than their diesel counterparts.

For future vehicle technologies, improvement in road load technologies benefits all powertrains, increasing fuel economy, as shown in Figure 2. Improvements are also achieved in engine break thermal efficiency and fuel cell peak efficiency, as summarized in Table 2.

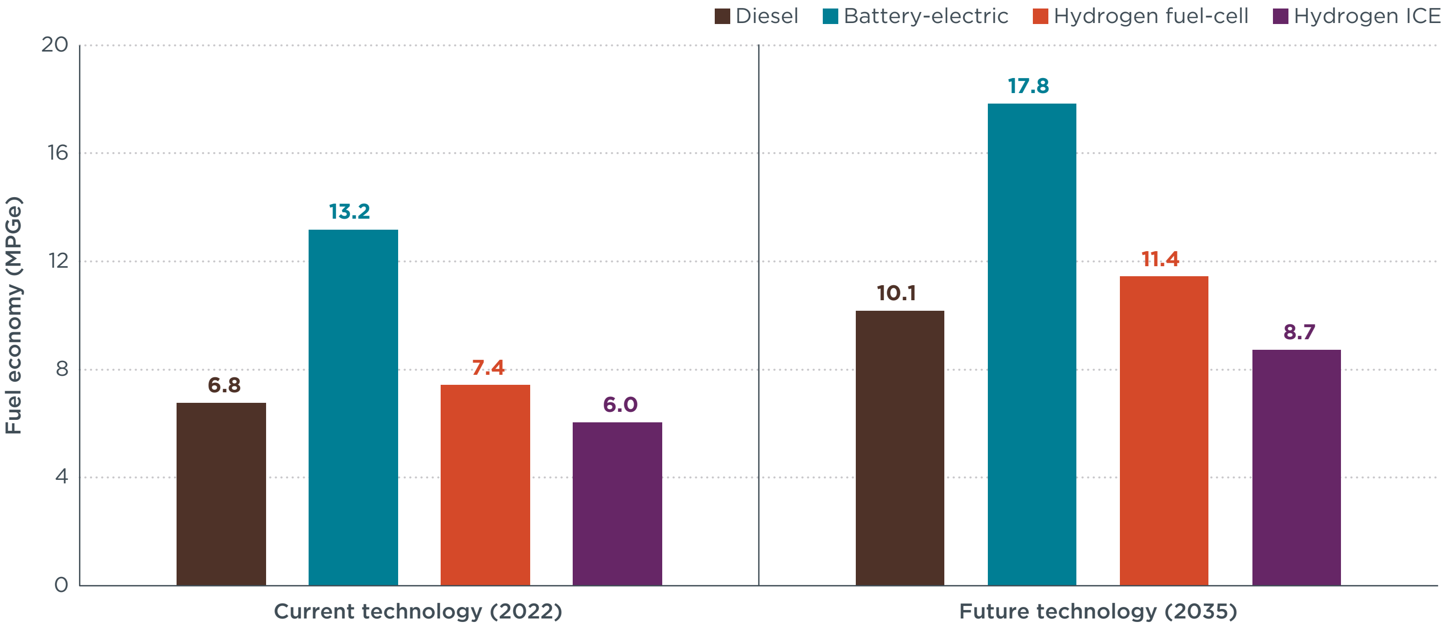

Figure 2. Summary of trucks' fuel economy for current and future vehicle technologies expressed in miles per diesel gallons equivalent, simulated under the NREL long-haul cycle and at reference payload of 38,000 lbs.

PAYLOAD CAPACITY ESTIMATION

The payload capacity of each powertrain technology is calculated using a bottom-up approach. The weights of the main powertrain components are estimated based on a teardown analysis conducted by Ricardo Strategic Consulting on behalf of ICCT (Ricardo Strategic Consulting, 2022). All trucks share a common base glider, i.e., the same chassis and cab design. The base glider weight is 10,439 lb for current technologies in 2022, which is assumed to decrease to 8,638 lb due to chassis light weighting for future technologies. In addition, all trucks share the same trailer, weighing 13,500 lb for current technologies and decreasing to 10,850 lb for future technologies.

The powertrain and energy storage weights differ significantly among the four considered truck technologies, mainly driven by the truck's technical specifications. The battery electric and hydrogen fuel-cell tractor-trailer powertrain components and accessory weights are summarized in Table 3. The diesel truck powertrain componentry weight is estimated to be around 7,559 lb (Ricardo Strategic Consulting, 2022), and the hydrogen ICE truck powertrain componentry weight is estimated to be 6,959 lb,[1] excluding the hydrogen storage tanks.

1 Assumed similar to CNG trucks. Numbers adopted from Hunter et al. (2021).

Table 3. Battery electric and hydrogen fuel-cell tractor-trailer powertrain components and accessory weights.

Component	Specification		Weight multiplier	
	Battery electric	Fuel cell	Current	Future
Battery	Varies by range	70 kWh	0.14 kWh/kg	0.25 kWh/kg
Fuel cell		210 kW	0.6 kW/kg	0.6 kW/kg
Hydrogen tank		Varies by range	0.046 kg/kg	0.046 kg/kg
Electric drive	339 kW		0.4375 kW/kg	
Power electronics	339 kW		3.6 kW/kg for battery electric 5 kW/kg for hydrogen fuel-cell	
On-board charger	44 kW	6.6 kW	0.95 kW/kg for high power 1.12 kW/kg for low power	
Air compressor	6 kW		0.087 kW/kg	
Steering pump	9 kW		0.072 kW/kg	
Air conditioning unit	10 kW		0.91 kW/kg	
Heater	10 kW		1 kW/kg	
Battery thermal management	339 kW		3.5 kW/kg for battery electric 7.14 kW/kg for hydrogen fuel-cell	

Note: Data from Ricardo Strategic Consulting (2022) and Sharpe and Basma (2022)

Figure 3 shows the truck weight breakdown for the four considered powertrain technologies, highlighting the maximum truck payload capacity for current and future vehicle technologies. Hydrogen fuel-cell and hydrogen ICE powertrains show a similar payload capacity relative to their diesel counterparts, while battery electric trucks are expected to suffer from payload capacity losses of less than 20% relative to diesel for current vehicle technology. For future vehicle technologies, the truck battery size is expected to decrease due to energy efficiency improvement, battery energy density improvement, and the rollout of MW charging stations. This diminishes the payload capacity gap between battery electric and diesel trucks to less than 2%.

The payload capacity of current battery electric trucks under the considered truck specifications in this study is around 39,600 lb, which is higher than the 38,000 lb reference payload used in this study and defined by EPA's regulatory impact analysis of 2016. Therefore, we assume there will be no additional costs due to the payload losses for battery electric trucks in this study. The impact of higher truck payloads on the TCO analysis is examined in the sensitivity analysis section.

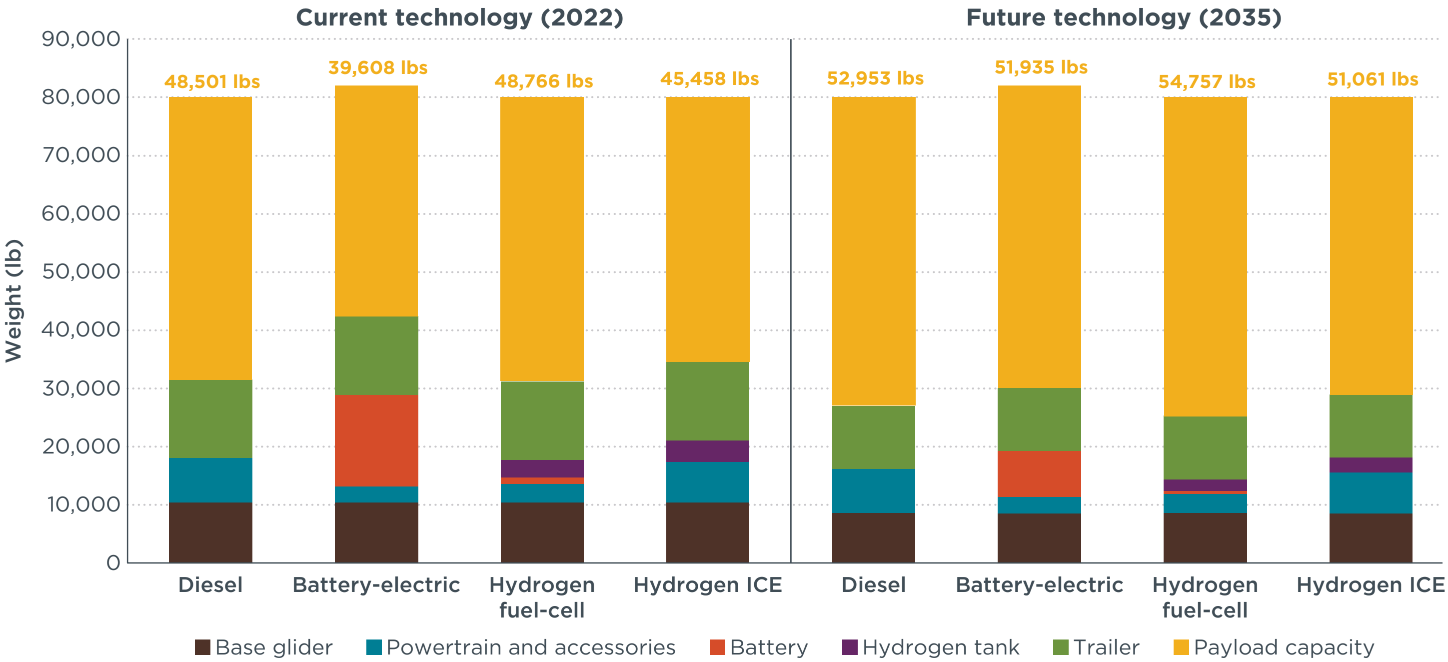

Figure 3. Weight breakdown for Class 8 sleeper cab long-haul trucks for different powertrain technologies. Battery size: 1 MWh for the current technology scenario and 740 kWh for the future technology scenario.

TOTAL COST OF OWNERSHIP MODELING

This section explains the TCO modeling approach for the four considered truck technologies. The TCO model for battery electric trucks has been thoroughly described in previous ICCT publications (Basma, Saboori, & Rodríguez, 2021; Basma, Rodríguez, Hildermeier, & Jahn, 2022). The model for hydrogen fuel-cell trucks is described in Basma, Zhou, and Rodríguez (2022). The model converts all fixed and operational expenses of a particular model year truck into cash flows, considering the analysis period and discount rate. The TCO analysis includes the truck's purchase and finance cost, insurance, residual value, diesel fuel, hydrogen fuel, charging, labor, and maintenance costs. The analysis period is five years, which is considered representative of first ownership in the United States, and the discount rate is 7%.

Capital expenses

The truck capital expenses include its retail price and the related financial costs, in addition to the truck residual value.

Manufacturer suggested retail price

The average manufacturer suggested retail price (MSRP) of a diesel Class 8 tractor in 2022, determined from several publicly available sources, is $158,000 (Slowik et al., 2023). We expect this cost to increase to $170,000 due to compliance with future emissions targets, assuming the diesel technology will reach its full potential by 2035 (Buysse, Sharpe, & Delgado, 2021). For the hydrogen ICE truck, we assume that the tractor cost, excluding the hydrogen tank, will be $3,000 less than its diesel equivalent, considering the diesel fuel tank and the simpler emission control systems.

We estimate MSRPs for the battery electric and hydrogen fuel-cell trucks using a bottom-up approach. First, the base glider cost, which includes the chassis and all powertrain accessories, is estimated based on the truck's technical specifications and the costs reported in Xie et al., (2023). The manufacturing costs of the main powertrain components are then estimated individually, including for the battery, fuel cell unit, hydrogen tanks, and electric drive. Table 4 summarizes these direct manufacturing costs. These costs are then aggregated to calculate the truck's direct manufacturing cost (DMC).

Table 4. Direct manufacturing costs of the main zero-emission truck components in 2022, 2030, and 2040.

Parameter	2022	2030	2040
Energy battery	230 $/kWh	123 $/kWh	99 $/kWh
Power battery	408 $/kWh	242 $/kWh	194 $/kWh
Fuel cell	826 $/kW	301 $/kW	242 $/kW
Hydrogen tank	1,261 $/kg	844 $/kg	675 $/kg
Electric drive	60 $/kW	23 $/kW	18 $/kW

The truck's retail price is calculated by multiplying the DMC by indirect cost multipliers (ICMs) adopted from U.S. Environmental Protection Agency and U.S. Department of Transportation (2016) to account for costs related to research and development, overhead, marketing and distribution, warranty expenditures, and profit markups. In general, technologies with low maturity levels will incur high ICMs. We use ICMs of complexity level "High 1" for the base glider components and the battery pack.[2] For the fuel cell and hydrogen storage tank, ICM complexity level "High 2" is used.[3]

Figure 4 shows the MSRP evolution for the four considered powertrain technologies. The calculated retail prices consider the incentives provided in the Inflation Reduction Act for battery electric and hydrogen fuel-cell trucks (Inflation Reduction Act, 2022). These incentives, which expire in 2032, are calculated as 30% of the price differential between a zero-emission truck and its diesel equivalent, capped at $40,000. The truck retail price is assumed to be financed through loans with a 4% annual interest rate over five years.

2 ICM Complexity level "High 1" corresponds to an ICM of 1.42 in 2022, which decreases linearly to 1.27 by 2035.

3 ICM Complexity level "High 2" corresponds to an ICM of 1.53 in 2022, which decreases linearly to 1.27 by 2035.

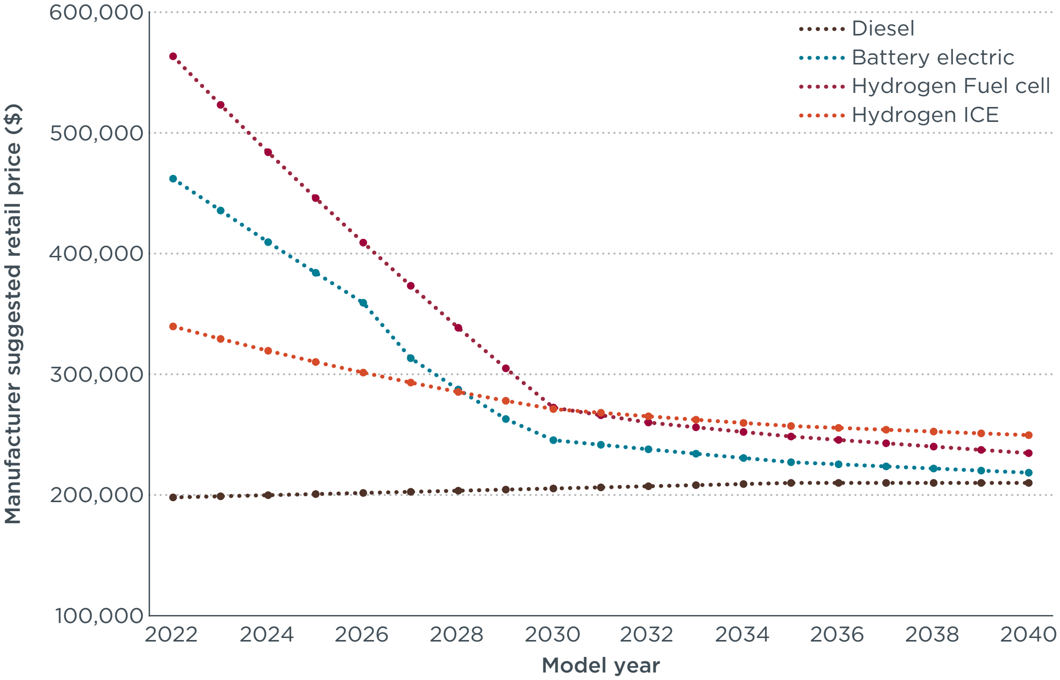

Figure 4. Retail price evolution of Class 8 long-haul tractor-trailers for diesel, battery electric, fuel-cell, and hydrogen internal combustion engine trucks between 2022 and 2040.

Fuel-cell trucks record the highest retail price in 2022, reaching $600k, primarily driven by the fuel cell unit and hydrogen tank cost, followed by the battery electric truck at around $500k. Hydrogen ICE trucks are almost $120k more expensive than their diesel counterparts due to the cost of the hydrogen tanks. The retail price of all alternative truck technologies decreases between 2022 and 2040, driven by cost reduction in main zero-emission powertrain components, such as batteries, fuel cells, and hydrogen tanks. The diesel truck retail price is expected to increase due to the more expensive needed technology packages needed to comply with future emissions standards, assuming that diesel technology will reach its full potential by 2035.

The estimated battery electric truck retail price shows a significant drop between 2026 and 2027, driven by our assumption that MW charging coverage in the United States by 2027 will be large enough so that manufacturers will size batteries considering the possibility of charging during the day, which results in smaller battery sizes and lower retail prices as discussed earlier. A detailed price breakdown can be found in Xie et al. (2023).

Residual value

The truck residual value at the end of the analysis period is estimated using similar methodology as in Basma, Zhou, and Rodríguez (2022) and Mao et al. (2021). For diesel trucks, depreciation is composed of a fixed annual depreciation rate of 7.5% and a variable depreciation rate as a function of the vehicle miles travelled and the truck lifetime. We assume the truck's lifetime is 15 years with a total cumulative VMT of ~ 1.3 million miles (United States Environmental Protection Agency, 2022). After operating for five years and covering a cumulative VMT of ~ 600,000 miles, the estimated truck residual value is 35%.

Alternative truck technologies include components with a potential second-life market, such as batteries, fuel cells, and hydrogen tanks. Current fuel cell durability is estimated to be around 15,000 hours of operation, which increases to 22,000 hours by 2030 (Ricardo Strategic Consulting, 2022). The fuel cell residual value is estimated based on the number of operating hours after five years. This results in a 25% fuel cell unit residual value for 2022 technology and 49% residual value by 2030. The battery lifetime is assumed to be 3,000 cycles in 2022, with the potential to increase to 5,000 cycles in the future (Nykvist & Olsson, 2021). The number of charge-discharge cycles per day depends on the charging power. Given our assumption that trucks today will primarily rely on 350 kW chargers during the day, the daily number of cycles is 1.25, resulting in 2,000 cycles after 5 years. When MW chargers are used as of 2027, the number of daily cycles will increase to 1.8, resulting in ~ 2,900 cycles after 5 years. We also assume that battery residual value at its end life, defined as 80% capacity retention, will be 15% of its original price (Burke & Zhao, 2017). That being said, for current battery and charging technologies, the estimated battery residual value is ~ 43%, increasing to 49% for future battery technologies. Hydrogen storage tanks are assumed to have a lifetime of 5,000 charge/discharge cycles (Pohl & Ridell, 2019), resulting in a 70% residual value after five years of operation. Table 5 summarizes the residual value assumptions.

Table 5. Residual value of components after five years of operation

Component	2022 Model year	2030 Model year
Base glider and e-drive	35%	35%
Battery	43%	49%
Fuel cell	25%	49%
Hydrogen tank	70%	70%

Federal excise tax

The retail sale of commercial vehicles is subject to a 12% federal excise tax (Office of the Federal Register, 2012). This implies that trucks with a higher MSRP will be subject to a higher federal excise tax.

Operational expenses

Operational expenses are related to the vehicle miles driven, including the costs of diesel fuel, hydrogen fuel, charging, maintenance, and labor.

Diesel fuel price

The price of diesel fuel in the United States differs among regions and states. Data from the U.S. Energy Information Administration categorizes diesel fuel prices based on geographic areas (U.S. Energy Information Administration, 2022b). Projecting these prices into the future incurs a very high level of uncertainty. To account for this uncertainty, we assume several scenarios for the diesel fuel price evolution, presented in the results section, with the baseline scenario being the 2022 average prices.

It is worth highlighting that diesel fuel prices have almost doubled between 2020 and 2022, driven by the global energy crisis. In addition, diesel fuel prices are as low as $4.70/gal in the Gulf Coast states, while California records the highest prices exceeding $6.00/gal, 28% higher than the U.S. national average.

Hydrogen fuel price

Hydrogen fuel prices across the U.S. states are taken from Slowik et al. (2023), where all detailed modeling methodology and data assumptions can be found. The prices include on-site renewable (green) hydrogen production costs, hydrogen refueling station costs, and tax credits for renewable electricity and clean hydrogen provided by the Inflation Reduction Act. Figure 5 shows the state-level green hydrogen price between 2023 and 2045 used in this study. Price variations across states result from varying solar and wind resources. States with more abundant solar or wind resources can run renewable electricity plants more often, achieving lower renewable electricity costs. Green hydrogen prices are expected to decrease over time as the technology matures.

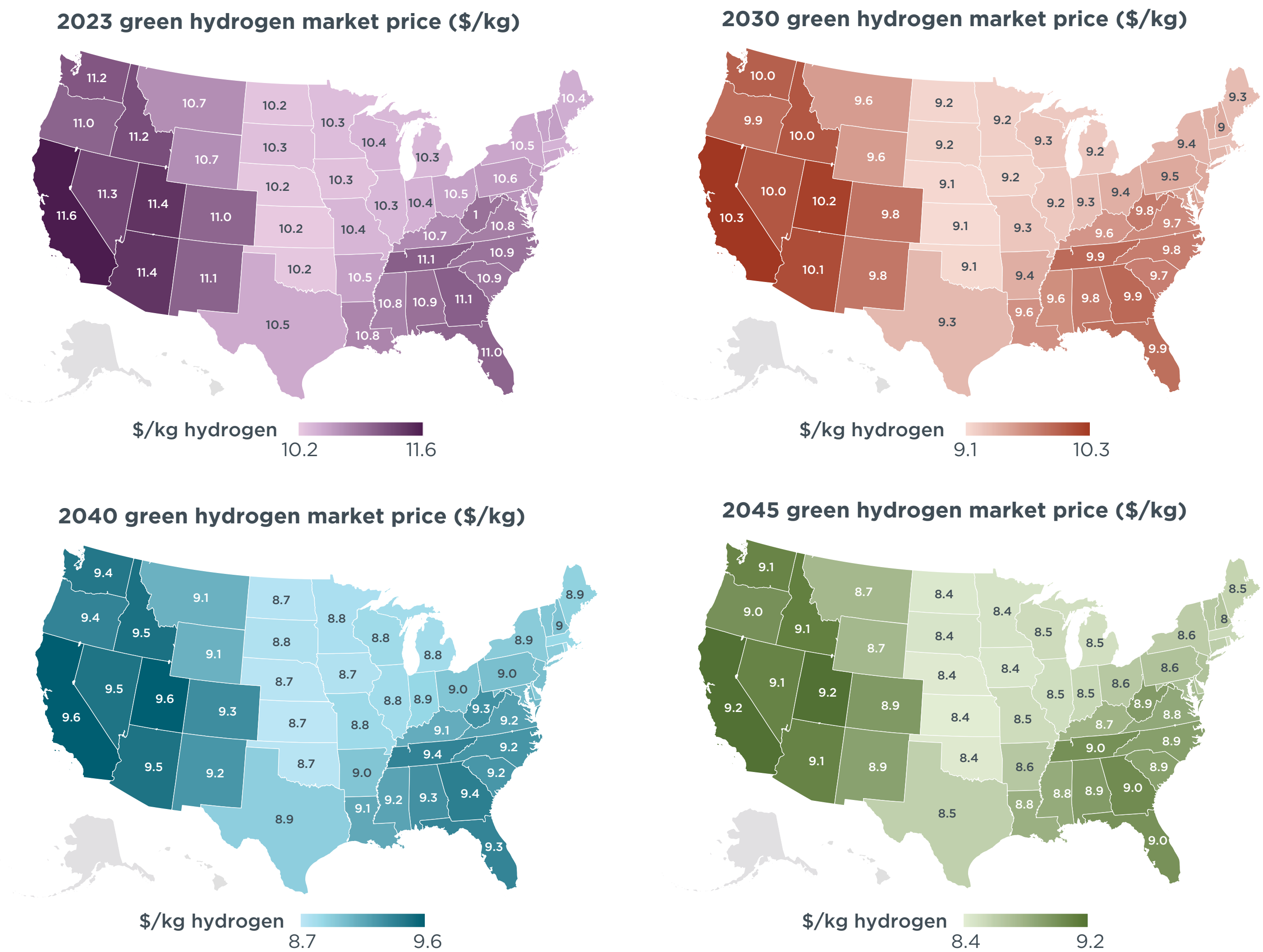

Figure 5. Summary of green hydrogen fuel market price at the pump in different states in 2023, 2030, 2040, and 2045.

Charging cost

Charging cost is comprised of the electricity cost and the cost of the charging infrastructure. Electricity costs vary among and within states depending on local electricity tariffs and rates set by the respective utilities. Infrastructure costs are assumed to be independent of the charging station location and correspond to public on-route charging stations at truck stops along highways. Figure 6 shows the charging cost modeling framework.

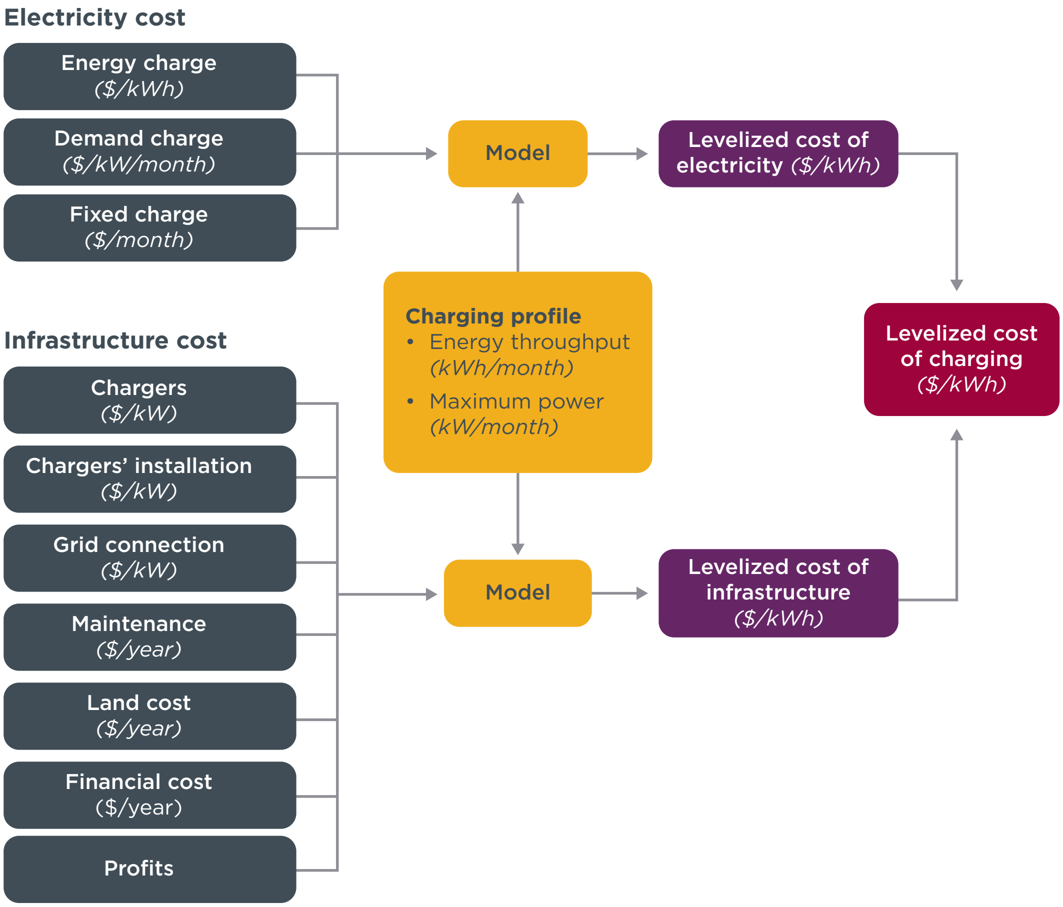

Figure 6. Charging cost modelling framework

We assume long-haul trucks will utilize on-route public charging stations at truck stops along highways. We assume a charging station size of 20 MW, including 17 1-MW chargers and 20 150-kW chargers. The charging station peak power demand is assumed to be 50% of the station size, considering the coincident load of MW charging events, as explained in Bennett et al. (2022). This peak demand drives grid upgrade costs and electricity demand charges.

Charging station utilization is dependent on the market uptake of battery electric trucks in the United States. We assume that the long-term utilization rate of on-route public charging stations is 15% by 2035, assuming utilization will increase linearly until 2035 in an approach similar to Bennett et al. (2022). The station utilization rate will directly impact the levelized cost of charging, as detailed in the proceeding sections.

Levelized cost of electricity

Electricity costs are estimated for each of the seven representative states using cost information from the largest utilities in each state and those covering long-haul routes.

Table 6 summarizes the electricity rates considered in the selected states and the corresponding levelized cost of electricity.

Table 6. Summary of electricity rates considered in selected states.

State	Source	Rate	Energy charge ($ cents/kWh)	Demand charge ($/kW/month)	Fixed charge ($/month)	Levelized cost of electricity (¢/kWh)
California	Pacific Gas and Electric Company (2022)	BEV-2-P rate (Primary distribution > 100 kW)	19.57 [a)]	-	17,196 [b)]	20.48
Florida	Florida Power and Light (2023)	General Service Large Demand Sheet 8.412	1.68	13.57	255	8.84
Georgia	Georgia Power (2022)	Power & Light Large Schedule PLL-13	Levelized cost provided by utility			13.1
Illinois	Billing sample estimate-Commonwealth Edison (2023)	Extra-large load (above 10 MW)	6.53 [c)]	11.17	1,962	12.51
New York	Billing sample estimate - National Grid (2023)	SC3 General – Primary service	4.63	14.08	2,583	12.18
Texas	Oncor (2022)	Primary - > 10 kW substation	3.5 [d)]	8.3 [e)]	-	7.87
Washington	Puget Sound Energy (2022)	Schedule 31	5.6	9.94 [f)]	358	10.85

a) There are three time-of-use energy charges: (1) peak (4p-9p) at 39.046 cents/kWh, (2) off-peak (9p-9a, 2p-4p) at 18.158 cents/kWh, and (3) super off-peak (9a-2p) at 15.892 cents/kWh. We assume 60% of charging will occur during off-peak hours, 10% during peak hours, and 30% during super off-peak hours.
b) Subscription charge at $85.98 per 50 kW block assuming 10 MW peak site capacity.
c) All state and municipal taxes are added to an energy charge of 3.5 cents/kWh, assumed based on the historic 5-year average.
d) Assumption based on a 5-year historic average.
e) aggregates demand and distribution charges.
f) Average between a summer tariff at 7.94 $/kW and a winter tariff at 11.94 $/kW.

Levelized cost of infrastructure

Infrastructure cost includes the grid connection, charger, and the station's operational expenses. Figure 7 illustrates the major components of the battery electric truck charging infrastructure ecosystem. The grid connection costs include all expenses incurred in front of the meter, in addition to on-site transformers, electric panels, and switchgear.

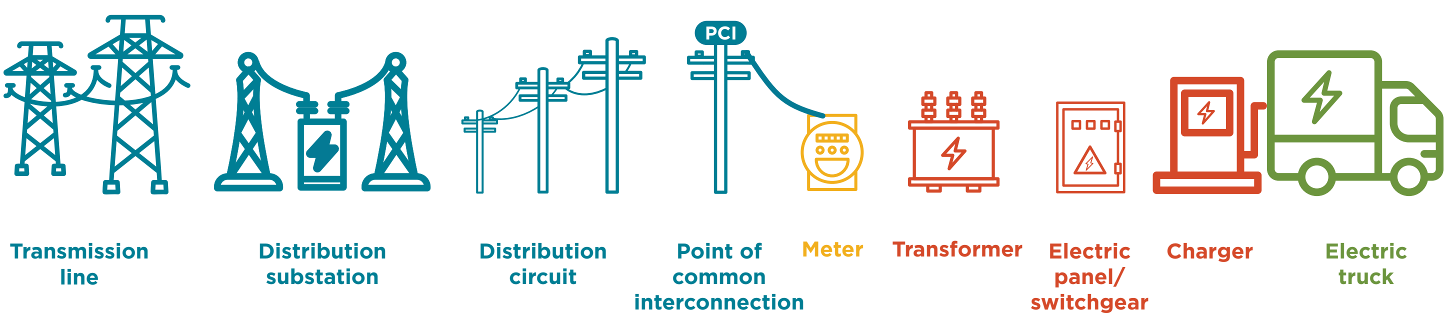

Figure 7. Battery electric truck charging infrastructure ecosystem.

The grid connection cost can add significant cost to the investment needed to deploy public MW charging stations. The underlying assumptions for our grid connection cost estimates are summarized below:

» There will be flexibility in choosing the station locations to reduce grid connection costs. We assume that there will either be sufficient space inside the existing substation to add another substation transformer or it will be possible to upgrade an existing substation transformer. Thus, the land costs for a new substation were not included in the infrastructure cost calculations, as well as the engineering, design, right-of-way acquisition activities (time), and costs.

» The station is connected to the primary voltage grid. Large charging hubs will most probably buy power from the utility at primary voltage.

» There is no onsite energy storage system to help reduce the peak load. Onsite energy storage batteries incur high investment costs. On the other hand, such technology can lower the charging station operational expenses related to demand charges and/or deal with the utility's inability to alleviate grid congestion.

» There is no renewable power generation at this public charging site.

» The charging station will incur all grid connection and upgrade costs.

Based on those underlying assumptions, Table 7 summarizes the grid connection, upgrade, the charger installation costs. These costs are developed based on utility experts' feedback for the 10 MW peak load charging site. The levelized cost is calculated assuming that all the mentioned components have a lifetime of 40 years. All costs are converted into annual cashflows considering an 8% internal rate of return.

Table 7. Summary of grid upgrade and connection costs, and charger's-related costs behind the meter.

Component	Category	Notes	Cost	Levelized cost (¢/kWh)
Sub-transmission line	Sub-transmission	115 kV line – Not included – Assumed the existing substation has sufficient space to accommodate another transformer, or a larger capacity substitute transformer.	-	-
Greenfield substation	Substation	Not included – Assuming the existing substation has sufficient space to accommodate another transformer.	-	-
Substation transformer addition		One 28 MVA transformers added to an existing distribution substation. Cost Includes foundation, grounding, conduit and wiring, supply and install.	$2,000,000	0.74
Other equipment		Feeders, tie, transfer switches	$1,100,000	0.40
Distribution feeder to the closest point on the grid (Point of Interconnection)	Distribution	Assuming an overhead distribution feeder, 1 mile in length.	$900,000	0.33
Connection to the meter: closest point on the grid to a utility meter	To-the-meter	Assuming 300-feet long connection	$100,000	0.04
Utility meter and meter base		Primary service metering	$15,000	0.01
Primary Transformer (converting 13kV to 480V)	Behind-the-meter	1,500 kVA – Assumed 10 1500kVA transformers to meet a 10 MW peak demand, with some redundancy for maintenance, futureproofing, and to meet electrical safety/code requirements.	$600,000	0.22
Charger installation		Includes switchgear, wiring, onsite construction, and trenching. Assumed $195,000 per 1 MW charger (total 17) and $137,250 per 150 kW charger (total 20)	$6,060,000	2.23
Total			**$10,775,000**	**3.97**

Table 8 summarizes the costs for the chargers and charging station, which are adopted from Bennett et al. (2022). The levelized cost is calculated assuming the chargers have a lifetime of 10 years. All these cost components are converted into annual cashflows considering an 8% internal rate of return.

Table 8. Summary of charger and station operation costs. Adopted from Bennett et al. (2022).

Component	Costs	Levelized cost (¢/kWh)
Charger acquisition	1 MW charger: $300,000 per charger (Total 17) 150 kW charger: $53,655 per charger (Total 20)	4.04
Annual maintenance per charger	$3,200 per charger (Total 37)	0.52
Annual land cost	$25,000 for 1 acre	0.11
Total		**4.67**

The total charging cost is the sum of electricity and infrastructure levelized costs, as summarized in Figure 8. This is the estimated average levelized cost of charging over the station's lifetime. In other words, although we expect lower utilization rates during the early years of operation, we assume that charging station operators will average their expenses and profits over the station's lifetime.

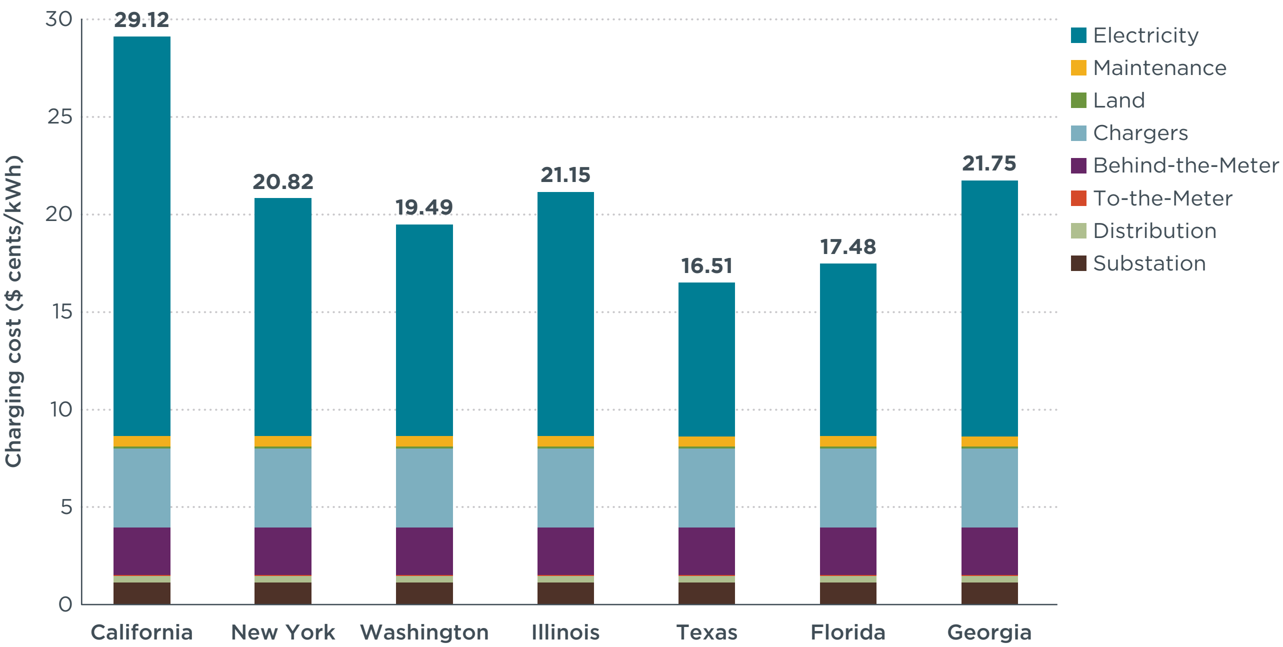

Figure 8. Charging costs in selected states. Data correspond to 2022–2023 electricity rates in each state.

Maintenance cost

Maintenance costs for diesel, battery electric, and hydrogen fuel-cell Class 8 long-haul trucks are adopted from a recent publication by UC Davis (Wang et al., 2022). Figure 9 shows the truck maintenance costs breakdown for the different powertrain technologies. Maintenance costs include common components among all powertrain technologies, such as brakes, gears, air conditioning, tires, and cabin air filters. Powertrain-specific components, such as engine-related maintenance, battery, fuel cell, and hydrogen storage, are also highlighted. Hydrogen ICE trucks are assumed to have similar maintenance costs to their diesel counterparts, with additional costs related to the maintenance of the hydrogen storage system.

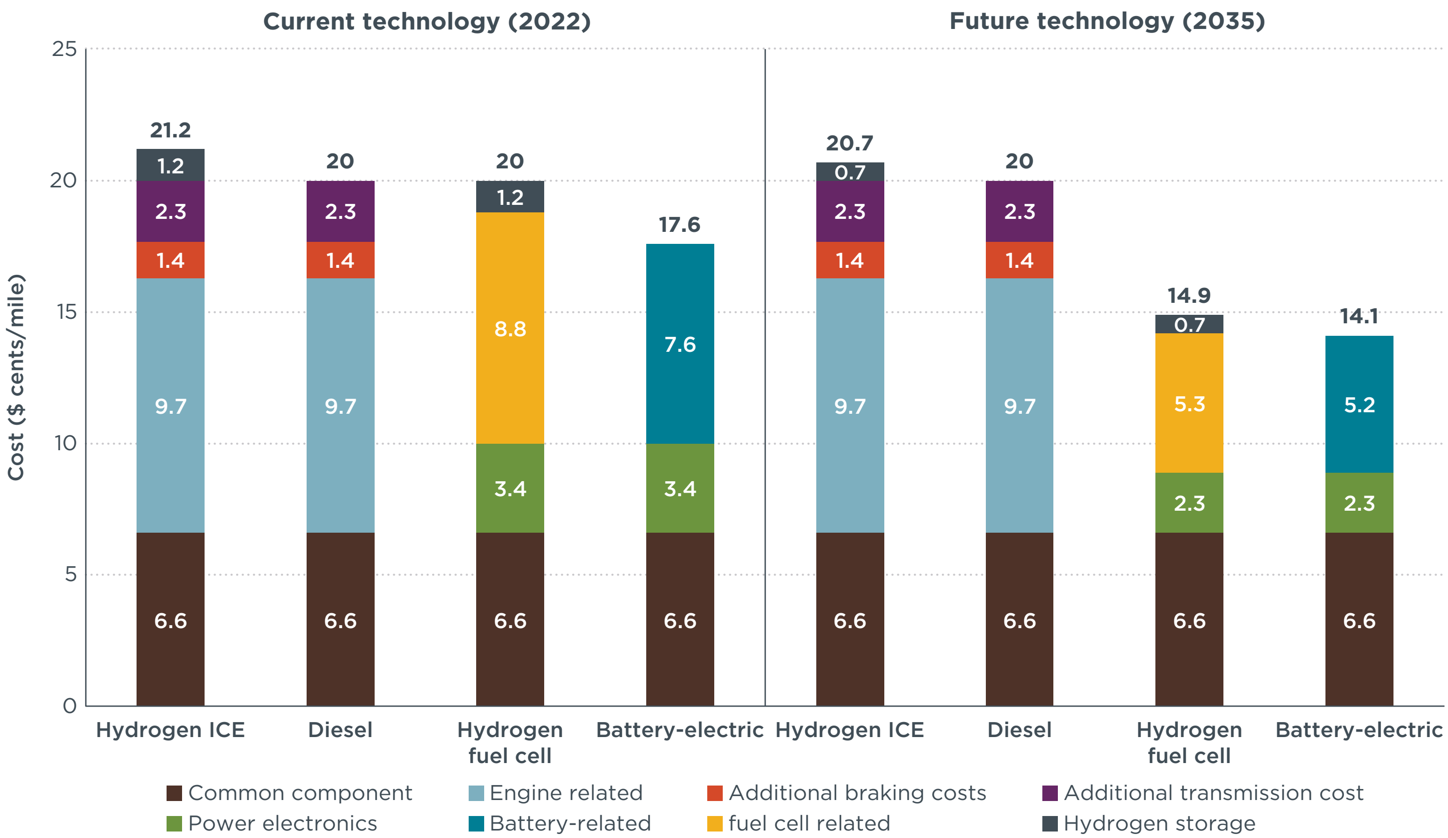

Figure 9. Maintenance costs breakdown for different powertrain technologies for Class 8 long-haul trucks in the United States. Adopted from Wang et al. (2022).

For current vehicle technology, battery electric trucks record the lowest maintenance costs at $0.176/mi, relative to $0.20/mi–$0.212/mi for other technologies. With the expected development in battery and fuel cell technologies over time, associated maintenance costs are expected to decrease to around $0.14/mi–$0.15/mi by 2035 due to the learning curve effect for new technologies.

Labor cost

Labor costs are estimated on a per-mile basis assuming a rate of $0.79 per mile, according to Burnham et al. (2021). For battery electric trucks, drivers may need to stop more frequently to recharge, increasing their number of working hours during the day. This is the case for battery electric trucks before the wide deployment of MW charging stations along long-haul routes prior to 2027. The additional labor cost is calculated depending on the additional number of working hours due to truck charging. Prior to the deployment of MW chargers, this can lead to a 10%–15% increase in labor cost.

Insurance

Insurance costs for tractor-trailers can be a significant TCO component. This study considers comprehensive and collision insurance in addition to liability insurance. The former is an annual cost estimated to be around 3% of the truck purchase price, and the latter is calculated as a fixed per-mile cost at $0.065/mi, similar to Burnham et al. (2021). This approach distinguishes between different powertrain technologies with different retail prices, and also distinguishes between different truck annual VMT.

NATIONAL ANALYSIS: MONTE CARLO SIMULATIONS

The TCO analysis at the U.S. national level is carried out using a stochastic Monte Carlo approach, given the significant variation in several TCO cost components among different states, primarily diesel, hydrogen, and charging costs. In addition, the analysis captures the reported variations in the technology cost, such as for the battery, fuel cell, and hydrogen tanks. Table 9 summarizes the stochastic variables' mean and standard deviation data used to develop the respective probability density functions. Figure 10 illustrates the probability density functions for the different stochastic variables used in the Monte Carlo analysis. We assume that all variables will follow a lognormal distribution.

All technology cost data are available in a recent ICCT publication (Xie et al., 2023), where we collect data from different sources and estimate the sample mean and standard deviation per component. We rely on the state-specific data presented earlier in the operational expenses section for hydrogen fuel, diesel fuel, and charging cost data. We define weights to the different state-specific cost data based on the percent distribution of tractor-trailer vehicle's miles traveled, as shown in Figure A1 in the appendix. We then estimate each stochastic variable's weighted average mean and standard deviation. Diesel and hydrogen fuel price data are collected for all 50 states, while charging costs are only developed for the 7 states considered in this paper, assuming they cover a wide spectrum of charging costs in the United States. Another important stochastic variable to define is the vehicle's daily mileage, which will drive the vehicle energy storage size, mainly the battery energy storage capacity. Variation in daily mileage is also considered, where we define a "mileage variability" variable used in the vehicle energy storage sizing.

Table 9. Summary of stochastic variables used to develop the respective probability density functions.

Variable	Mean			Standard deviation		
	2022	2030	2040	2022	2030	2040
Energy battery cost ($/kWh)	232	123	99	53.4	22.6	7
Power battery cost ($/kWh)	409	242	198	123	63	15
Fuel cell cost ($/kW)	827	301	241	502	191	70
Hydrogen tank cost ($/kg)	1,262	844	675	313	224	120
Electric drive cost ($/kW)	60	23	18	9	4.1	2
Diesel fuel price ($/gal)		4.13			2.95	
Charging cost ($ cents/kWh)		19.6			3.2	
Green hydrogen price ($/kg)	11.2	9.58	9.08	0.4	0.35	0.29
Daily driving mileage (miles)		400			75	
Daily mileage variability		1.1			0.1	

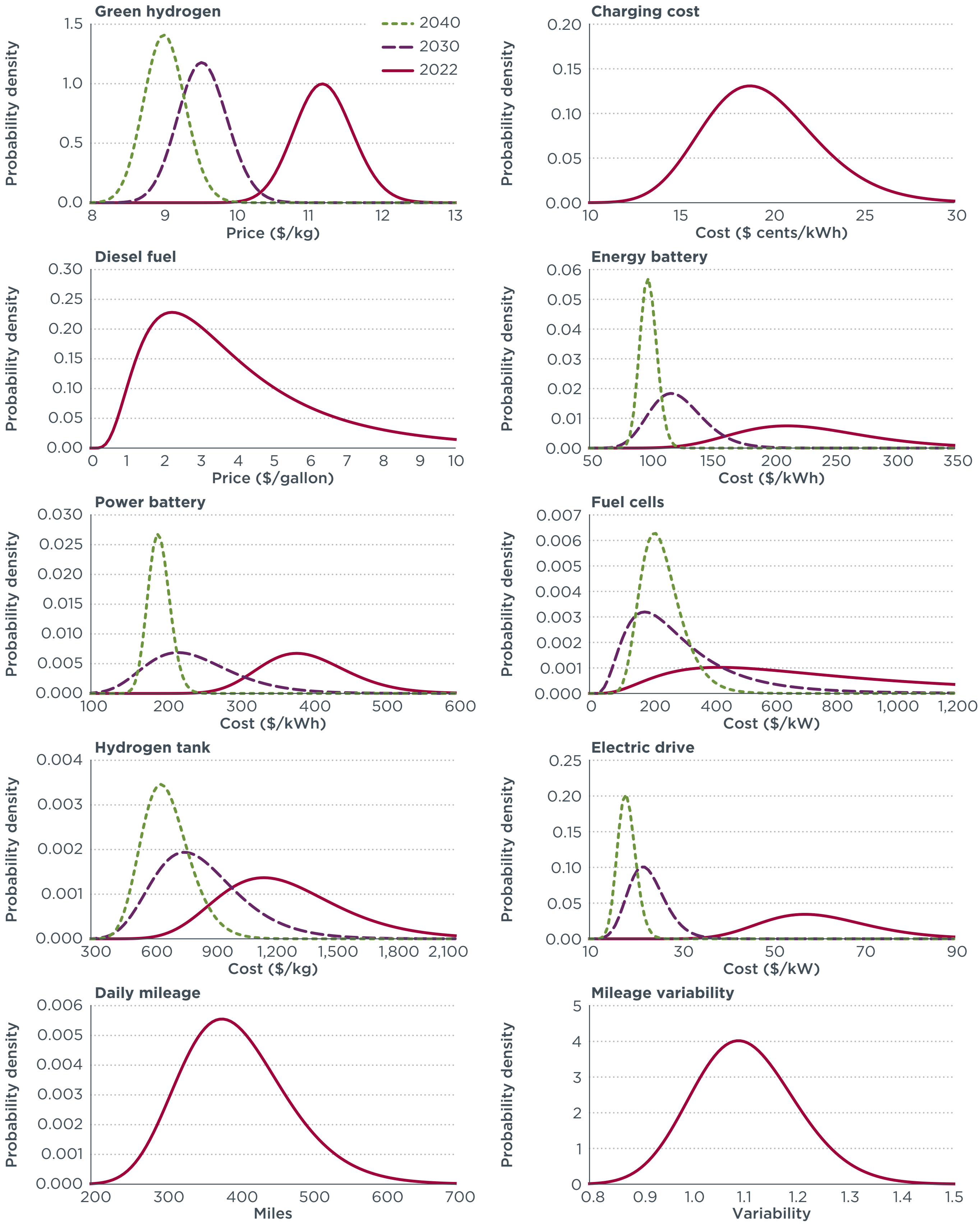

Figure 10. Summary of probability density functions for the different stochastic variables used in the Monte Carlo analysis.

RESULTS AND DISCUSSION

STATE-SPECIFIC ANALYSIS

This section presents the state-specific TCO, considering the average capital expenses and the state-specific fuel and energy prices presented earlier. We consider that diesel and charging costs are fixed between 2022 and 2040 due to the high uncertainty in predicting the diesel and electricity cost evolution during this timeframe. The impact of diesel fuel and charging cost variations on the TCO are examined in the sensitivity analysis section. Hydrogen fuel prices are assumed to vary between 2022 and 2040, as discussed previously.

Figure 11 shows the state-specific TCO for all technologies for truck model year 2022. Across all states, diesel trucks are the cheapest to operate, as their TCO ranges from $1.88/mi (Texas) to $2.06/mi (California). The highest TCO for diesel trucks is recorded in California due to the high diesel fuel prices there. Battery electric trucks come as the second cheapest technology from a TCO perspective. The lowest TCO for battery electric trucks is recorded in Texas at $2.18/mi, driven by the low charging costs, while battery electric trucks operating in California record the highest TCO at $2.50/mi. Battery electric trucks generally record a 13% to 26% higher TCO than their diesel counterparts in 2022.

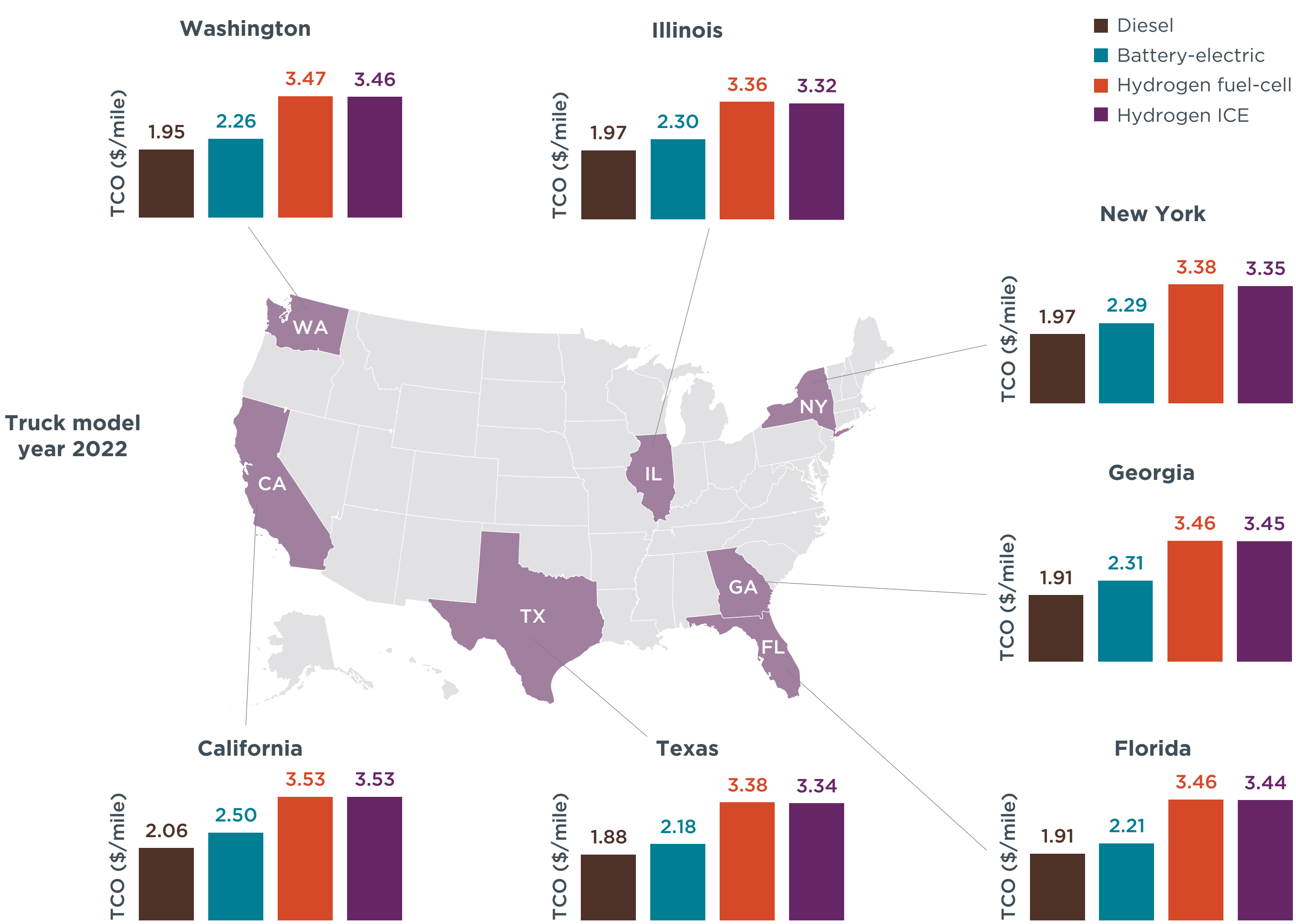

Figure 11. State-specific total cost of ownership for different truck technologies. Case of truck MY 2022.

Hydrogen fuel-cell and hydrogen ICE trucks show a very similar TCO for MY 2022, reaching as high as $3.53/mi for trucks operating in California and as low as $3.36/mi for trucks operating in Illinois. This is mainly driven by the green hydrogen fuel price in each state, which are expected to be the highest in California and the lowest in Illinois. Both hydrogen-powered trucks record a 68%–81% higher TCO than diesel trucks and 34%–59% higher TCO than their battery electric counterparts.

Figure 12 shows the state-specific TCO for all technologies for truck MY 2030. In all considered states, battery electric trucks are expected to record the lowest TCO, ranging from $1.63/mi (Texas) to $1.90/mi (California). Diesel trucks follow with the second lowest TCO, ranging between $1.76/mi and $1.91/mi. For MY 2030 trucks, battery electric trucks are expected to record a 3%–8% lower TCO than diesel trucks. The TCO analysis for MY 2040 trucks is presented in Figure A9 in the appendix.

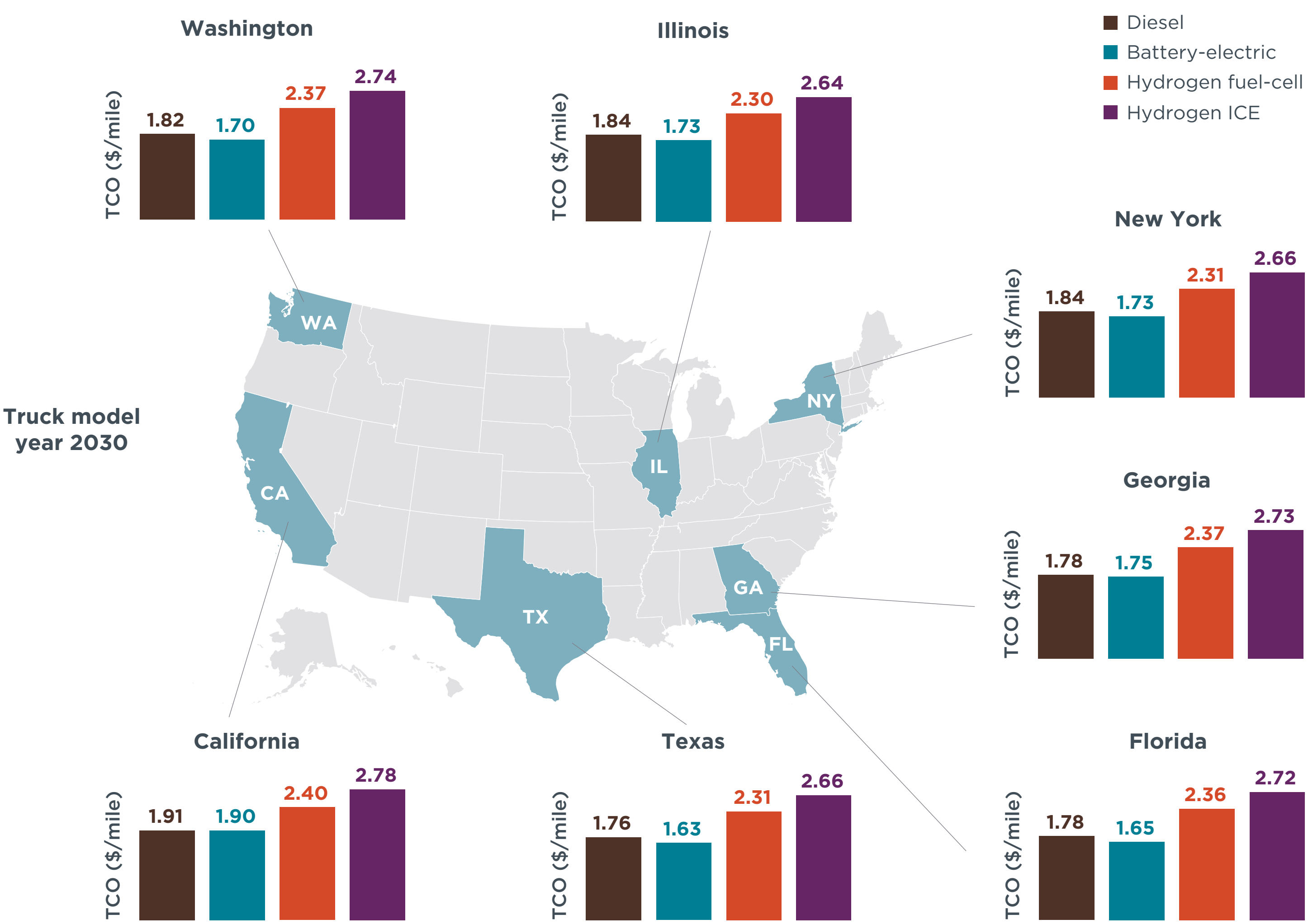

Figure 12. State-specific total cost of ownership for different MY 2030 truck technologies.

The TCO of hydrogen fuel-cell trucks is expected to remain much higher than their diesel and battery electric counterparts but lower than that of hydrogen ICE trucks. Hydrogen fuel-cell trucks record a TCO in the range of $2.30/mi to $2.40/mi, while the TCO of hydrogen ICE trucks ranges from $2.64/mi to $2.78/mi, or almost 20% higher than the TCO of hydrogen fuel-cell trucks.

Table 10 summarises the year of TCO parity of alternative truck technologies relative to diesel trucks in selected states.

Table 10. Summary of TCO parity year between alternative truck technologies and diesel trucks in selected states.

Technology	California	Florida	Georgia	Illinois	New York	Texas	Washington
Battery electric	2030	2028	2029	2028	2028	2027	2028
Hydrogen fuel-cell	> 2040	> 2040	> 2040	> 2040	> 2040	> 2040	> 2040
Hydrogen ICE	> 2040	> 2040	> 2040	> 2040	> 2040	> 2040	> 2040

The TCO findings for MY 2040 trucks and the detailed state specific TCO breakdown are documented in the appendix.

SENSITIVITY ANALYSIS

The previous state-specific analysis uses the 2022 average diesel fuel prices in selected states and 2022 electricity rates. It assumes these prices and costs will remain fixed during the entire analysis period between 2022 and 2040. However, energy and fuel prices are subject to continuous variations, and this section examines the impact of these prices on the TCO of different truck technologies. This section also examines the impact of truck payload on the TCO analysis.

Impact of fuel and energy prices

Figure 13 shows the TCO parity sensitivity to diesel fuel prices and charging costs. The inclined lines represent the TCO parity year between both truck technologies. The sensitivity analysis covers a wide range of fuel prices, where diesel fuel prices are varied between \$2.00/gal and \$7.50/gal, representing the minimum and maximum prices observed in the United States between 2017 and 2022. Charging cost is varied between \$0.10/kWh and \$0.35/kWh. For example, if the diesel fuel price is \$5.00/gal and the charging cost is \$0.20/kWh, TCO parity between battery electric and diesel trucks is expected between 2027 and 2028.

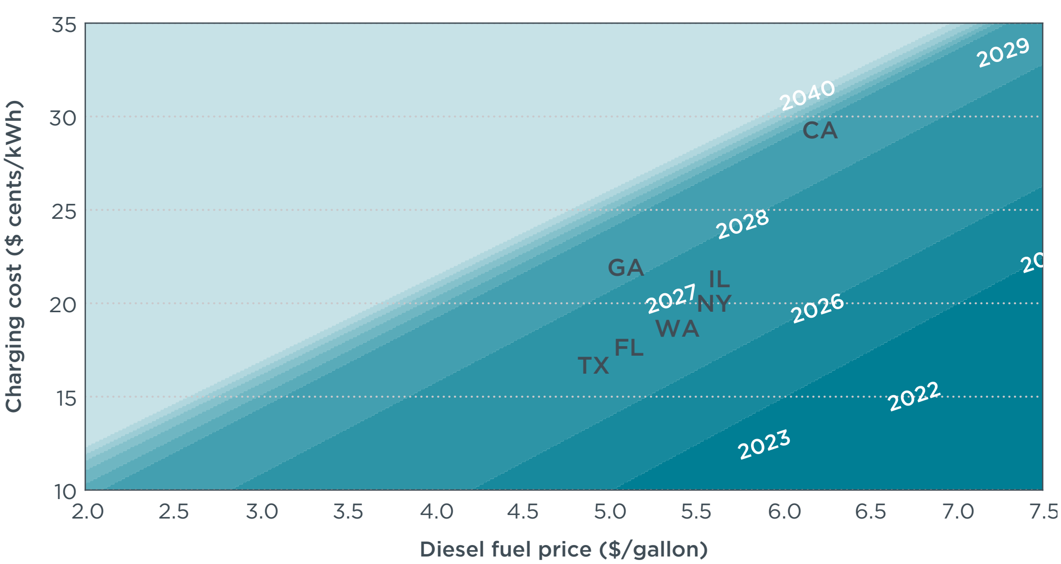

Figure 13. Total cost of ownership parity sensitivity to diesel fuel prices and charging costs. A comparison between battery electric and diesel.

Variations in diesel fuel prices and charging costs significantly impact the year battery electric trucks achieve TCO parity with diesel trucks. For the current range of diesel fuel prices in the United States of between $4.00/gal and $6.00/gal, and the range of charging costs between $0.15/kWh and $0.30/kWh, battery electric trucks can achieve TCO parity with diesel trucks by the end of this decade.

Figure 14 shows the TCO parity sensitivity to diesel and hydrogen fuel prices. The inclined lines represent the TCO parity year between both truck technologies. Hydrogen fuel price is varied between $2.00/kg and $12.00/kg. The higher limit considers the maximum modeled green hydrogen fuel price between 2022 and 2040. The lower limit is a hypothetical figure to model a highly favorable green hydrogen fuel price.

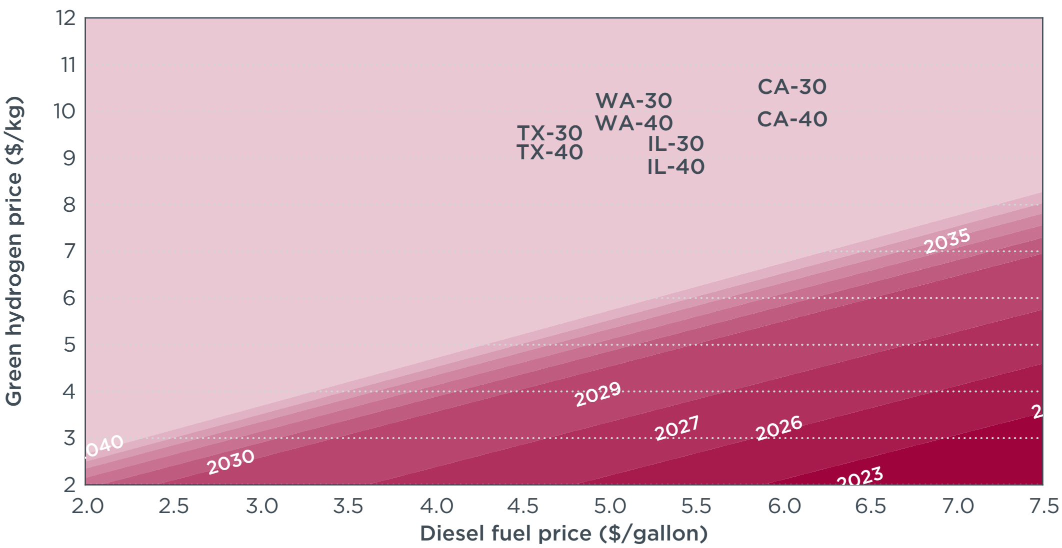

Figure 14. Total cost of ownership parity sensitivity to diesel and hydrogen fuel prices. A comparison between hydrogen fuel-cell and diesel trucks.

Variations in diesel and green hydrogen fuel prices significantly impact the TCO parity year between fuel-cell and diesel long-haul trucks. Fuel-cell long-haul trucks may achieve TCO parity with diesel trucks by 2025 if diesel fuel prices exceed $6.00/gal and green hydrogen fuel price drops below $5.00/kg. The figure highlights the current diesel fuel prices and the expected green hydrogen fuel price in 2030 and 2040 in selected states, ranging between $8.50/kg and $10.50/kg. Under the current diesel fuel prices, if fuel-cell trucks are to achieve TCO parity with diesel trucks by 2030, green hydrogen fuel prices would need to be between $4.00/kg and $6.00/kg. By 2040, the break-even hydrogen price is in the range of $5.00/kg to $7.00/kg.

Figure 15 shows the hydrogen ICE and diesel TCO parity sensitivity to diesel and hydrogen fuel prices. Hydrogen ICE trucks operating in long-haul are unlikely to reach TCO parity with diesel trucks any time before 2040 unless extreme scenarios result in very high diesel fuel prices exceeding $5.00/gal and very low green hydrogen fuel prices below $3.00/kg.

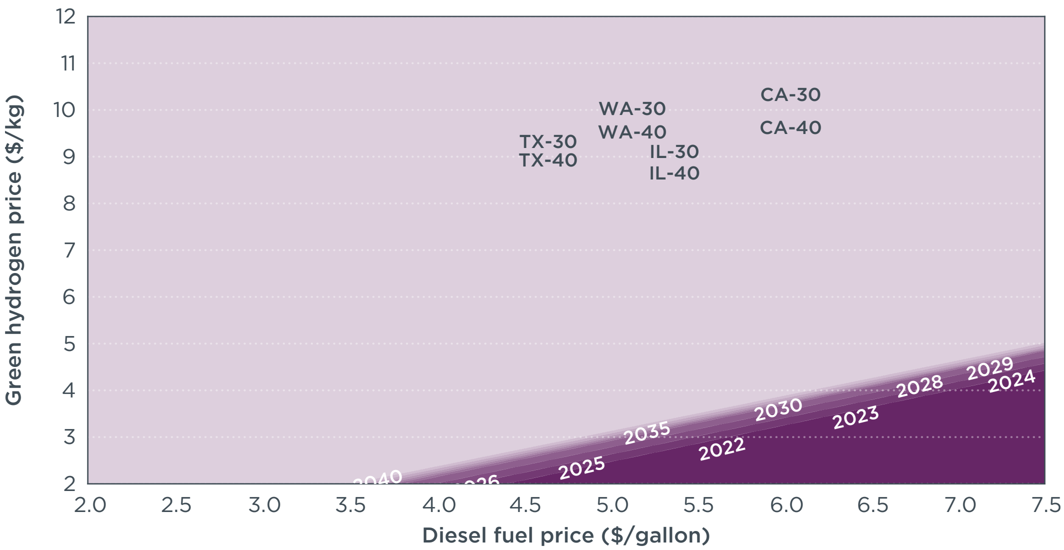

Figure 15. Total cost of ownership parity sensitivity to diesel and hydrogen fuel prices. A comparison between hydrogen ICE and diesel trucks.

Impact of payload

The average payload of the truck and its payload capacity can significantly affect its economic viability. The average use case presented in this study assumes an average payload of 38,000 lb, which is below the payload capacity of all considered powertrain technologies. This section examines the impact of operating at full payload on the TCO of the different trucks. However, as shown earlier, different truck powertrain technologies will have different payload capacities. To be able to compare the TCO for different maximum payloads, we calculate the TCO of each truck technology in $/ton. mi, i.e., dividing the TCO by the maximum payload capacity of each truck, expressed in U.S. tons.

With higher payloads, the fuel consumption of each truck technology increases, which yields higher fuel and energy costs. More energy-efficient powertrains will be less sensitive to this increase in payload. On the other hand, trucks with higher payload capacities can realize lower TCO per ton. Figure 16 shows the TCO for different technologies at average and maximum payloads. The TCO parity between battery electric and diesel trucks will be delayed by three to four years for the case of maximum payload compared to the case of average payload. The TCO gap between battery electric and both hydrogen-powered trucks will also be narrower, but their TCO would still be higher than that of their diesel and battery electric counterparts.

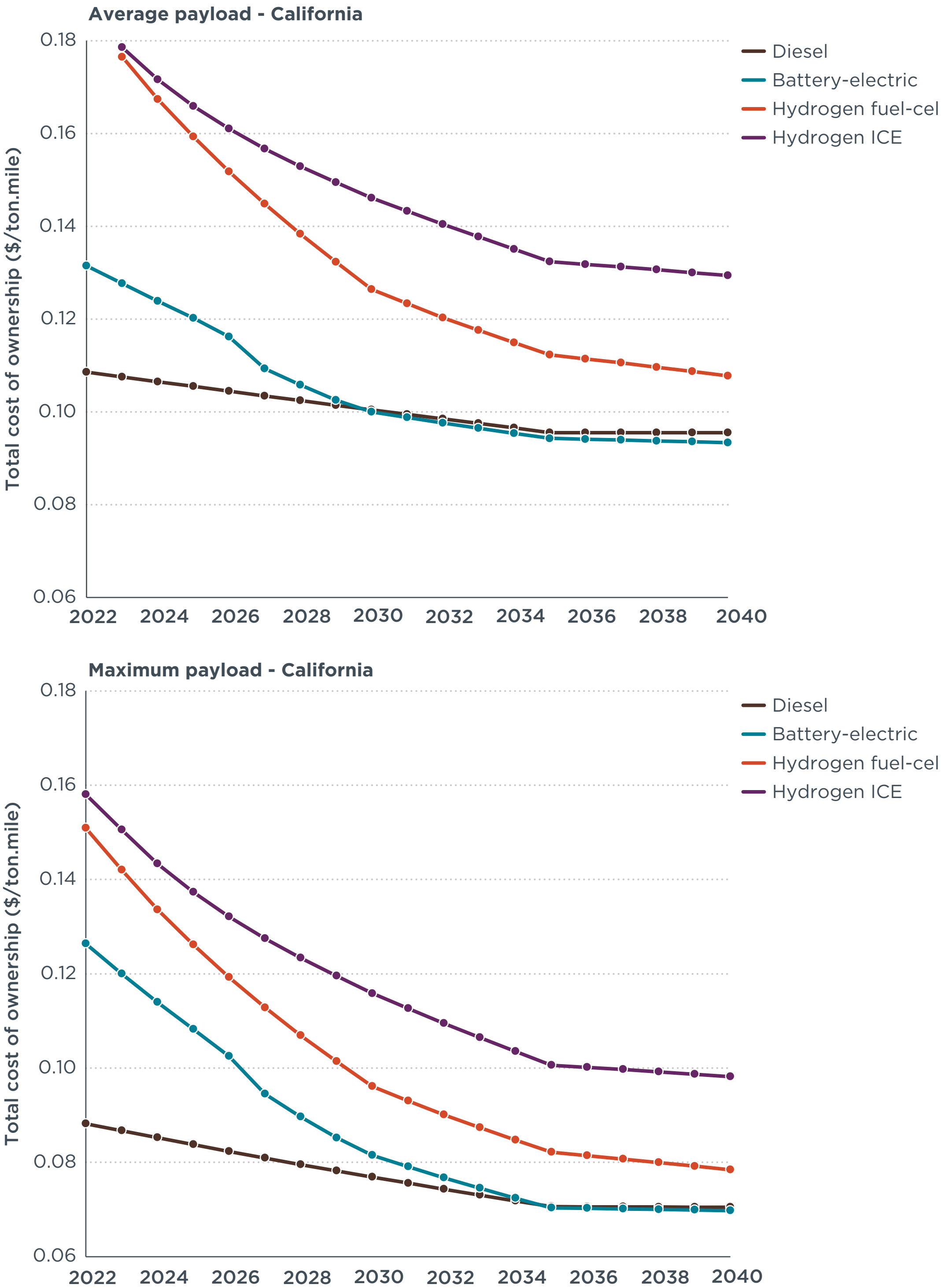

Figure 16. TCO of different truck technologies at average and maximum payloads.

TCO of battery electric versus hydrogen fuel cell trucks

Both battery electric and hydrogen fuel-cell trucks are zero-emission powertrain technologies at the tailpipe level and have the potential to achieve significant GHG emission savings relative to diesel trucks from a lifecycle perspective. As both technologies share a similar environmental performance, their future market uptake in the long-haul segment is expected to be driven by their economic performance, namely their TCO.

Figure 17 shows the TCO parity sensitivity of battery electric and hydrogen fuel-cell trucks to charging costs and green hydrogen fuel prices for several model years. For MY 2023 trucks, given the expected charging cost range of between \$0.15 /kWh and \$0.30/kWh, the break-even green hydrogen price is in the range of \$2.00/kg–\$5.00/kg, which is much lower than the \$10.00/kg–\$12.00/kg estimated price range in 2023. Even under very pessimistic charging cost assumptions of \$0.50/kWh, the required break-even green hydrogen price is \$8.50/kg, which is still lower than the estimated price range in 2023.

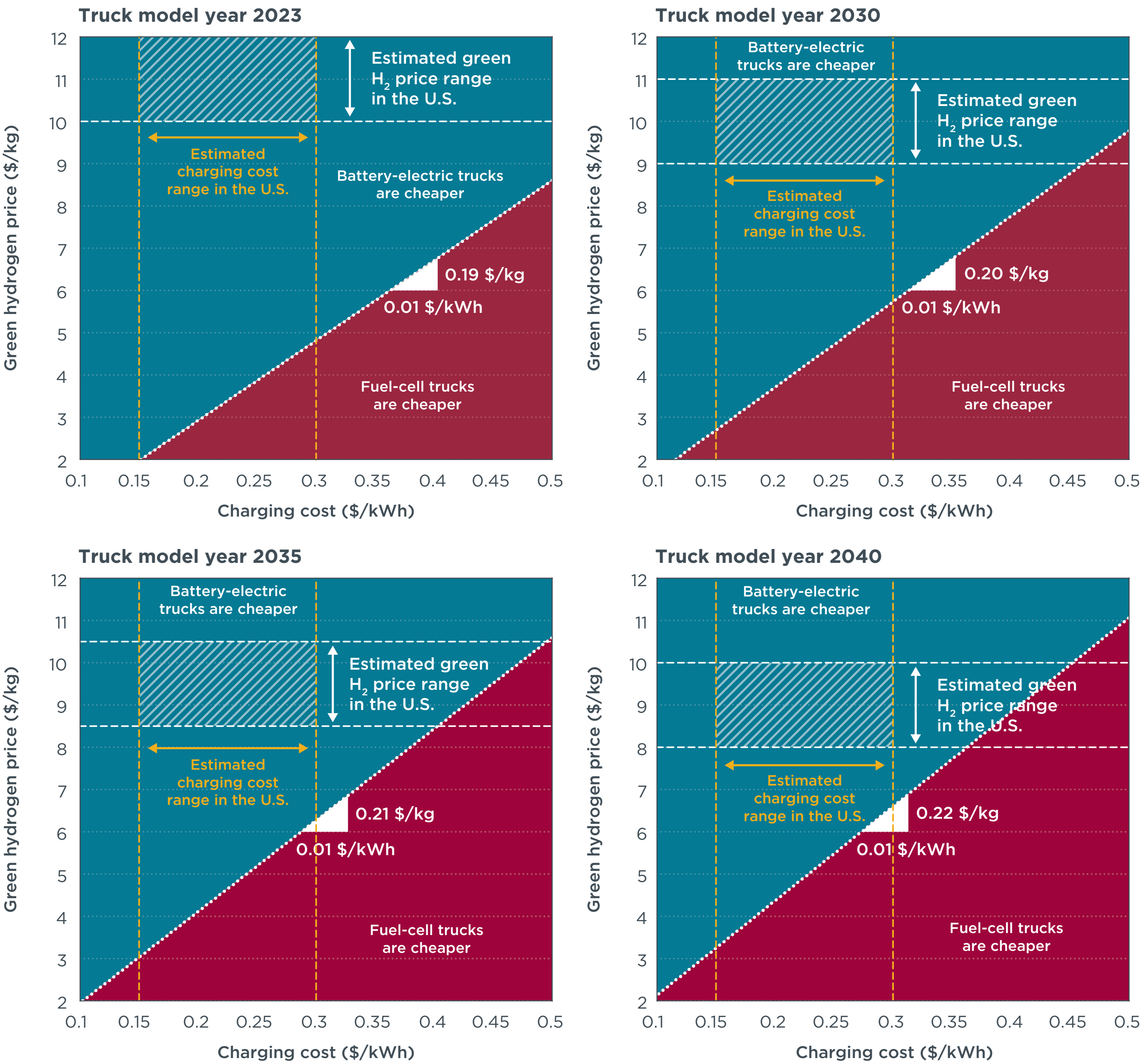

Figure 17. Total cost of ownership parity sensitivity to charging costs and hydrogen fuel prices for several truck model years. A comparison between battery electric and hydrogen fuel cell.

As the fuel-cell truck technology becomes more mature over time, the break-even hydrogen prices slightly increase, as shown in the panels of Figure 17 representing different truck model years. For MY 2040 trucks, given the expected charging cost range of between $0.15 /kWh and $0.30/kWh, the break-even green hydrogen price ranges from $3.50/kg to $7.00/kg, which is still lower than the $8.00/kg–$10.00/kg estimated price range in 2022.

Under the current and future estimates for green hydrogen prices, fuel-cell trucks can achieve a better TCO than their battery electric counterparts as of 2035 only if charging costs exceed $0.45/kWh, which is much higher than the modelled charging costs in this study. Nonetheless, this might be the case for some states or regions that are not considered in this study.

It is worth mentioning how TCO parity is more sensitive to variations in hydrogen fuel prices than charging costs, as implied by the triangle slopes in Figure 17. This is primarily related to the fuel economy, as battery electric trucks are more energy-efficient and consume less per mile than hydrogen fuel-cell trucks.

TCO of hydrogen fuel cell versus hydrogen ICE trucks

Figure 18 shows the TCO parity between both hydrogen-powered trucks as a function of the truck model year, highlighting the break-even hydrogen fuel price point per model year. In general, hydrogen ICE trucks incur a lower MSRP than their hydrogen fuel cell rivals. On the other hand, hydrogen fuel cell trucks have shown better fuel economy, as presented earlier in Figure 2. In cases of low hydrogen fuel prices, hydrogen ICE trucks are expected to have a better TCO because their operational expenses are not high enough to diminish their MSRP gap with hydrogen fuel cell trucks.

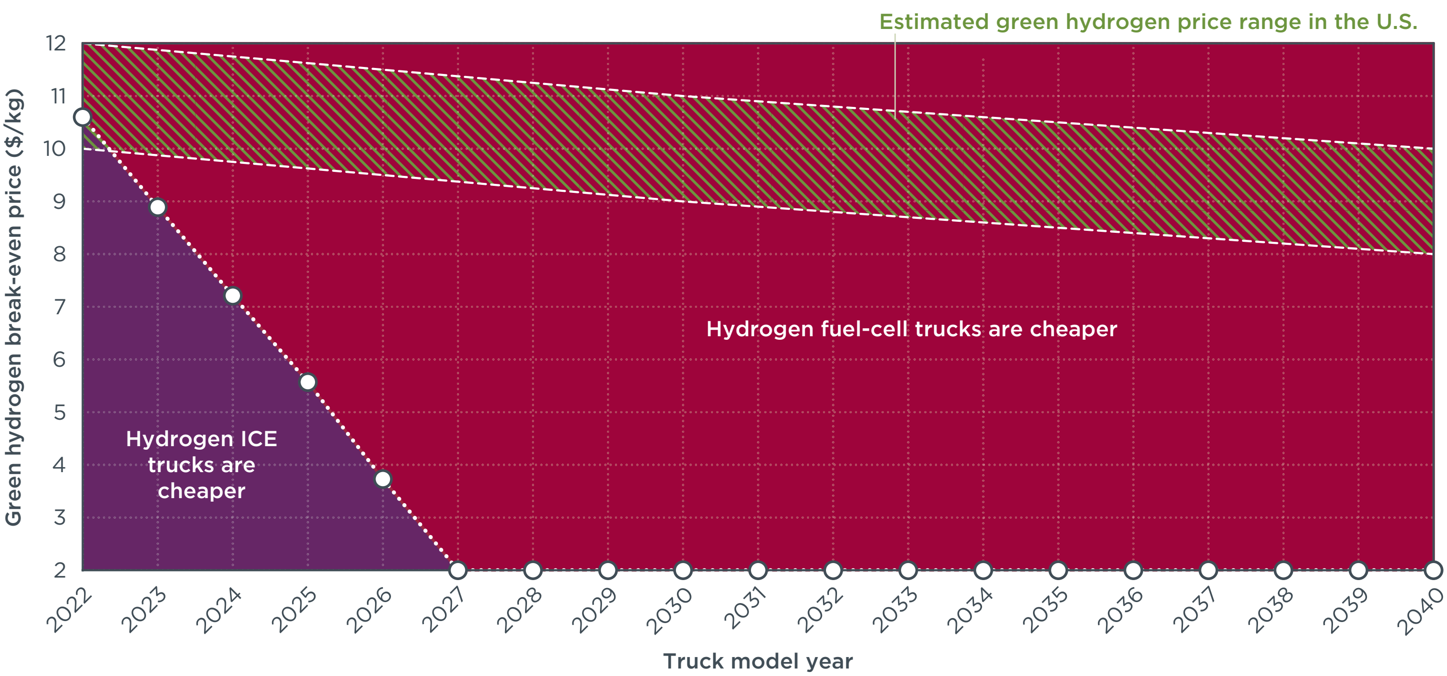

Figure 18. Total cost of ownership parity sensitivity to hydrogen fuel prices from 2022 to 2040. A comparison between hydrogen fuel-cell and hydrogen ICE trucks.

During the early market uptake phase, when fuel-cell truck MSRP is expected to be the highest, the break-even hydrogen fuel price is around $10.50/kg in 2022. In other words, if green hydrogen fuel price at the pump is below 10.5 $/kg, hydrogen ICE trucks will have a lower TCO. The hydrogen break-even price decreases over time as the hydrogen fuel-cell truck MSRP decreases, closing the gap with hydrogen ICE trucks. By 2025, the hydrogen break-even price between both hydrogen-powered technologies will be around $5.70/kg. As of 2027, the break-even price will be very low, reaching unlikely hydrogen prices below $2.00/kg.

Hydrogen ICE trucks may have a better TCO than hydrogen fuel-cell trucks in the short term if hydrogen fuel prices are low enough. However, when fuel-cell technology costs decrease in the long term, hydrogen fuel-cell trucks are expected to have a better TCO even for very low hydrogen fuel prices.

NATIONAL ANALYSIS

The stochastic analysis is conducted considering the inputs presented in Table 9. The analysis quantifies the percentage of cases where a certain technology will achieve the lowest TCO for a given truck model year. Figure 19 shows the split between the different considered truck technologies between 2022 and 2040 based on their TCO. The split is determined based on a Monte Carlo sample size of 10,000. For truck model year 2022, diesel truck is recognized as the technology with the lowest TCO for more than 95% of the cases, followed by battery electric trucks for the remaining 5%. For future truck model years, the percentage of cases where battery electric trucks record the lowest TCO increases continuously, reaching 70% by 2030 and 85% by 2040. This behavior is related to the reduction in the truck's MSRP and improved fuel economy over time, which reduces the operational expenses of battery electric trucks. It is worth highlighting the steep jump from model year 2026 to 2027. This is related to our assumption that MW charging stations will be available with wide coverage as of 2027, allowing long-haul trucks to be equipped with smaller batteries, which reduces their MSRP. Beyond 2030, the increase becomes less steep, driven by the slower reduction in the battery electric truck's retail price.

Both hydrogen-powered trucks are not recognized as the cheapest truck technology in any truck model year, mainly due to the high green hydrogen fuel price.

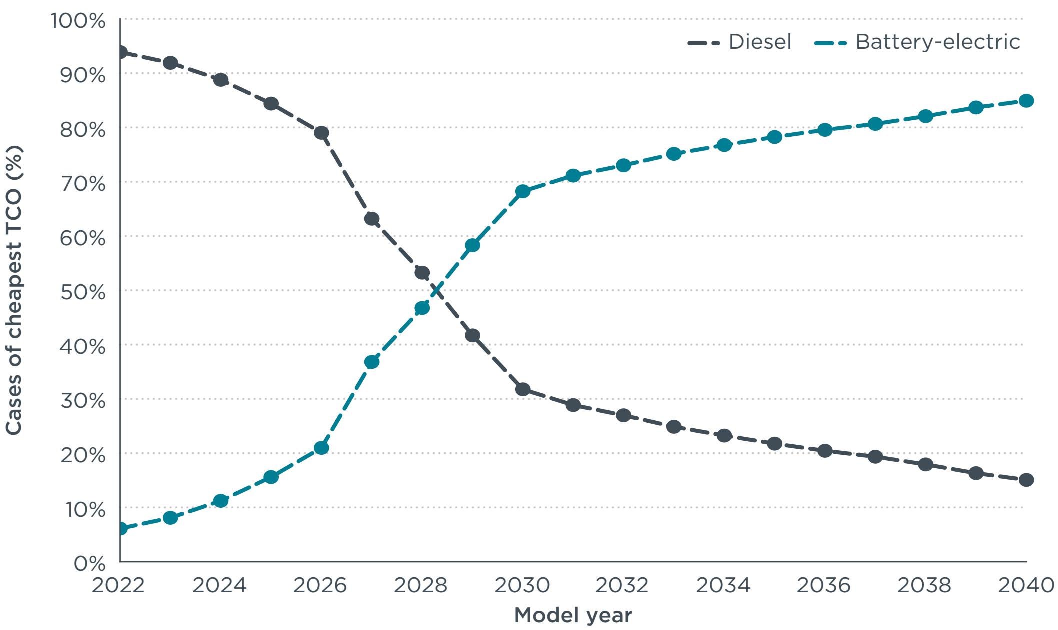

Figure 19. Split among different truck technologies between 2022 and 2040 based on TCO. The share of both hydrogen-powered trucks is 0%.

Battery size will have a significant impact on the TCO parity between battery electric and diesel trucks. A required battery size is affected by several factors, mainly the daily truck mileage and available charging technology. While the average daily truck mileage is a representative metric in the TCO calculation, truck operators will most likely size their batteries considering the worst-case scenario for the daily mileage needs, which could be significantly higher than the average daily mileage. This is captured in the truck daily mileage variability, which corresponds to the maximum variation in the truck's day-to-day average daily miles covered. For example, a daily mileage variability of 10% implies that the maximum number of daily miles covered by a truck is 10% higher than its average daily mileage.

Figure 20 shows the impact of the truck's average daily mileage and the daily mileage variability on its economic viability compared to diesel trucks. The figure corresponds to truck model year 2040 and for the national average diesel and charging costs. The battery design point is the product of the truck's average daily mileage and mileage variability.

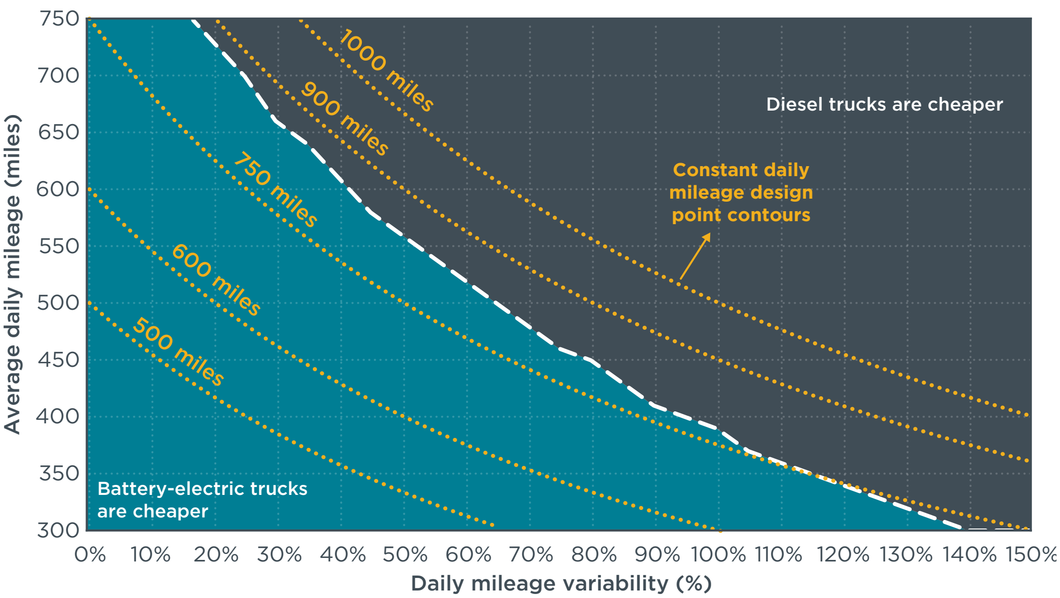

Figure 20. Impact of daily mileage and mileage variability on the TCO of MY 2040 battery electric and diesel trucks.

Generally, a higher average daily mileage or higher mileage variability will result in a higher battery design point in miles; thus, larger and more expensive batteries are needed, increasing the TCO of battery electric trucks. On the other hand, although an increase in the average daily mileage will require a larger battery size, the truck's annual mileage will also increase, benefiting battery electric trucks as their operational expenses per mile are much lower than their diesel counterparts.

This tradeoff is clearly presented in Figure 20. Battery electric trucks are expected to record a lower TCO than diesel trucks, even for average daily mileages reaching 750 miles, as long as the day-to-day mileage variability is low. As daily mileage variability increases, battery electric trucks will struggle to reach TCO parity with their diesel counterparts. For example, for an average daily mileage of 750 miles without any variability, the battery design point is 750 miles. In this case battery electric trucks record a lower TCO than diesel trucks. On the contrary, for a 300-mile average daily mileage coupled with a 150% variability, diesel trucks are expected to record a lower TCO than battery electric trucks, although the battery design point in this case is also 750 miles. This is driven by the fact that the annual truck mileage is much higher in the first case, counterweighting the higher cost of larger batteries due to the lower operational costs of battery electric trucks.

In conclusion, battery electric trucks can achieve better TCO than their diesel counterparts even for very high daily mileages, given that their day-to-day mileage variability is low.

CONCLUSIONS

This study evaluates the economic viability of several powertrain technologies for Class 8 long-haul trucks in the United States between 2022 and 2040. In addition to conventional diesel trucks, we quantify the total cost of ownership of several alternative technologies, including battery electric, hydrogen fuel-cell, and hydrogen internal combustion engine trucks.

We arrive at the following main findings:

» **Battery electric long-haul trucks are expected to reach total cost of ownership parity with diesel trucks in all representative states considered in this analysis before 2030**. Given their higher energy efficiency and lower operational expenses, battery electric trucks are expected to become cheaper than their diesel counterparts in all selected states by the end of the decade.

» **Hydrogen fuel-cell and hydrogen internal combustion engine trucks operating in long-haul will struggle to become cost competitive compared to their diesel counterparts**. Hydrogen fuel-cell and hydrogen ICE trucks are expected to be roughly 25% and 50% more expensive, respectively, to own and operate than diesel trucks by 2030. The high hydrogen fuel costs are the main factor behind this behavior. Green hydrogen fuel prices in the United States are estimated to range between $9.00/kg and $11.00/kg by 2030, including the tax subsidies in the Inflation Reduction Act. For hydrogen fuel-cell trucks to become cost-competitive with diesel trucks during the next decade, green hydrogen prices need to range between $5.00/kg and $7.00/kg.

» **Battery electric trucks are expected to be the most cost-effective zero-emission truck technology for long-haul applications, recording a significantly lower total cost of ownership than hydrogen fuel-cell trucks**. Battery electric trucks benefit from a considerably higher fuel economy than their hydrogen fuel-cell counterparts, which results in much lower operational expenses. This yields a lower TCO for the battery electric technology. Given our modeled charging costs in several states of between $0.15/kWh and $0.30/kWh, green hydrogen fuel prices would have to be as low as $3.00/kg to $6.50/kg for hydrogen fuel-cell trucks to reach TCO parity with diesel trucks during the next decade, a range that is most likely to fall out of the expected green hydrogen fuel price range by 2030.

» **Hydrogen fuel-cell trucks will be the cheaper hydrogen-powered technology for long-haul applications, driven by their better fuel economy compared to hydrogen internal combustion engine trucks**. Hydrogen ICE trucks may have a better TCO than hydrogen fuel-cell trucks in the short term if hydrogen fuel prices are low enough due to the high MSRP of hydrogen fuel-cell trucks during the early market. However, as fuel-cell technology costs decrease in the long term, hydrogen fuel-cell trucks are expected to have a better TCO even for very low hydrogen fuel prices.

» **At the national level, battery electric trucks are expected to record the lowest total cost of ownership among all truck technologies for more than two-thirds of long-haul trucking activity by 2030**. Given the variations in diesel, hydrogen, and charging costs among states and the uncertainty in technology costs evolution between 2022 and 2040, battery electric trucks are the most cost-effective technology for almost 67% of the cases. This number will increase to 84% by 2040, driven by the expected reduction in battery prices and the rollout of MW charging infrastructure.

» **For very high daily mileages, battery electric trucks can still achieve a better total cost of ownership than their diesel counterpart.** As the truck's average daily mileage or mileage variability increases, larger batteries are needed to meet the truck's energy needs on the most demanding days, which increases the MSRP of battery electric trucks. However, given that the operations cost per mile of battery electric trucks is lower than that of diesel trucks, higher average daily mileages benefit the TCO of battery electric trucks relative to diesel. Overall, battery electric trucks are expected to record a better TCO for average mileages as high as 750 miles per day, provided that the day-to-day variability is low.

Based on the analysis presented in this study, battery electric trucks have the potential to ensure a cost-effective transition from the current diesel truck fleets in the United States before the end of the decade, providing a significant reduction GHG emissions from in the heavy-duty vehicle sector. Even for semi-trucks operating in long-haul, which are considered among the most challenging truck classes to decarbonize, the TCO of battery electric trucks is likely to become lower than that of diesel trucks as early as 2027 in some states and by 2030 for all considered states in this analysis.

Given the urgency of the climate crisis and the need for rapid and deep decarbonization of the heavy-duty vehicle sector GHG emissions, our study sheds light on the role that zero-emission technologies can play in the Phase 3 HDV GHG emissions standards. Our findings show that there is an opportunity for significant electrification by 2030 and beyond to support more stringent standards.

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APPENDIX

Table A1. Summary of battery sizing approach

MY	Charging power (kW)	Charging efficiency (%)	Daily mileage (miles)	Driver's break (hours)	Energy efficiency (kWh/mi)	Required design point (miles)	Battery size (kWh)	Actual design point (miles)
2022	350	95%	500	1	2.86	384	1,000	**297**
2023	350	95%	500	1	2.80	381	1,000	**303**
2024	350	95%	500	1	2.75	378	1,000	**310**
2025	350	95%	500	1	2.69	376	1,000	**316**
2026	350	95%	500	1	2.63	373	1,000	**323**
2027	1,000	95%	500	1	2.57	300	900	**300**
2028	1,000	95%	500	1	2.51	300	880	**300**
2029	1,000	95%	500	1	2.45	300	860	**300**
2030	1,000	95%	500	1	2.39	300	840	**300**
2031	1,000	95%	500	1	2.34	300	820	**300**
2032	1,000	95%	500	1	2.29	300	800	**300**
2033	1,000	95%	500	1	2.23	300	780	**300**
2034	1,000	95%	500	1	2.18	300	760	**300**
2035	1,000	95%	500	1	2.12	300	740	**300**
2036	1,000	95%	500	1	2.12	300	740	**300**
2037	1,000	95%	500	1	2.12	300	740	**300**
2038	1,000	95%	500	1	2.12	300	740	**300**
2039	1,000	95%	500	1	2.12	300	740	**300**
2040	1,000	95%	500	1	2.12	300	740	**300**

Notes: Values in red text represent the case where the actual design point is lower than the required design point. Values in green represent that case where the actual design point is equal to the required design point.

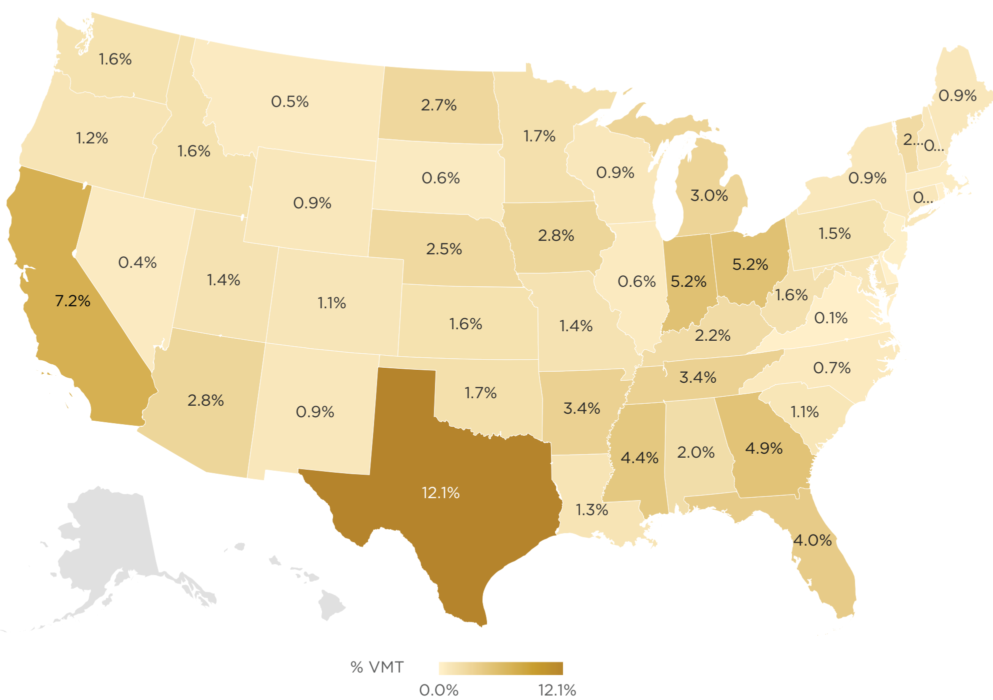


Figure A1. Percent distribution of tractor-trailers vehicles miles travelled in the United States Data adopted from Federal Highway Administration (2018).

California

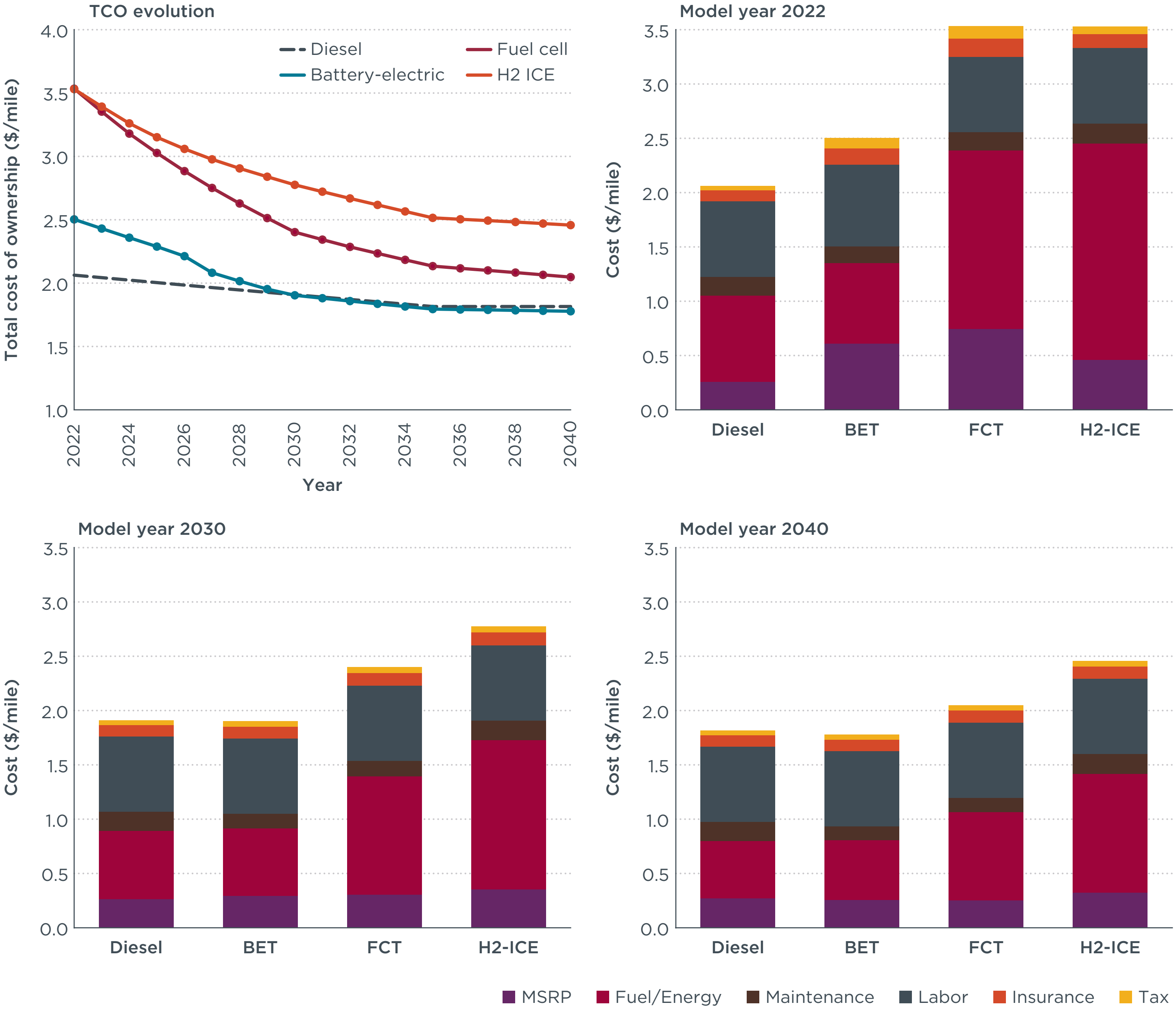


Figure A2. Total cost of ownership (TCO) evolution between 2022 and 2040 and TCO breakdown for truck MYs 2022, 2030, and 2040 in California.

Florida

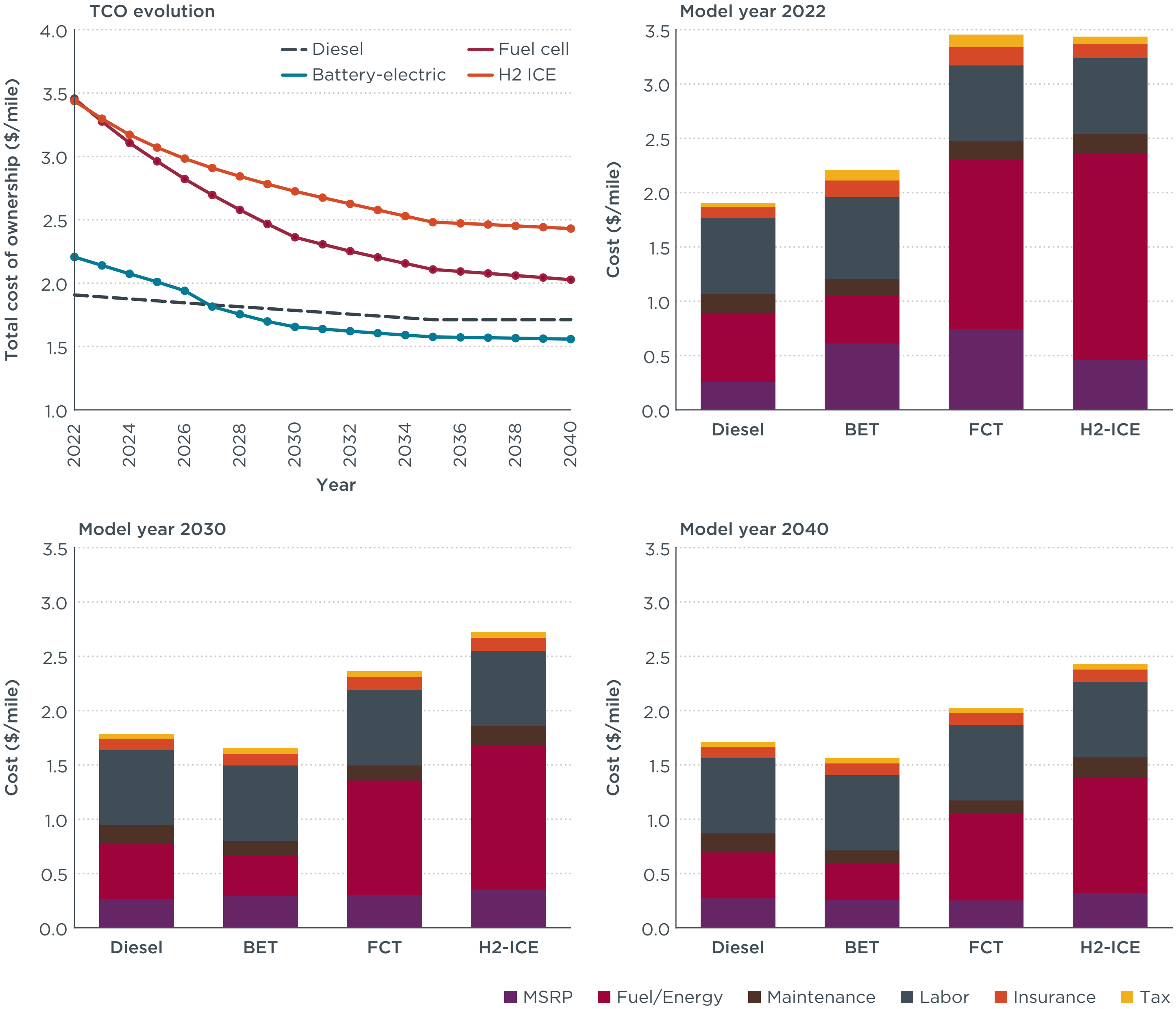


Figure A3. Total cost of ownership (TCO) evolution between 2022 and 2040 and TCO breakdown for truck MYs 2022, 2030, and 2040 in Florida.

Georgia

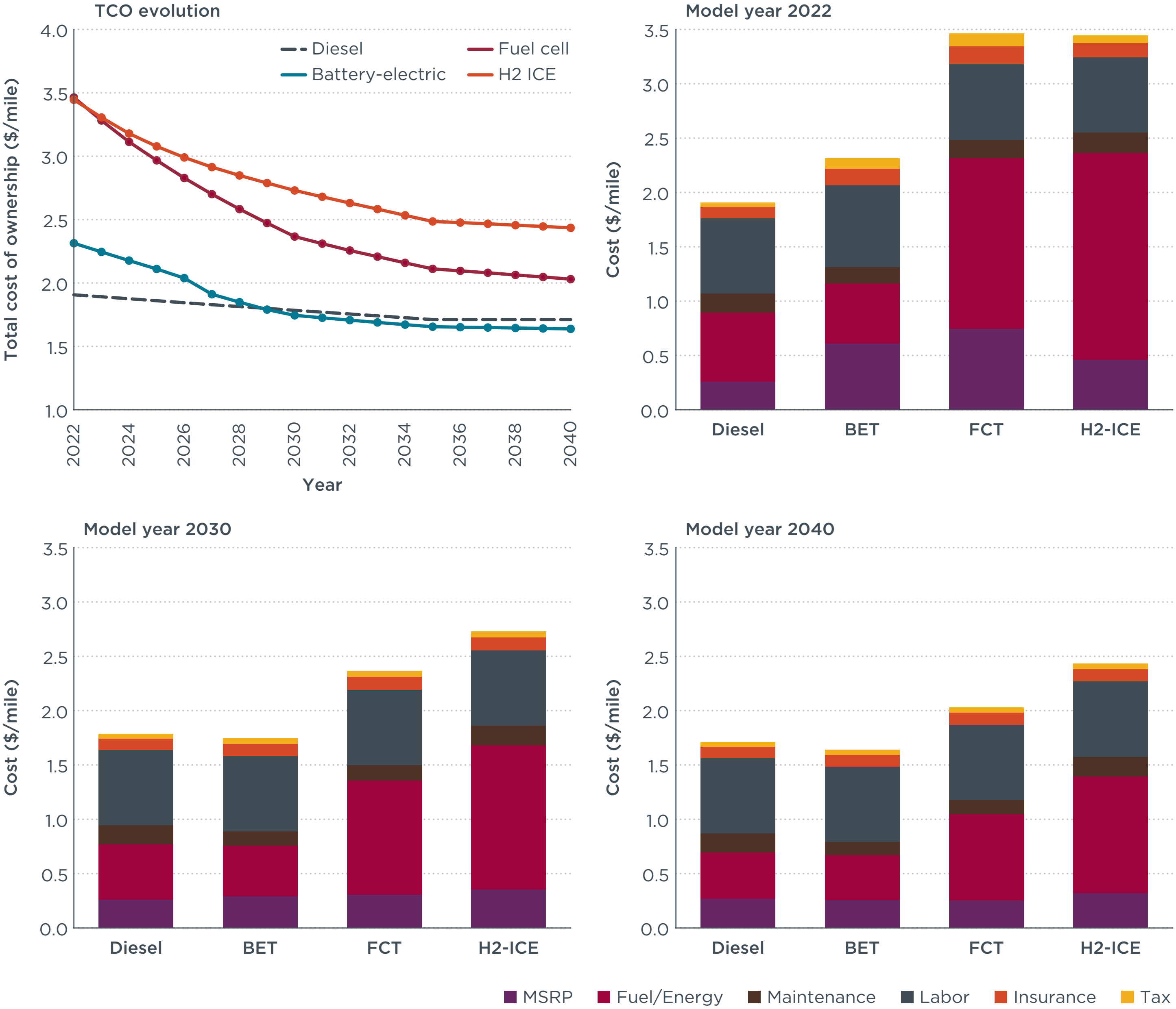


Figure A4. Total cost of ownership (TCO) evolution between 2022 and 2040 and TCO breakdown for truck MYs 2022, 2030, and 2040 in Georgia.

Illinois

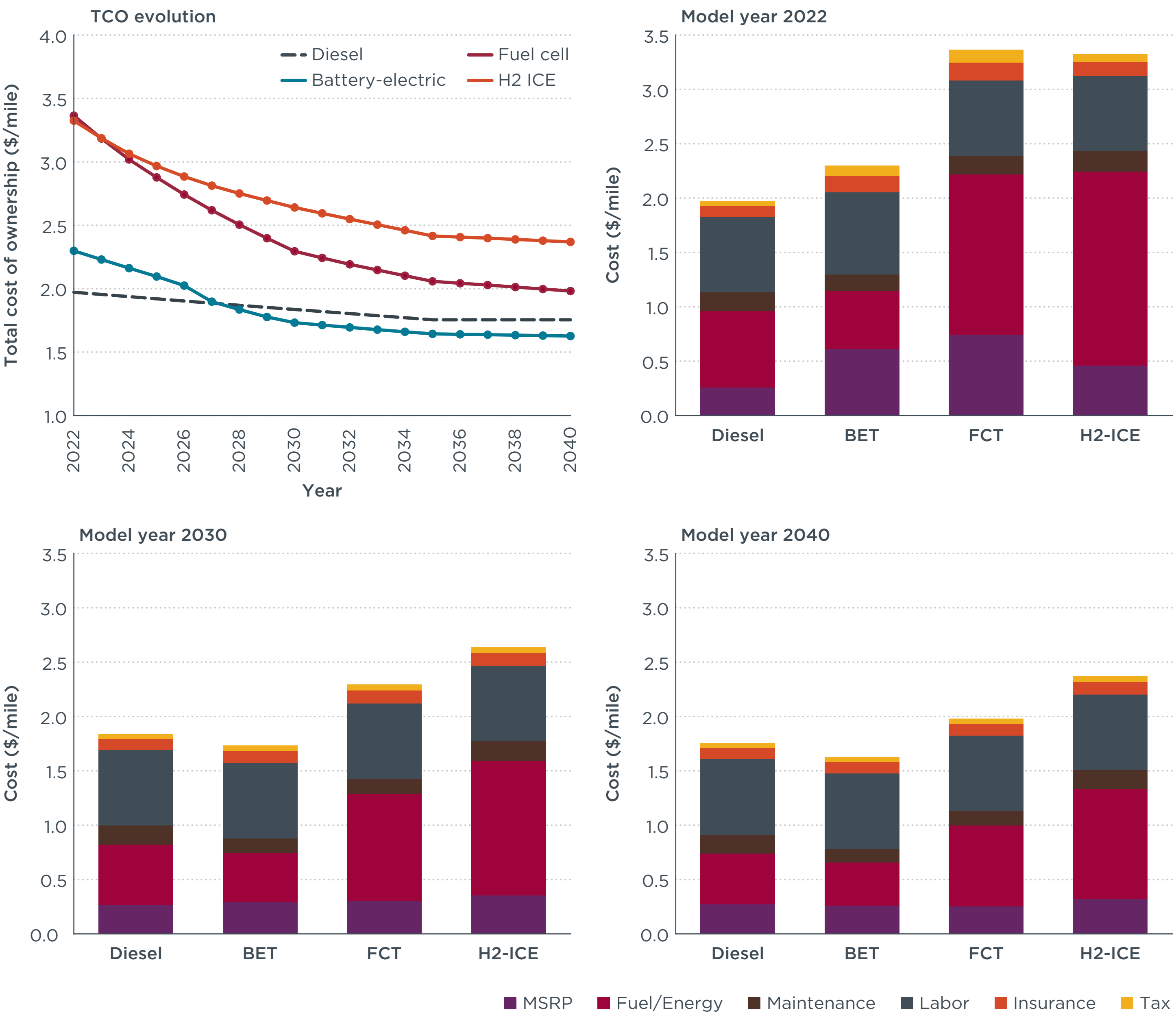


Figure A5. Total cost of ownership (TCO) evolution between 2022 and 2040 and TCO breakdown for truck MYs 2022, 2030, and 2040 in Illinois.

Washington

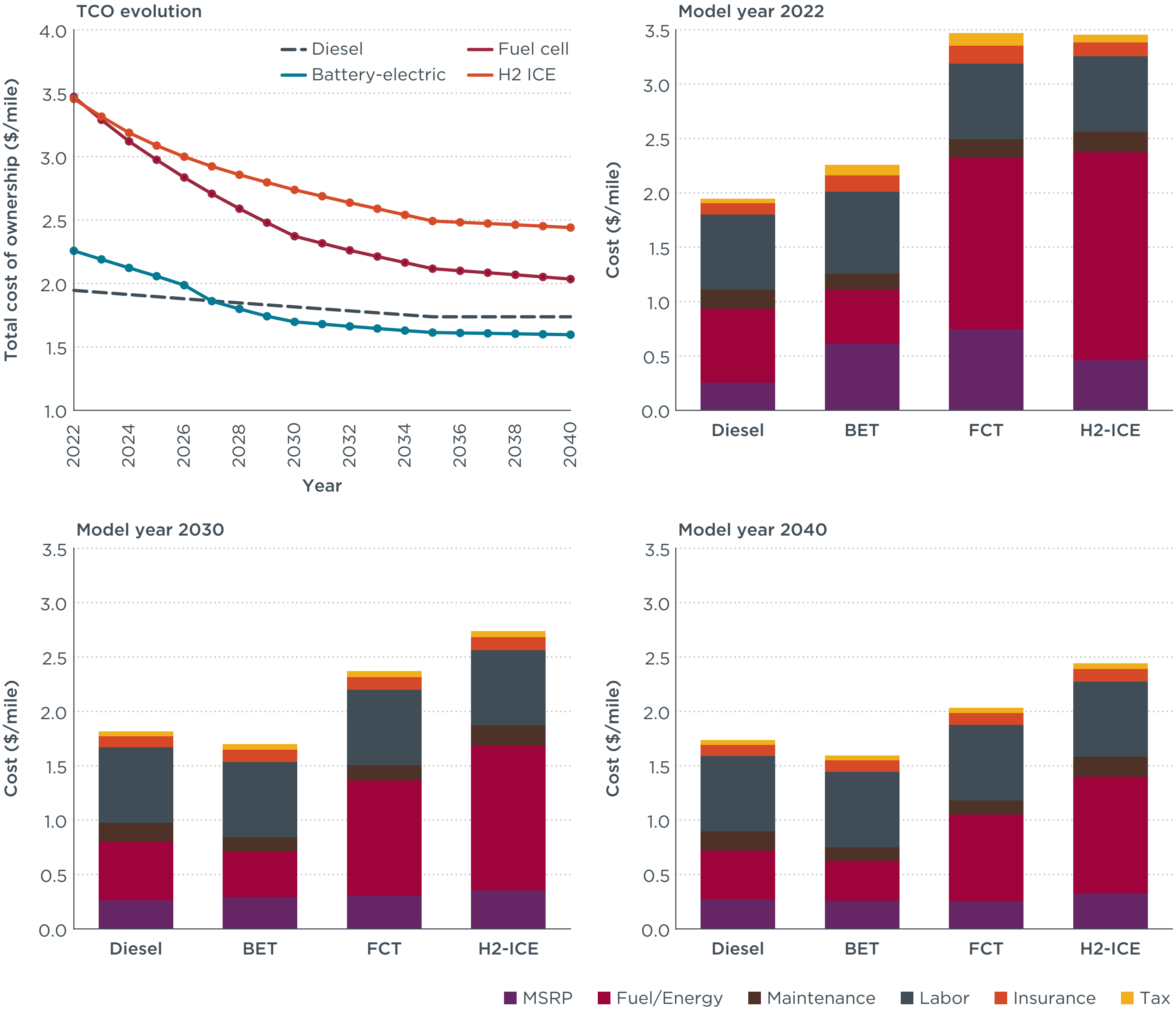


Figure A6. Total cost of ownership (TCO) evolution between 2022 and 2040 and TCO breakdown for truck MYs 2022, 2030, and 2040 in Washington.

New York

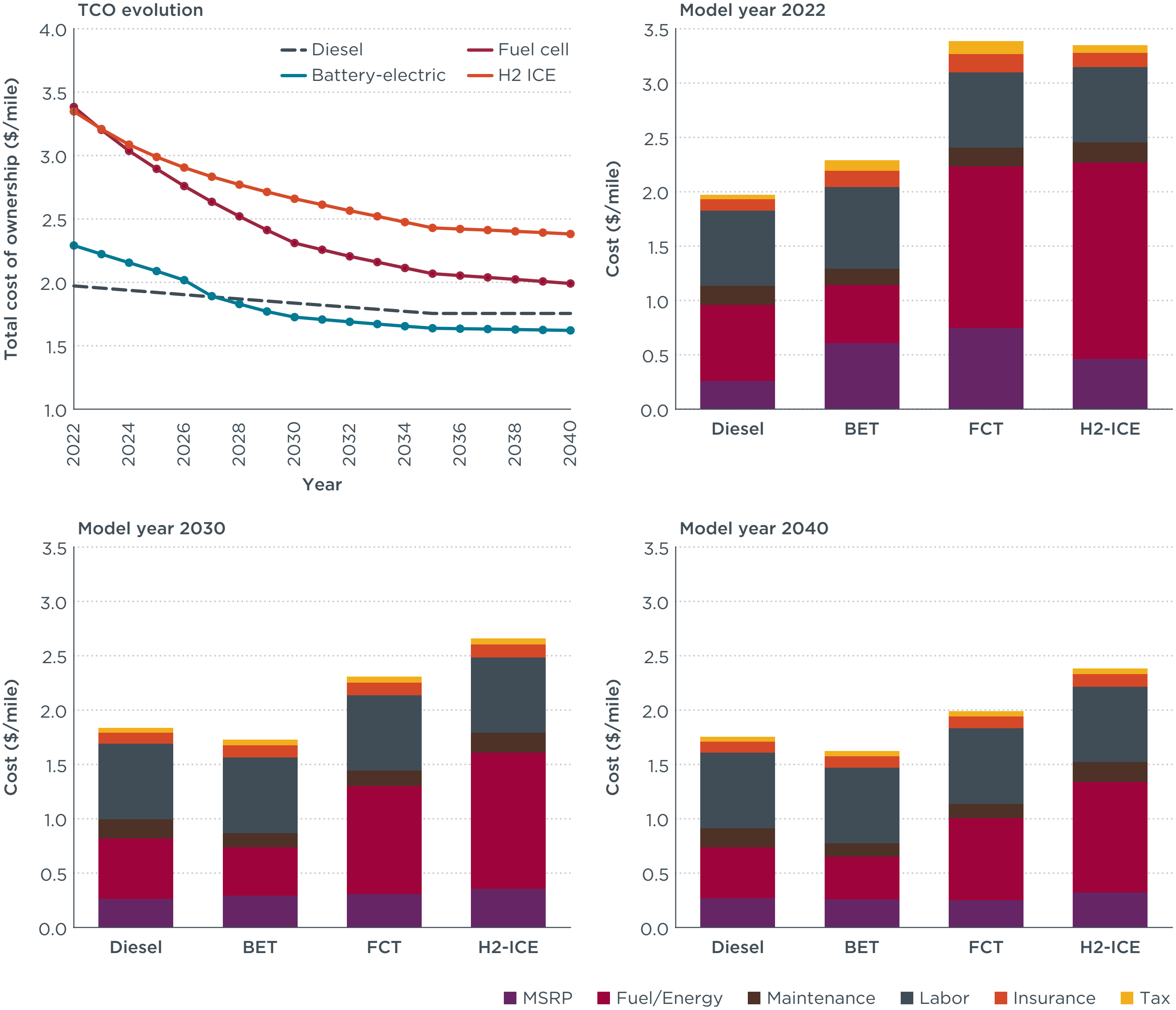


Figure A7. Total cost of ownership (TCO) evolution between 2022 and 2040 and TCO breakdown for truck MYs 2022, 2030, and 2040 in New York.

Texas

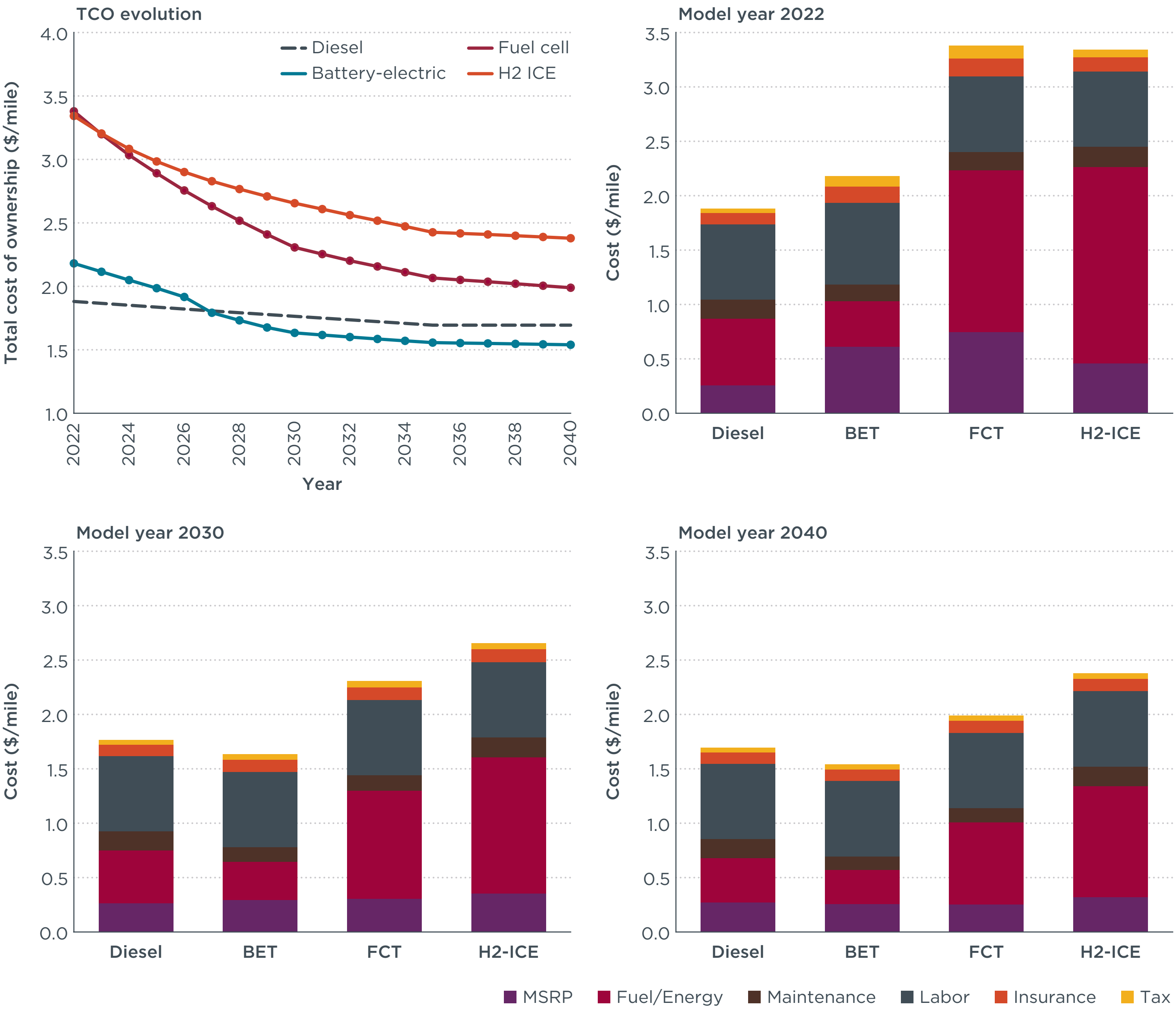


Figure A8. Total cost of ownership (TCO) evolution between 2022 and 2040 and TCO breakdown for truck MYs 2022, 2030, and 2040 in Texas.

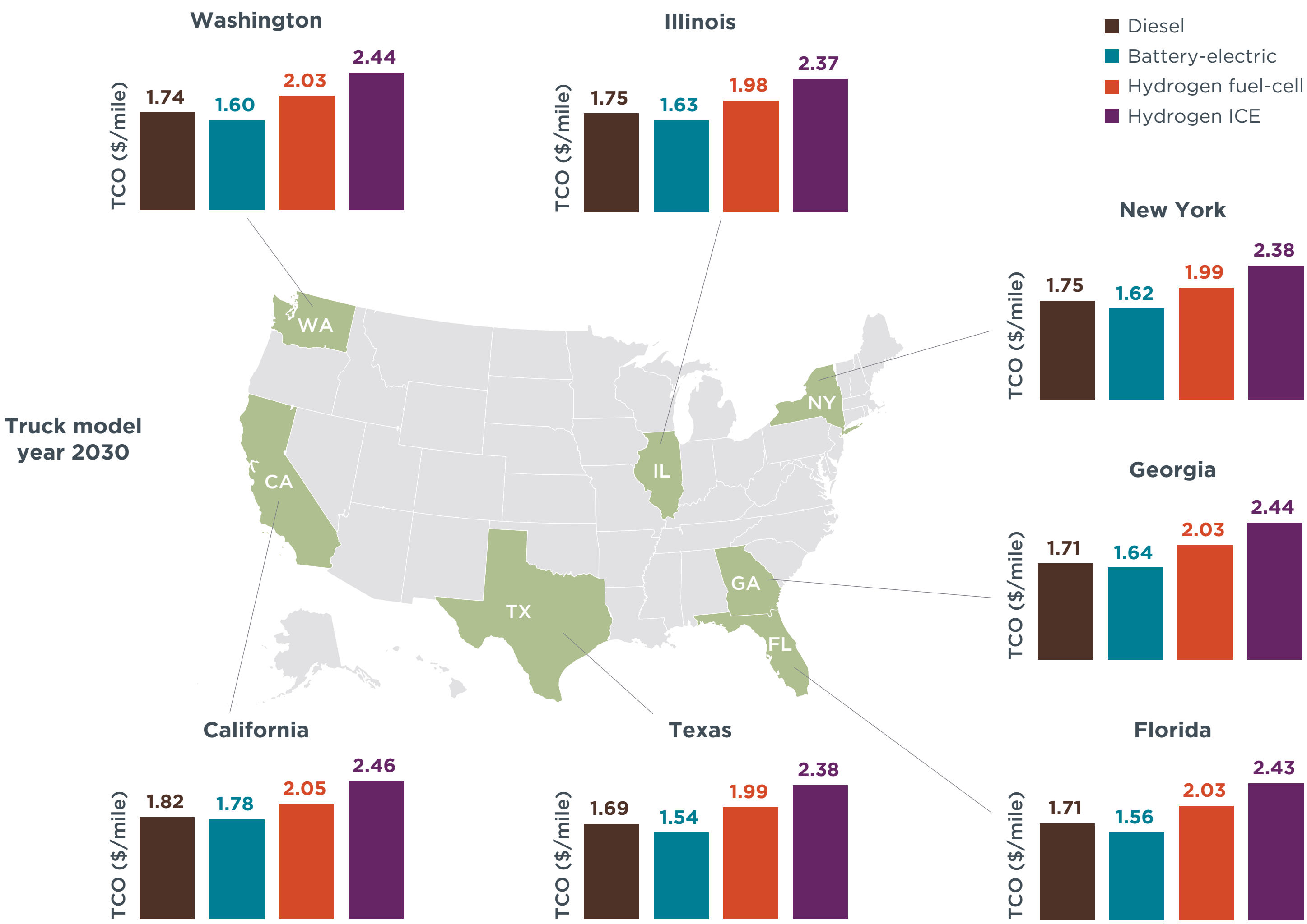
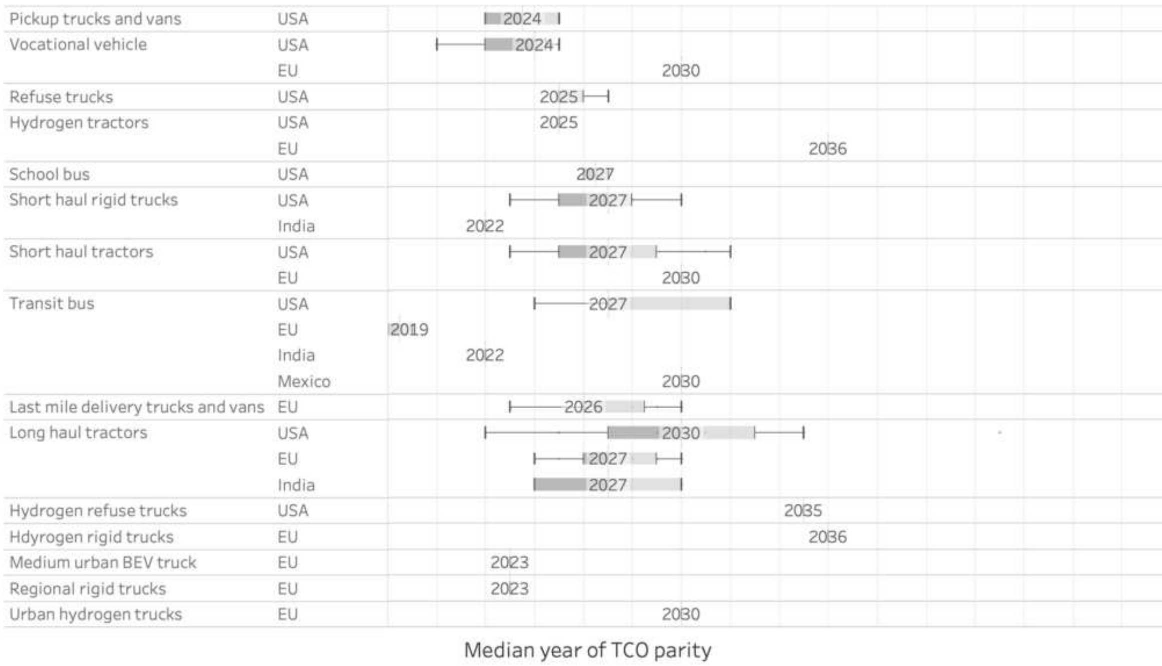


Figure A9. State-specific total cost of ownership for different MY 2040 truck technologies.

ZEV cost: Total cost of ownership

Verified on 20 November 2024

Median year of TCO parity between ZEV and ICE HDV in current literature by market and vehicle segment



Source: *ICCT Research. For a full list of studies and parity projections, please see the table below.*

Box and whiskers plot analyzing the TCO parity projections in current literature for various vehicle segments in a given market. In the case a single study exists for a market – vehicle segment combination, the median year of TCO parity is the median between a range of years in which ZEV HDVs are likely to achieve TCO parity with ICE HDVs. In the case of multiple studies, the median value reported is the median of median values aggregated from different studies.

Median year of TCO parity between ZEV and ICE HDV by research group, market, vehicle class, and vehicle segment

20 entries per page Search:

Research Group	Study Year	Market	Vehicle Class	Vehicle Segment	Median year of TCO Parity	L U
ANL - BEAN	2021	USA	Bus	Transit bus	2024	3,
ANL - BEAN	2021	USA	Bus	City bus	2032	3,
ANL - BEAN	2021	USA	Bus	School bus	2026	3,
ANL - BEAN	2021	USA	HDT	Refuse trucks	2025	3,
ANL - BEAN	2021	USA	MDT	Vocational vehicle	2024	3,
ANL - BEAN	2021	USA	HDT	Short haul tractors	2031	3,
ANL - BEAN	2021	USA	HDT	Short haul rigid trucks	2028	3,
ANL - BEAN	2021	USA	HDT	Long haul tractors	2043	3,
NREL	2021	USA	MDT	Vocational vehicle	2020	3,
NREL	2021	USA	HDT	Short haul tractors	2023	3,
NREL	2021	USA	HDT	Long haul tractors	2050	3,
ANL	2021	USA	MDT	Short haul rigid trucks	2023	3,
ANL	2021	USA	HDT	Short haul tractors	2027	3,
ANL	2021	USA	HDT	Long haul tractors	2031	3,

Research Group	Study Year	Market	Vehicle Class	Vehicle Segment	Median year of TCO Parity	L U
EDF - MJB	2021	USA	HDT	Refuse trucks	2025	3,
EDF - MJB	2021	USA	MDT	Vocational vehicle	2025	3,
EDF - MJB	2021	USA	HDT	Short haul rigid trucks	2025	3,
EDF - MJB	2021	USA	HDT	Short haul tractors	2025	3,
EDF - MJB	2021	USA	MDT	Long haul tractors	2030	3,
EDF - MJB	2021	USA	HDT	Long haul tractors	2025	3,

Showing 1 to 20 of 93 entries

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ZEROING IN ON ZERO-EMISSION TRUCKS

The State of the U.S. Market

Jacob Richard
Jessie Lund
Baha Al-Alawi

January 2024

CALSTART

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Unless otherwise noted, all figures are copyright CALSTART based on data from author correspondence with manufacturers, IHS Markit, MarkLines, California's Clean Off-Road Equipment Voucher Incentive Program, public press releases, California's Clean Truck and Bus Voucher Incentive Project, and the New York Truck Voucher Incentive Program. See Appendix D for more information about these data sources.

Cover image: A lineup of heavy-duty zero-emission truck models. Photo credit: Harbor Trucking Association and Marc Harris Photography

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LIST OF ACRONYMS

ACF	Advanced Clean Fleets rule
ACT	Advanced Clean Trucks rule
BET	Battery-electric truck
CaaS	Charging-as-a-Service
CARB	California Air Resources Board
CDL	Commercial driver’s license
CORE	California’s Clean Off-Road Equipment Voucher Incentive Project
DOE	U.S. Department of Energy
EPA	U.S. Environmental Protection Agency
FCEV	Fuel cell electric vehicle
FHWA	Federal Highway Administration
GHG	Greenhouse gas
Global MOU	Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles
HD	Heavy-duty
HVIP	California’s Clean Truck and Bus Voucher Incentive Project
IRA	Inflation Reduction Act
IRMA	Initiative for Responsible Mining Assurance
ISEF	Innovative Small e-Fleet Program
kW	Kilowatt
kWh	Kilowatt-hour
lbs.	Pounds
MCS	Megawatt Charging System
MD	Medium-duty
MHD	Medium- and heavy-duty
MOU	Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding

LIST OF ACRONYMS

NACFE	North American Council for Freight Efficiency
NOx	Nitrogen oxides
NYTVIP	New York Truck Voucher Incentive Program
OEM	Original equipment manufacturer
PM2.5	Fine particulate matter
TaaS	Truck-as-a-Service
TCO	Total cost of ownership
ZE	Zero-emission
ZET	Zero-emission truck
ZEV	Zero-emission vehicle

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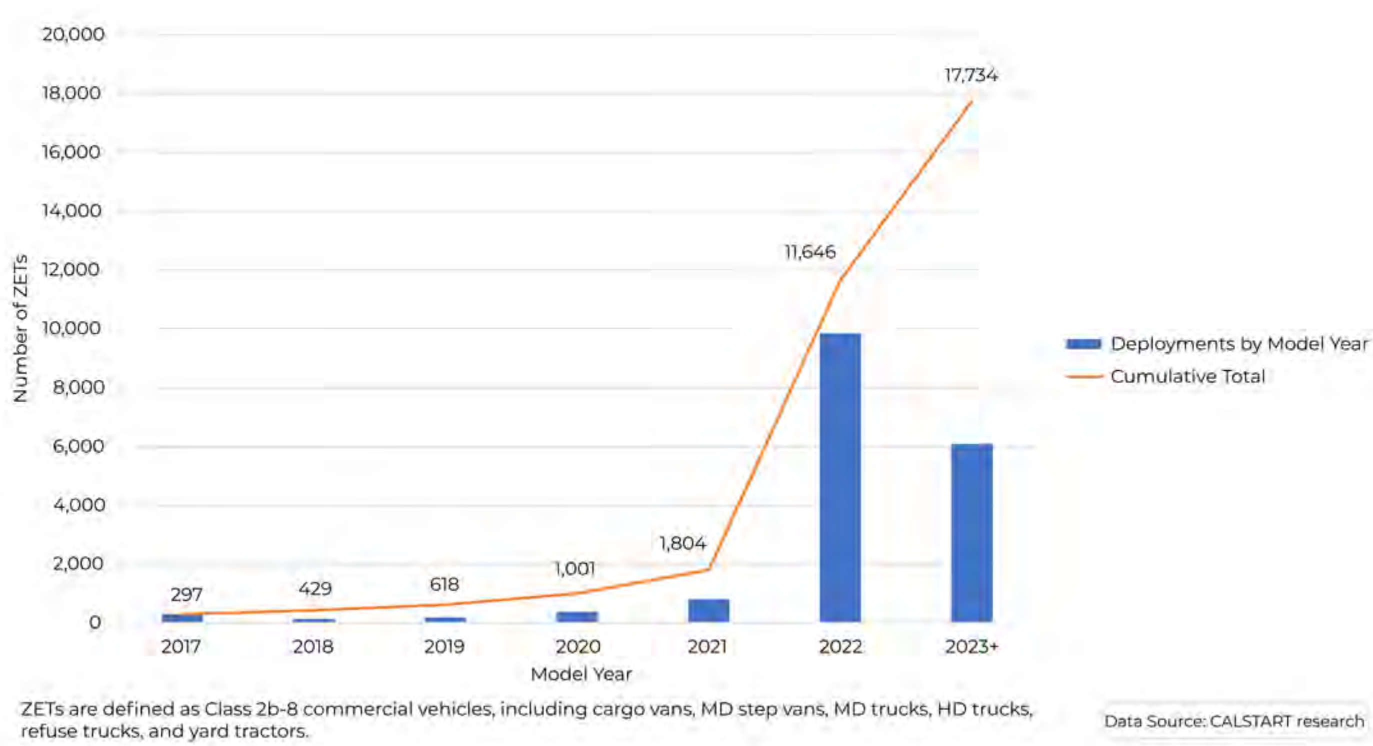
EXECUTIVE SUMMARY

Medium- and heavy-duty (MHD) freight vehicles are a top priority for decarbonizing U.S. transportation and mitigating transportation-related greenhouse gas (GHG) emissions. These vehicles play a vital role in the U.S. economy, but because of their critical high-mileage haulage of the nation's goods, they emit significant amounts of GHGs and criteria pollutants, often in the most vulnerable communities. Fortunately, existing and ever-expanding technology can eliminate tailpipe emissions and significantly reduce the overall carbon footprint of MHD vehicles. More than 160 models of zero-emission trucks (ZETs) are now available from over 40 original equipment manufacturers (OEMs), and **as of June 2023, more than 17,500 ZETs have been deployed in the United States** (Figure ES-1).[1]

Figure ES-1. U.S. ZET Deployments by Vehicle Model Year (2017–June 2023)



1 ZET data are gathered from sources outlined in Appendix D. In previous iterations of this report, "deployments" were referred to as "deployed sales" and model year served as a proxy for deployment year per IHS Markit guidance.

This recent surge can be attributed primarily to the cargo van segment, which represents more than 80 percent of all ZET deployments (Table ES-1) and has limited market barriers for mass adoption (CARB, 2023a).

Table ES-1. U.S. ZET Deployments and Market Share by Segment (As of June 2023)

Vehicle Segment	ZET Deployments	Total Stock	ZET Market Share
Cargo Van	**14,400**	3,687,740	.39%
MD Step Van	843	266,866	.32%
MD Truck	442	3,573,915	.01%
HD Truck	867	**5,104,926**	.02%
Refuse	48	118,135	.04%
Yard Tractor[2]	1,134	23,437	**4.84%**
Total	**17,734**	**12,775,019**	**.14%**

Incentives and regulations continue to be significant drivers of ZET adoption. **States that have passed the Advanced Clean Trucks (ACT) regulation[3] account for 38 percent of all ZET deployments despite making up just 25 percent of all truck registrations.** Meanwhile, ACT states in conjunction with Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding (MOU) states constitute 51 percent of all deployments. States that have had ZET incentive programs prior to 2022 encompass 39 percent of all deployments.[4]

With nearly half of ZET deployments in states without ZET regulations, the maturity of this technology is now undeniable, as well as the fact that the market has evolved to the point where fleets can deploy ZETs without incentives and regulations. In fact, for the first time ever, ZETs have now been deployed in all 50 states. These ZET deployment trends, along with the United States' signing of the Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles (Global MOU)[5] to enable 100 percent of new truck and bus sales be zero-emission by 2040, create a compelling market signal to OEMs and fleets to invest in ZETs.

Furthermore, investments are being made to establish dedicated infrastructure for ZETs along highly traveled trucking corridors, bolster domestic manufacturing of essential vehicle components, and further reduce lifecycle vehicle emissions by looking at upstream and end-of-life practices. Additional

2 Yard tractor deployments are likely underreported as many are not registered for on-road use and much of the data on deployments come from vehicle registrations.

3 States that have adopted the ACT rule as of June 2023 include California, Colorado, Massachusetts, New Jersey, New York, Oregon, Vermont, and Washington. New Mexico, Maryland, and Rhode Island have since become the ninth, tenth, and eleventh states, respectively, to adopt the ACT rule in late 2023, though for the purposes of this update, which includes data through June 2023, New Mexico, Maryland, and Rhode Island are not considered ACT states.

4 States considered to have ZET incentive programs prior to 2022 include California, Massachusetts, New York, New Jersey, Pennsylvania, and Washington. More information is available in Appendix A.

5 Visit the Global Commercial Vehicle Drive to Zero's website for more information about the Global MOU at https://globaldrivetozero.org/mou-nations/.

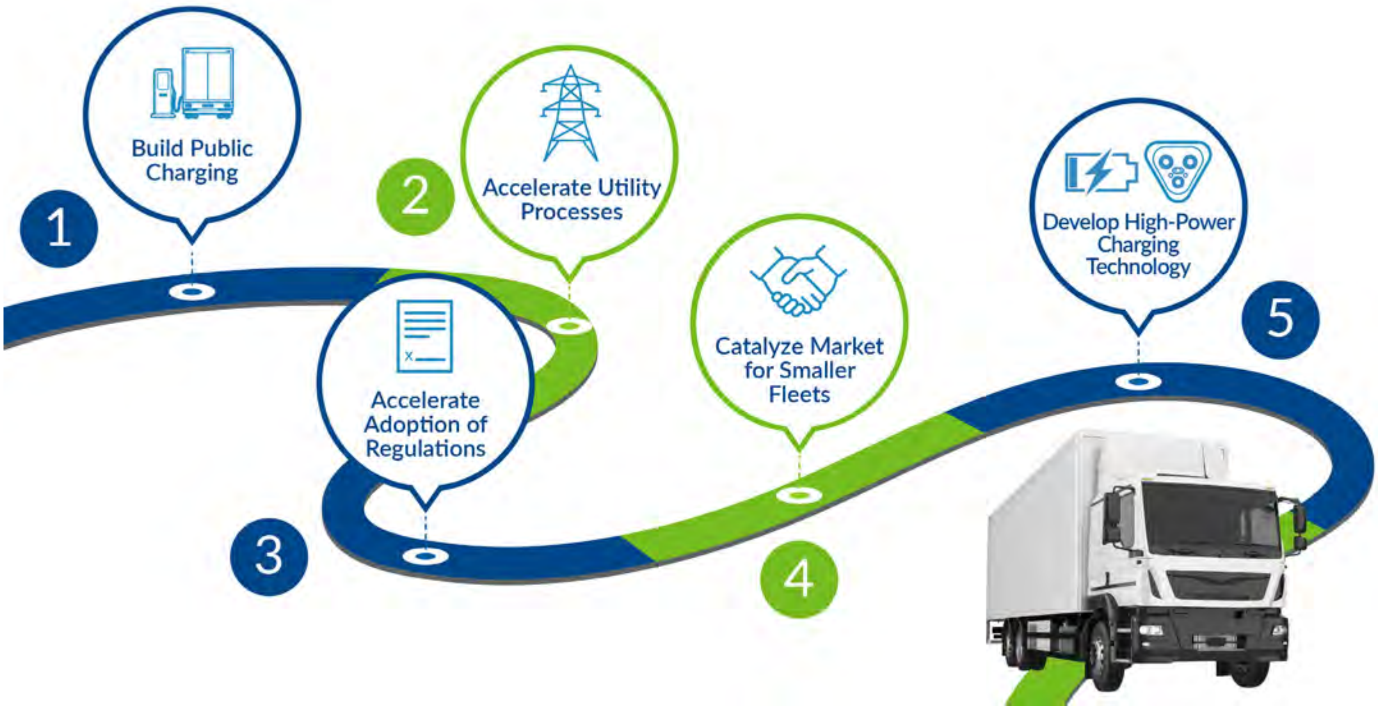
trends that are driving ZET deployments include: increased support for small fleets, increasingly large-scale deployments, shippers' increasing interest in reducing carbon emissions, and hydrogen fuel cell truck developments (Figure ES-2). As the technology continues to advance and economies of scale are achieved, ZETs will begin to dominate the U.S. truck market.

Figure ES-2. Observed 2023 U.S. ZET Market Trends

The momentum toward decarbonizing the trucking sector is indisputable. Nevertheless, sustained action and investment are essential to realize the full potential of this transformative shift (Figure ES-3). **Key opportunities to accelerate ZET deployments in the coming months and years include:**

1. **Building public charging.**
2. **Accelerating utility processes**, including grid buildout, energization of charging infrastructure, and make-ready program processing.
3. **Accelerating adoption of regulations** like the ACT rule and the U.S. Environmental Protection Agency's "Phase 3" heavy-duty GHG standards.
4. **Catalyzing a market for smaller fleets**, which includes a secondary ZET market, access to reasonable financing and insurance, and clear signals from customers.
5. **Developing high-powered charging technology.**

Figure ES-3. Top Five Actions Needed to Accelerate U.S. ZET Market



Unprecedented collaboration will be required from stakeholders across the industry, including fleets, OEMs, utilities, charging providers, shippers, regulators, policymakers, academia, nonprofits, and frontline communities. Everyone has a role to play to ensure the pace and success of this transition.

CHAPTER I

INTRODUCTION

THE U.S. TRUCKING INDUSTRY

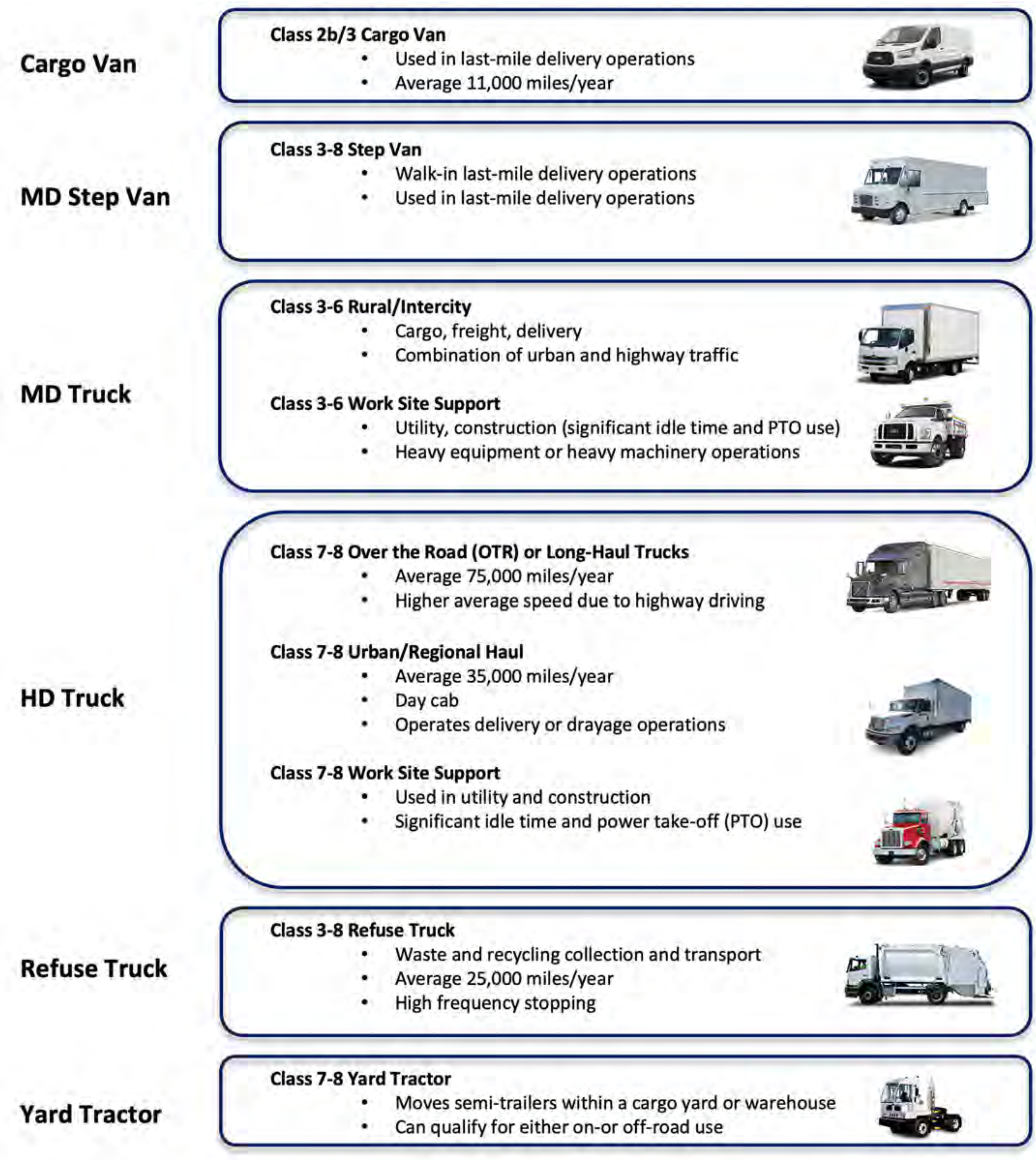
The trucking industry plays a vital role in the U.S. economy, serving as the lifeblood of logistics and transportation. It is the backbone of commerce, responsible for moving nearly three-quarters of all the country's freight. The U.S. trucking industry also employs roughly 8.4 million people while generating more than $940 billion each year in revenue (American Trucking Association, 2023).

The industry enables the timely and efficient delivery of goods, ensuring that products reach their destinations in a reliable and cost-effective manner. Its efficient operation is critical for businesses to thrive and for individuals to access the goods they need. The importance of trucking will only grow—the freight economy is expected to increase 25.6 percent by 2030 due to population and economic growth (American Trucking Association, 2019).

The trucking industry includes many components, including goods, drivers, and the vehicles themselves. In the United States, commercial vehicles are classified according to their gross vehicle weight ratings (GVWR). This analysis considers only Class 2b (8,501–10,000 lbs.) through Class 8 (33,000 lbs. and above) trucks, which are categorized into six distinct segments: cargo vans, medium-duty (MD) step vans, MD trucks, refuse trucks, yard tractors, and all other heavy-duty (HD) trucks (Figure 1).[6] For the purposes of this report, Class 2b–8 trucks that fall into one of these segments are referred to as trucks. In addition to on-road trucks, this analysis includes yard tractors, which may not be registered as on-road vehicles but provide a critical function related to moving freight in the United States.

6 Past reports have included pickup trucks; however, they are excluded in this report since most are privately owned and not used for commercial goods movement. Buses are also not included in this analysis. For information on zero-emission transit and school bus deployments, see CALSTART's *Zeroing in on Zero-Emission Buses* and *Zeroing in on Electric School Buses* reports, respectively. New editions of both reports will be published in 2024.

Figure 1. Vehicle Segmentation



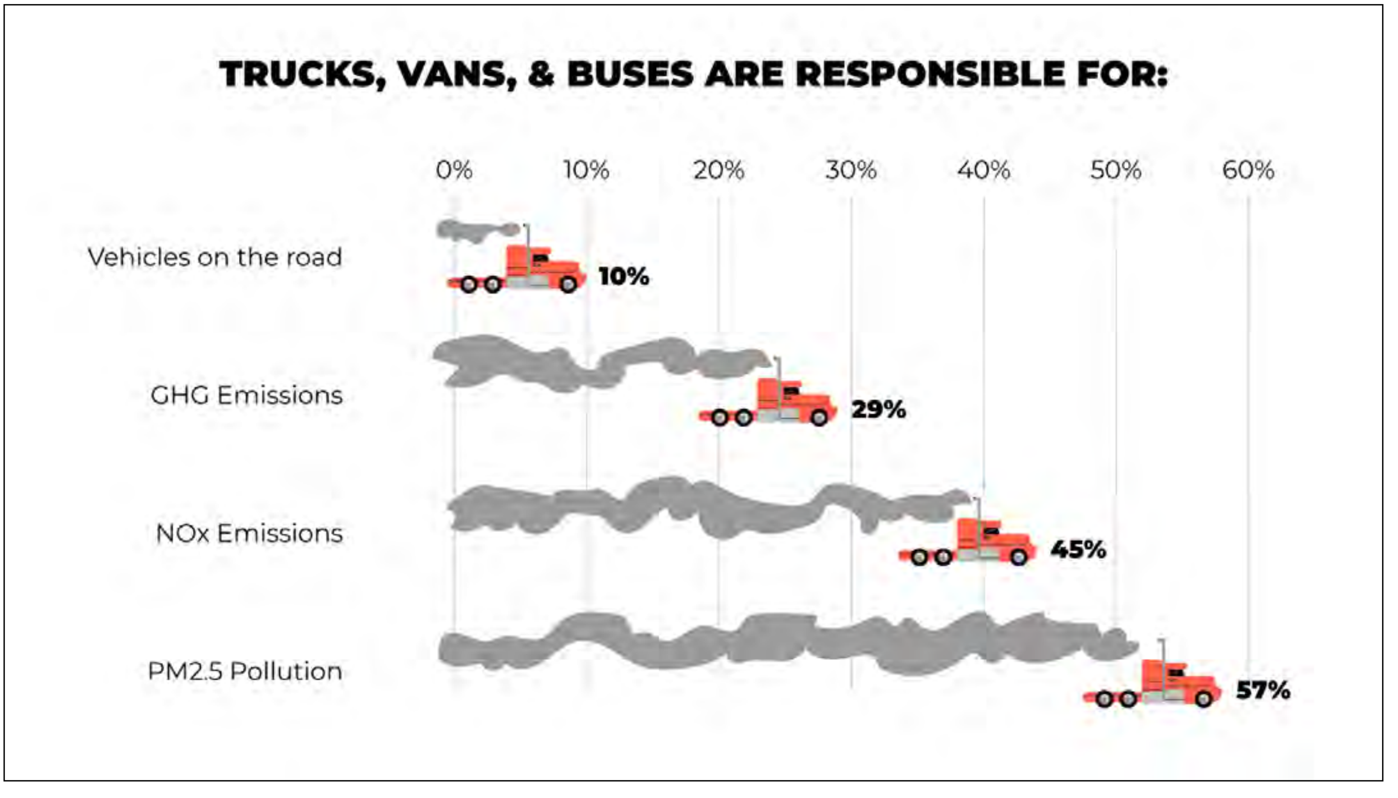
The trucking industry connects producers, suppliers, and consumers, making it an indispensable cornerstone of modern American society. Though the U.S. trucking industry has dramatically reduced its environmental and public health impacts in recent decades, it remains a major source of pollution, contributing to climate change and poor air quality, especially in the communities where these vehicles operate (Roeth, 2020).

WHY ZETS?

The transportation sector is responsible for the largest portion of greenhouse gas (GHG) emissions in the United States, generating roughly 28 percent of total GHG emissions (EPA, 2023). A significant portion of these emissions can be attributed to the trucking industry, which plays a vital role in the U.S. economy; however, its critical high-mileage haulage of the nation's freight emits significant amounts of GHGs and criteria pollutants, often in the most vulnerable communities.

While medium- and heavy-duty (MHD) vehicles represent only 10 percent of vehicles on the road, they are responsible for almost 30 percent of all transportation-related GHG emissions, 45 percent of nitrogen oxide (NOx) emissions, and more than half of fine particulate matter (PM2.5) emissions for all vehicles (Figure 2). Therefore, freight vehicles represent an outsized opportunity to reduce transportation-related emissions.

Figure 2. MHD Vehicle Share of Transportation Emissions (C40, 2023)



Transitioning to zero-emission trucks (ZETs) can substantially reduce harmful environmental impacts from the trucking industry, help to mitigate the effects of climate change, and protect public health. Emissions from freight vehicles also disproportionally affect the most vulnerable communities, as air quality is often worst near highways, warehouses, and ports—areas that tend to have more low-income communities and communities of color (EPA, 2023a). In sum, the transition to ZETs is needed to address environmental challenges and promote a more sustainable and healthier future for all.

WHAT ARE ZETS?

ZETs are a transformative category of commercial vehicles that emit zero tailpipe emissions (of carbon dioxide and criteria pollutants) and therefore reduce their environmental impact during use. These trucks utilize advanced technologies and alternative power sources to eliminate or significantly reduce the release of pollutants into the environment.

There are currently two technology types of ZETs readily available: battery-electric trucks (BETs), fueled with electricity, and fuel cell electric vehicles (FCEVs), fueled with hydrogen. While both use electricity to propel the vehicle, BETs store their electricity in battery packs and FCEVs store hydrogen in high-pressure tanks that, when combined with oxygen from the air in fuel cell stacks, produce electricity. Some consider FCEVs to be a "range extended" version of BETs since both have batteries, though FCEVs typically have much smaller battery packs. This report does not consider "low-emission" or "near-zero-emission" vehicles like natural gas (compressed, liquid, or renewable), hybrid electric, hydrogen internal combustion, renewable diesel, or biodiesel to be ZETs.

ZET technology offers a promising solution for decarbonizing the commercial transportation sector. Though the range of early generation BET models was limited to 100 or less miles on a single charge, thanks to increased energy density and declining battery prices, many of today's models boast ranges exceeding 300 miles, with some able to travel up to 500 miles before needing to refuel (CALSTART, 2022). These ranges can be further extended with electrified trailers and/or maximized regenerative braking. En-route charging mid-shift or between shifts can also allow vehicles to travel many more miles per day than they would otherwise be able to accommodate on a single charge. The majority of freight routes for MHD vehicles are well within these ranges, with approximately 67–87 percent of U.S. freight travelling in shipments less than 250 miles (Geotab, 2021; DOE, 2023).

Options are in development for long-haul trucking as well. Although there are not yet commercially available ZETs with sleeper cabs, FCEVs are coming to market with ranges up to 500 miles and BET technology continues to improve over time. Faster, smarter, and higher-power charging solutions and standards are also in development, enabling trucks to recharge in a timeframe close to parity with diesel refueling (CharIN, n.d.).

While the batteries and fuel cell tanks do add additional weight to the trucks—potentially limiting the payload a vehicle can carry—this impacts a relatively small segment of the trucking industry, as most trucks are constrained by volume more so than weight. In fact, nearly nine in ten trucks on the road operate below the 80,000-lbs. federal maximum weight (DOE, 2023a). Additionally, the Federal Highway Administration (FHWA) provides for a 2,000-lbs. weight exemption for BETs, allowing them to operate at up to 82,000 lbs. (FHWA, 2019).

While ZETs may not be feasible for every truck application today, it is evident that current models are generally sufficient to meet the needs of a majority of truck types and routes—and certainly to achieve the deployment levels required by existing policies. As the technology continues to develop, next-generation models are expected to meet the operational needs of remaining duty cycles.

U.S. COMMITMENT

Taking stock of the progress made by ZET technology, in November of 2022, the United States signed the Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles (Global MOU), committing to work with other signatory countries to enable 100 percent of new truck and bus sales to be zero-emission (ZE) by 2040, including an interim goal of 30 percent by 2030 (CALSTART, 2023). The Global MOU is co-led by CALSTART's Global Commercial Vehicle Drive to Zero program and campaign and the Government of The Netherlands, with the purpose of accelerating the growth of ZE commercial vehicle adoption. The Global MOU has been signed by a total of 33 nations and has been endorsed by more than 115 subnational governments, manufacturers, suppliers, and other industry stakeholders. The Global MOU symbolizes a commitment to work together to overcome strategic, political, and technical barriers to ZE commercial vehicle adoption. With an increase in investment and economies of scale, this transition can be faster, more cost-effective, and easier for all stakeholders.

The Global MOU has been signed by a total of 33 nations and has been endorsed by more than 115 subnational governments, manufacturers, suppliers, and other industry stakeholders.

In line with the Global MOU, the U.S. National Blueprint for Transportation Decarbonization emphasizes the need to transition to zero-emission vehicles (ZEVs) to meet the country's GHG reduction goals, including for MHD vehicles (DOE, 2023b). Data in this report track progress with respect to the U.S. truck fleet.

CHAPTER II

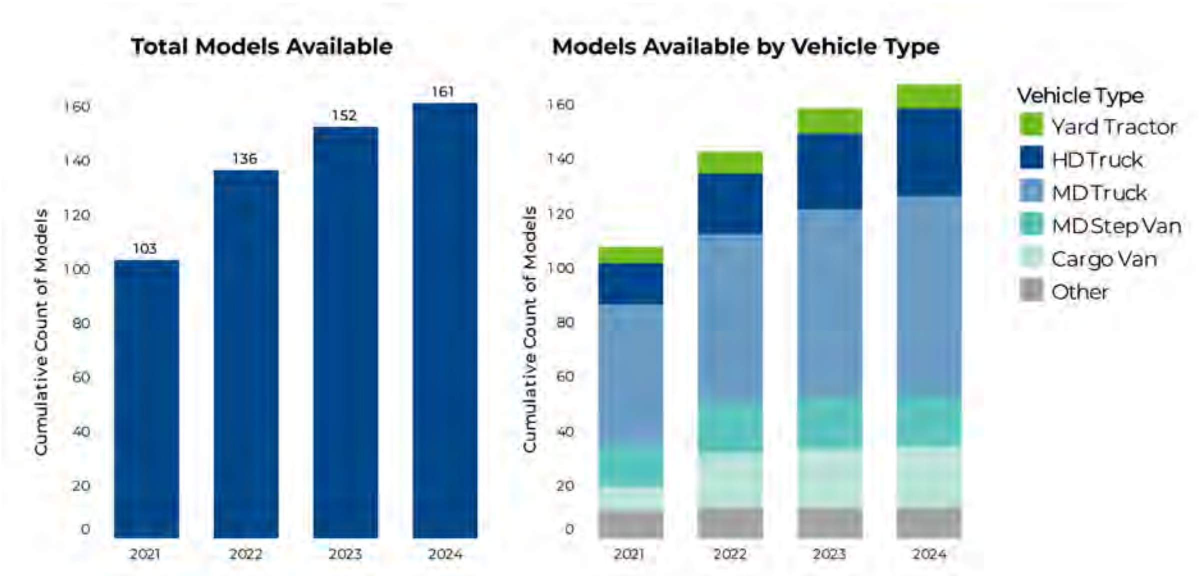
U.S. ZET MARKET UPDATE

ZET MODEL AVAILABILITY

The growth in ZET offerings has expanded each year and can be attributed to many technological advancements, original equipment manufacturer (OEM) investment, increased regulatory action, and nationally and organization-based climate goals. In 2019, only a couple dozen ZET models were available in the United States; there are now more than 160 models available.[7] And while ZET models were once dominated by retrofitters, today more than 40 OEMs have at least one ZET offering, including all the major legacy manufacturers. Numerous startups are also contributing to the advancement of ZETs.

The ZE MD truck market has the most options with 73 models available, followed by ZE HD trucks with 32 models and ZE cargo vans with 23 models (Figure 3). This is fitting given that these vehicle segments are the three largest in terms of current vehicle stock on the road.

Figure 3. ZET Model Availability Over Time (CALSTART, 2023b)



7 The Zero-Emission Technology Inventory (ZETI) Data Explorer includes current and future ZET models that have been announced.

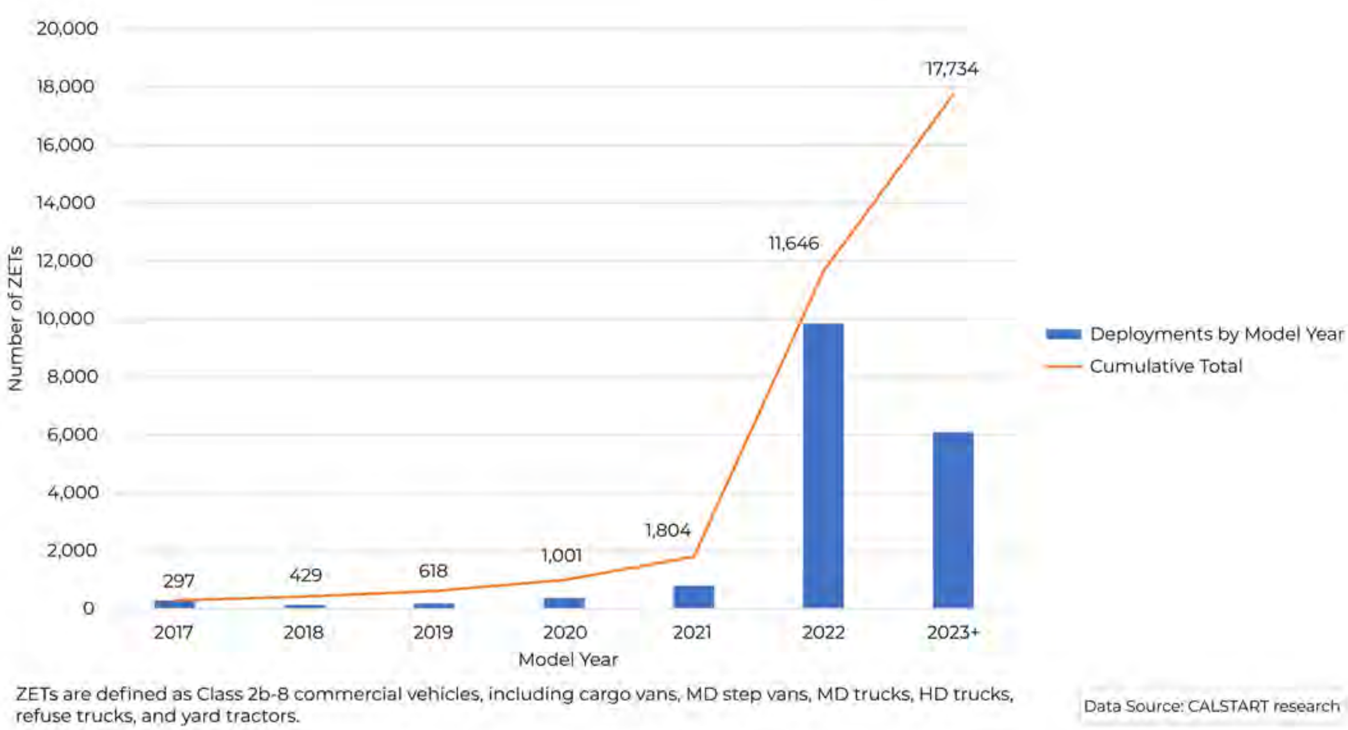
As expected, the number of new ZET models coming to market has tapered off in 2023 due to the significant progress made from 2019 to 2022. Many OEMs are now focused on increasing sales of existing models while also refining their initial ZET offerings based on real-world customer experience and feedback and developing second- or third-generation versions.

Most of the available ZET models fall under the battery-electric technology type. However, FCEV models are starting to see significant growth in availability. In 2021, four FCEV models were available, and as of this writing, there are 12 models available, mainly in the HD truck segment. FCEV model availability is expected to increase in the coming years as many OEMs are currently developing FCEV options (see *Hydrogen Fuel Cell Developments* section).

TOTAL ZET DEPLOYMENTS

As of June 2023, more than 17,500 ZETs have been deployed in the United States,[8] more than doubling the number of total deployments reported in the previous *Zeroing in on Zero-Emission Trucks: May 2023 Market Update*. Figure 4 outlines the distribution of ZET deployments by vehicle model year along with the cumulative total year-over-year, and Table 1 breaks down ZET deployments by vehicle segment and model year.

Figure 4. U.S. ZET Deployments by Vehicle Model Year (2017–June 2023)



8 Trucks are defined as "deployed" if they have been delivered to the customer and registered with the Department of Motor Vehicles. Deployed truck counts do not include undelivered sales or fleet commitments for purchases. Past reports have referred to this as "deployed sales."

Table 1. U.S. ZET Deployments by Vehicle Segment and Model Year (2017-June 2023)

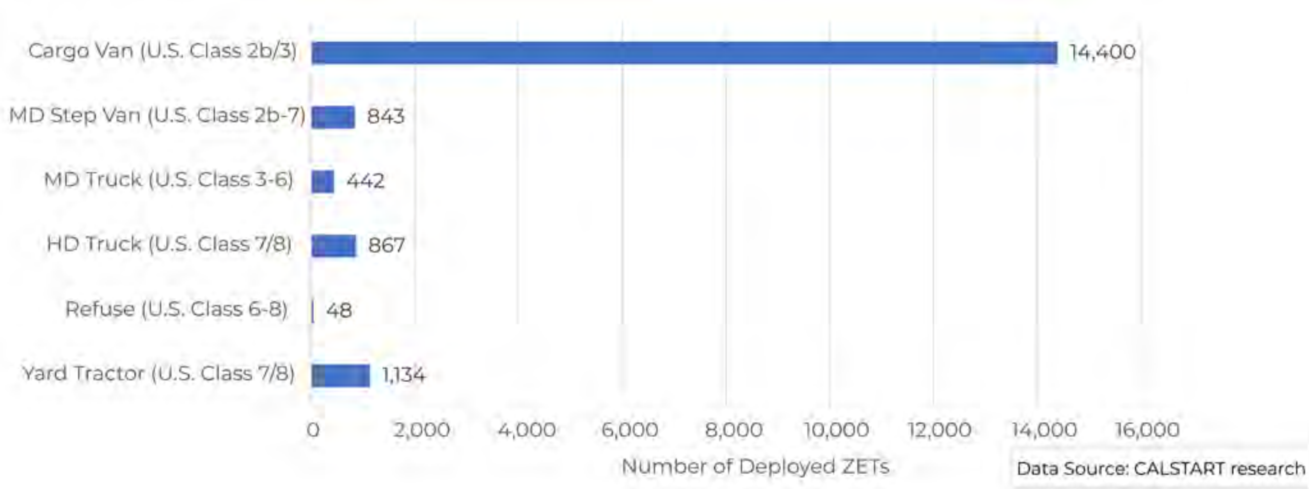
Vehicle Segment	2017	2018	2019	2020	2021	2022	2023+
Cargo Van	30	8	17	5	52	8,991	5,297
MD Step Van	223	25	21	14	275	238	47
MD Truck	18	57	12	44	124	98	89
HD Truck	8	0	16	93	90	219	441
Refuse	1	0	1	4	12	19	11
Yard Tractor[9]	17	42	122	223	250	277	203
Total	**297**	**132**	**189**	**383**	**803**	**9,842**	**6,088**

The continued significant increase in deployments can be attributed to a multitude of factors, including increased incentives, confidence in the technology, model availability, production capacity, and ZET policy adoption.

DEPLOYMENTS BY SEGMENT

The driving force behind such a dramatic increase in ZET deployments has been the meteoric rise of ZE cargo van deployments. Approximately 14,400 ZE cargo vans have now been deployed in the United States (Figure 5), which means 11,835 of these vehicles were deployed in the first half of 2023—a 461-percent increase in deployments from the previous report. Following cargo vans with respect to total ZET deployments are yard tractors (1,134), HD trucks (867), MD step vans (843), MD trucks (442), and lastly, refuse trucks (48).

Figure 5. Cumulative U.S. ZET Deployments by Vehicle Segment (2017–June 2023)



9 Yard tractor deployments are likely underreported as many are not registered for on-road use and much of the data on deployments come from vehicle registrations.

ZE cargo vans have been deployed more than other segments due to various factors, including smaller batteries, high production volumes (and marketing campaigns) from multiple OEMs, ideal duty-cycle capability, and much lower upfront costs compared to other vehicle segments. These factors have allowed several large companies to deploy ZE cargo vans throughout the country relatively quickly. The Commercial Clean Vehicle Credit also provides up to $7,500 toward the purchase price for ZE cargo vans,[10] which brings the price down to be cost competitive with combustion-powered cargo vans (IRS, 2023).

There have been steady increases in ZET deployment numbers among every other segment, though ZE HD trucks stand out as the only other segment that saw its first half of 2023 deployment numbers more than double its total deployments from the previous report, boasting a 250-percent increase. HD trucks are the most common among the vehicle segments, with more than 5 million total trucks registered in the country. The vast number of HD trucks on the road, combined with their high mileage, relatively low efficiency, and therefore high fuel burn, have made them a focal point for decarbonization, especially given the disproportionate amount of GHG and criteria pollutant emissions from these vehicles.

Since charging infrastructure is still in the process of being planned and built out along key freight corridors to support the electrification of long-haul trucks, ZE HD trucks have primarily been deployed in urban/regional or drayage duty cycles. While a number of states now have ZE HD trucks operating within their borders, California continues to lead in ZE HD truck deployments due to ambitious targets, initiatives, and incentives that support reducing emissions from this critical vehicle segment.

10 The Commercial Clean Vehicle Credit allows for up to $7,500 and $40,000 off the initial purchase price for Class 2b–3 and Class 4–8 commercial vehicles, respectively.

California Prioritizes Funding for HD Drayage Trucks

A driver in a heavy-duty fuel cell electric truck at California's Port of Oakland.
Photo Credit: Harbor Trucking Association and Marc Harris Photography

In 2020, California Governor Gavin Newsom issued an Executive Order (N-79-20) that set a goal that all MHD vehicles in the state would be ZE by 2045 for "all operations where feasible" but specified an accelerated timeline for drayage trucks, requiring them to transition by 2035 (State of California, 2020). To realize this goal, the California Air Resources Board (CARB) launched Project 800, an initiative to support 800 ZE drayage truck orders to jumpstart the sector and pave the way for more ZETs serving California ports in the near future (CARB, 2021).

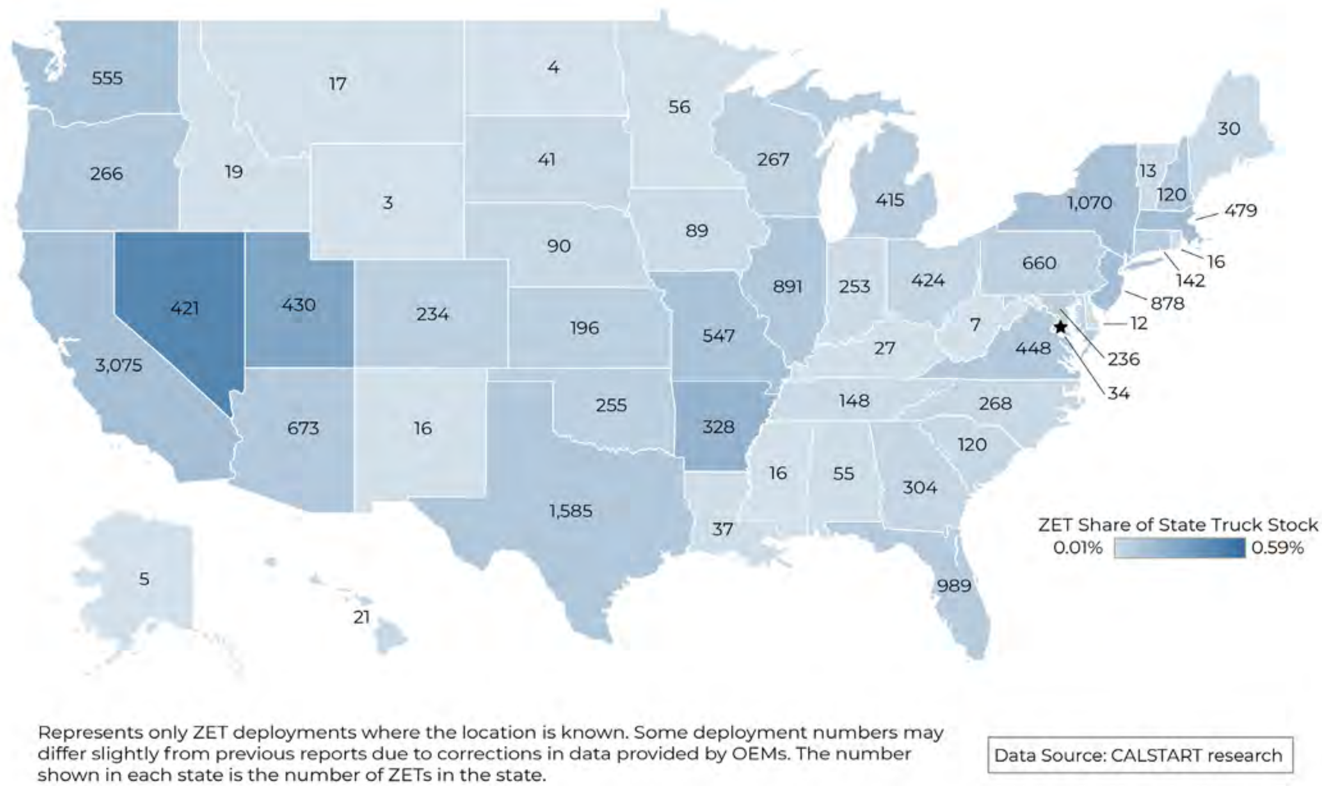
CARB also created special set-asides for drayage trucks within its Clean Truck and Bus Voucher Incentive Project (HVIP). More than 40 HVIP drayage vouchers have already been redeemed—with trucks now in operation—and hundreds more are in process. Additional funding for drayage trucks is available through the Port Plus Up, funded by the Port of Los Angeles and the Port of Long Beach (HVIP, 2023). Combined, these incentives can cover more than $400,000 toward the cost of a drayage truck.

Meanwhile, the California Energy Commission (CEC) has funding set aside through its Energy Infrastructure Incentives for Zero-Emission (EnergIIZE) Commercial Vehicles Project to support charging and hydrogen refueling infrastructure for ZE drayage trucks (EnergIIZE, 2023). With this statewide collaboration, financial support, and policies like the Advanced Clean Fleets (ACF) rule, California is expected to continue to lead the nation in ZE HD truck deployments in the years to come.

DEPLOYMENTS BY STATE

Tracking ZET deployments by state (Figure 6) can provide key insights to understand what conditions may best influence market growth. For example, a range of factors including policy mandates, incentive programs, utility make-ready programs, and electricity prices compared to diesel may all factor into a fleet's decision on if and where to deploy ZETs. Even proximity to OEM manufacturing facilities may sometimes impact ZET deployment locations.

Figure 6. Cumulative U.S. MHD ZET Deployments by State (2017–June 2023)



California continues to lead the nation with respect to ZET deployments, with approximately 3,075 ZETs deployed to date, though it now accounts for less than one-fifth of total U.S. ZET deployments. This is a testament to the viability of ZETs to perform in a wide range of climates and applications, and to the momentum being built to transition MHD vehicles to ZE across the country.

The top states for overall ZET deployments after California include Texas, New York, Florida, and Illinois. However, leading states differ by vehicle segment:

- ZE cargo vans from seven OEMs have primarily been deployed in Texas (1,498), California (1,494), and Florida (953).

- ZE MD step vans from five OEMs have been deployed the most in California (320), New Hampshire (94), and North Carolina (63).
- ZE MD trucks from 12 OEMs have primarily been deployed in California (227), Iowa (38), and New York (25).
- ZE HD trucks from 12 OEMs have been deployed the most in California (346), Wisconsin (93), and New Jersey (91).
- ZE refuse trucks from four OEMs have primarily been deployed in Pennsylvania (10), California (7), Florida (5), and New Jersey (5).
- ZE yard tractors from three OEMs have been deployed the most in California (681), New York (55), New Jersey (39), and Colorado (39).

Note that much of the data used for this report are based on private correspondence with OEMs and vehicle registration data.[11] However, vehicles may not operate exclusively in the state in which they are registered.

OVERALL TRUCK MARKET

The U.S. truck market consists of more than 12 million Class 2b–8 trucks registered as of June 2023.[12] This truck stock is dominated by three segments, with HD trucks being the most common, accounting for roughly 5.1 million vehicles. HD truck registrations are followed by cargo vans and MD trucks, with approximately 3.7 and 3.6 million vehicles, respectively. These three segments combined make up roughly 97 percent of all truck registrations in the United States (excluding pickups).

This market segmentation is generally true of recent deployments as well, as these three segments accounted for 95 percent of model year 2022 deployments. However, more 2022 MD trucks were deployed (roughly 187,000) than HD trucks (roughly 185,000). Truck deployments are cyclical and can vary dramatically from one year to the next (Roeth, 2020a). For example, 2022 deployments were impacted by supply chain challenges, and the increased demand for MD trucks may be due in part to the professional driver shortage—one of the top four issues facing the trucking industry (The American Transportation Research Institute, 2023). As fleets attempt to hire drivers, some are increasingly open to those without commercial driver's licenses (CDLs), which represent a larger candidate pool because of the reduced training required. These non-CDL drivers are not certified to operate HD trucks but can still haul freight using MD trucks.

11 All data sources used to track ZET deployments are outlined in Appendix D.

12 As stated above, this analysis includes Class 2b–8 trucks, excluding pickup trucks.

Figure 7 illustrates the total truck stock and model year 2022 deployments as of June 2023 by vehicle segment.

Figure 7. U.S. MHD Truck Total Stock and Model Year 2022 Deployments by Vehicle Segment (Thousands)

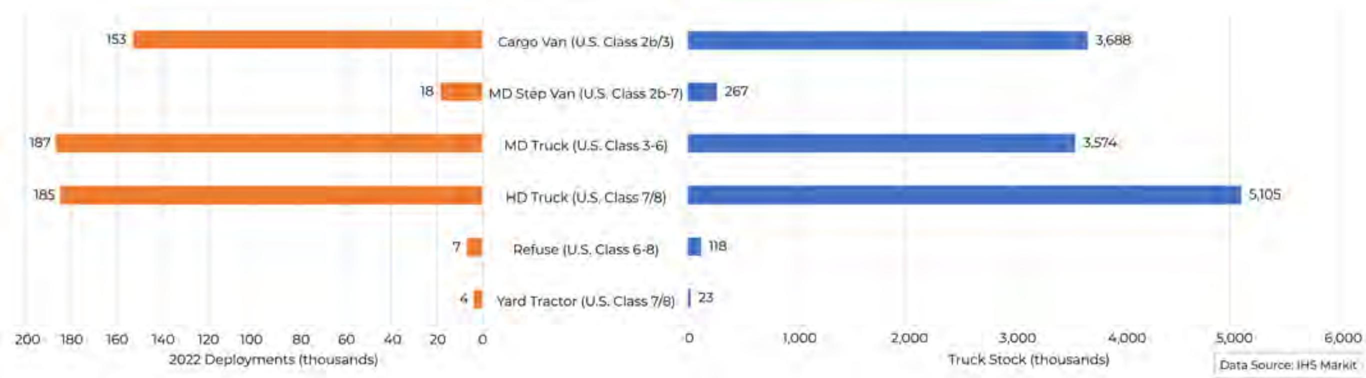
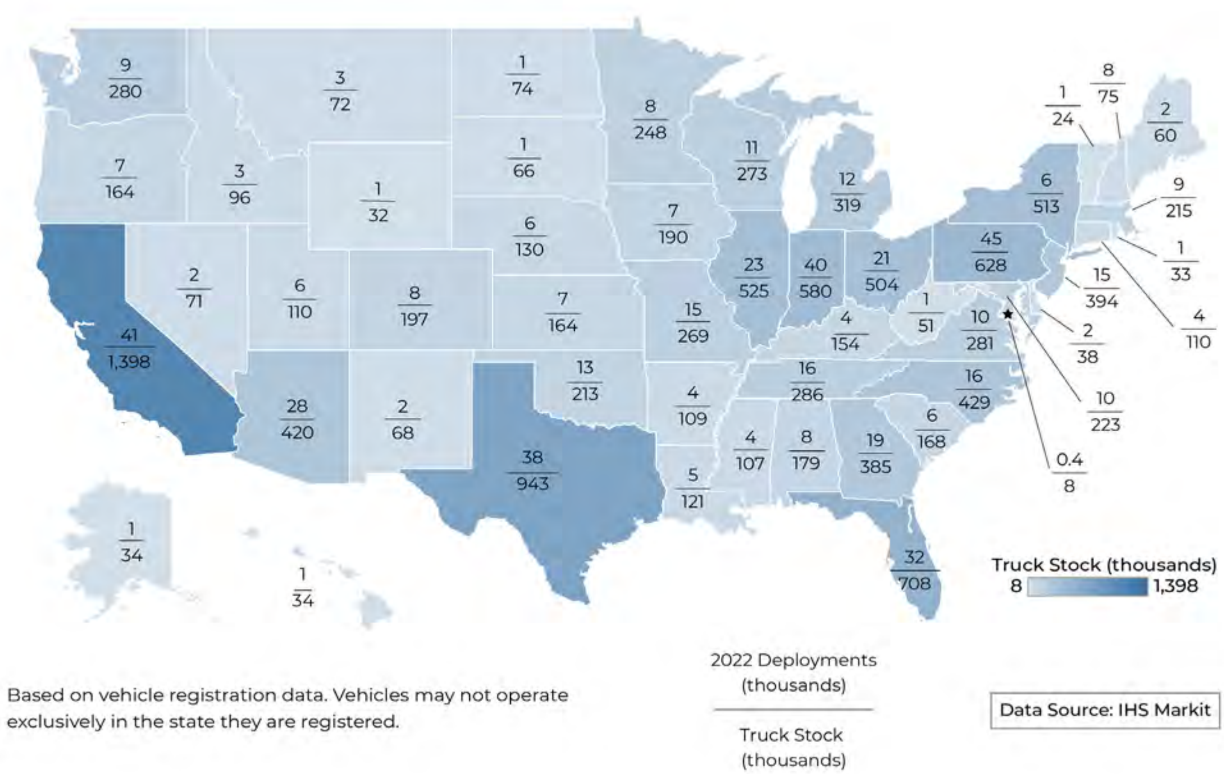


Figure 8 shows the total U.S. truck stock and model year 2022 deployments in thousands by state.

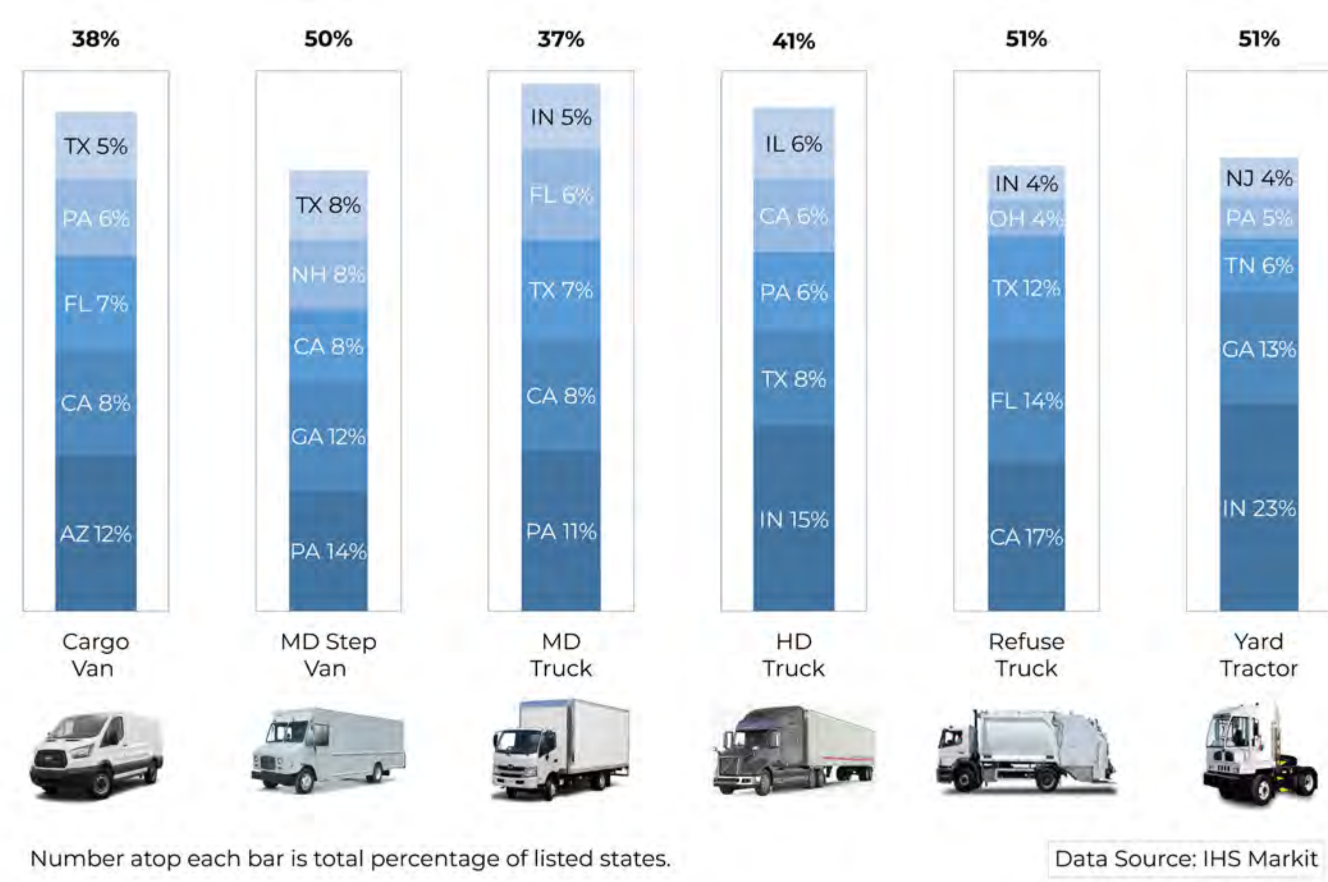
Figure 8. U.S. Truck Stock and Model Year 2022 Deployments by State (Thousands)



The largest truck populations can be found in California (10.9 percent of total U.S. stock), Texas (7.4 percent), and Florida (5.5 percent). However, these are not necessarily the largest markets for new deployments. Rather, 2022 truck deployments were greatest in Pennsylvania (8.1 percent), California (7.3 percent), and Indiana (7.1 percent).

Similar to the ZET market, top states for overall truck deployments differ by vehicle segment. Figure 9 displays the five leading states for 2022 deployments by vehicle segment. For each segment, the top five states make up more than one-third of the total deployments, and in some cases more than half of the total deployments: cargo van (38 percent), MD step van (50 percent), MD truck (37 percent), HD truck (41 percent), refuse truck (51 percent), and yard tractor (51 percent).

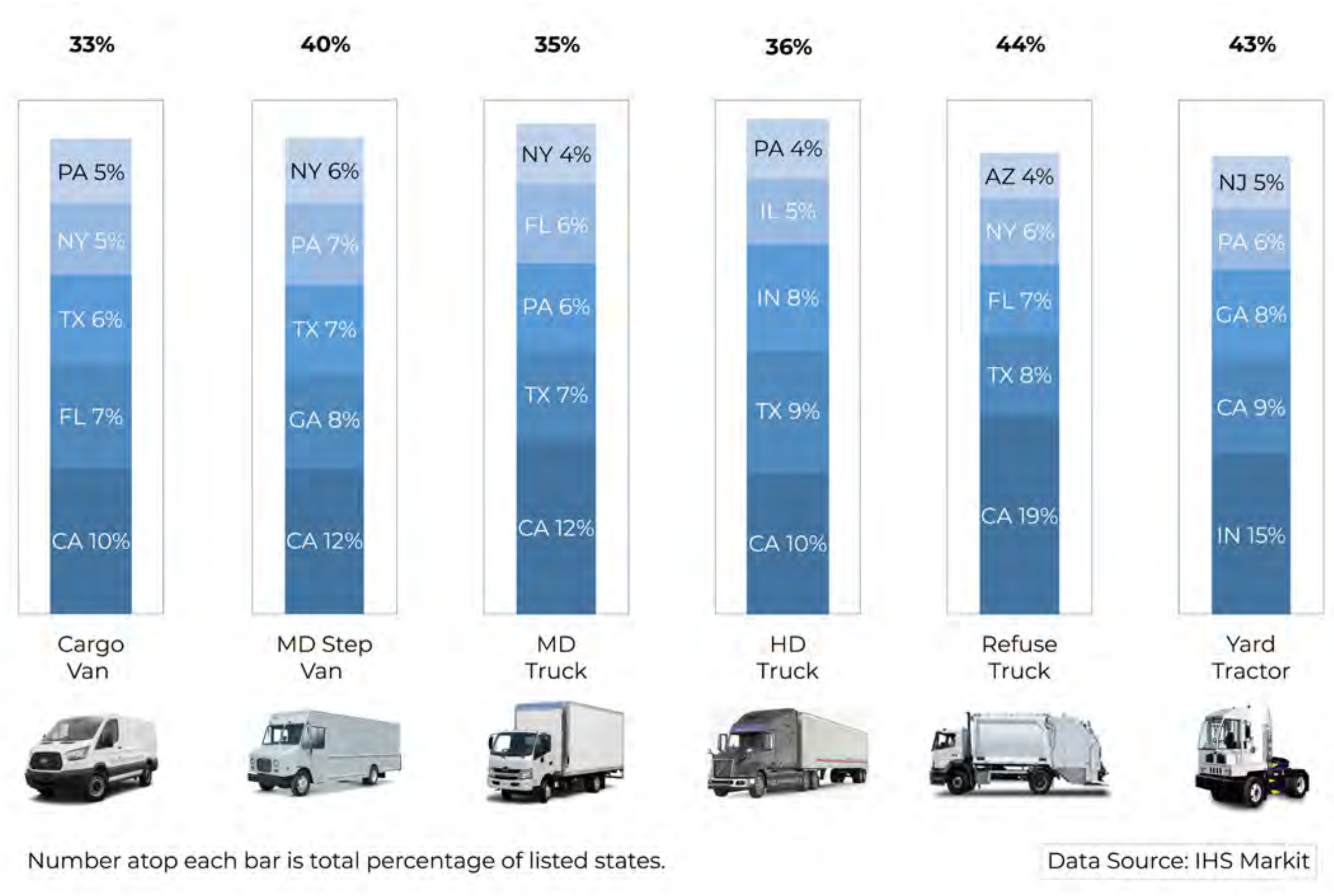
Figure 9. Top Five U.S. States for Model Year 2022 Truck Deployments by Vehicle Segment



The distribution of deployments by vehicle segment has seen little change over the past six months. Most new deployments continue to be concentrated around freight hubs like Indiana, California, Georgia, Texas, and Pennsylvania, as all five states are well represented in 2022 deployments across all vehicle segments.

The distribution is similar when overall truck stock is considered by state and by segment. Figure 10 shows the five leading states for overall truck stock by vehicle segment. Like deployments, the top five states represent more than one-third of the total registrations for each truck segment: cargo van (33 percent), MD step van (40 percent), MD truck (35 percent), HD truck (36 percent), refuse truck (44 percent), and yard tractor (43 percent).

Figure 10. Top Five U.S. States for Truck Stock by Vehicle Segment



Where certain vehicle segments tend to be registered has not changed significantly in the past few years. California continues to lead across all vehicle segments, except for yard tractors. California leads in overall truck stock with 10.9 percent of the market.

CHAPTER III

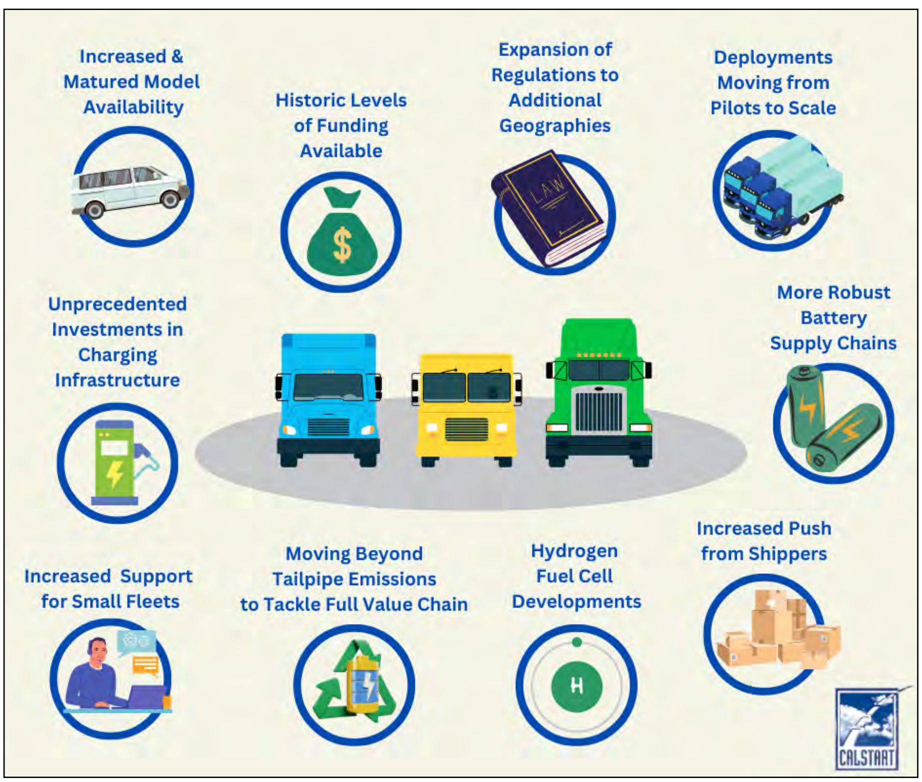
THE ROAD AHEAD

Rapidly accelerating the adoption of ZETs is necessary to reduce pollution from the trucking industry, improve public health, and mitigate climate change. An understanding of the current market and the tactics that have worked to deploy ZETs can provide insight on how to build off early successes.

OBSERVED MARKET TRENDS

Ten key market trends are currently driving ZET deployments (Figure 11).

Figure 11. Observed 2023 U.S. ZET Market Trends



INCREASED AND MATURED MODEL AVAILABILITY

The noticeable increase in ZET adoption since the previous version of this report is due in part to the increased availability of models from all OEMs. As Figure 3 showed earlier, there are now more than 160 ZET models available in the United States from more than 40 OEMs. With these increasingly diverse market offerings, fleets have never had more options capable of meeting their operational needs. This increased competition—along with increasing production volumes and decreasing battery prices—is expected to bring ZET prices down over time, as has been observed in the passenger car market (Dnistran, 2023).

Increased model availability is due in part to the emissions reduction commitments of many truck manufacturers, including legacy OEMs (Garcia Coyne et al., 2021). Table 2 outlines the major OEMs that have set forth a U.S. ZEV or carbon neutrality goal as of December 2023.[13] These goals, coupled with the influx of exclusively ZE companies, have spurred ZET model availability to an all-time high.

Table 2. OEM Commitments to U.S. ZEV Sales and Carbon Neutrality

OEM	ZET Target	Target Year	Source
Cummins	Reduce Scope 3 absolute lifetime GHG emissions from newly sold products by 25%	2030	Cummins, n.d.
Daimler Trucks North America	All new trucks and buses will be carbon neutral	2039	Daimler Truck, n.d.
Ford	100% fossil-free new vehicle sales	2040	Foote, 2021
General Motors	Sell ZE version of all HD trucks	2035	Mihalascu, 2022
Hyundai	Carbon neutrality	2045	Hyundai, 2021
Isuzu	Zero GHG emissions arising directly from Isuzu Group operations	2050	Isuzu, n.d.
Navistar	100% new vehicle sales to be ZE	2040	Navistar, n.d.
PACCAR	Net-zero GHG emissions	2050	Climate Action 100, 2023
Volvo Group	100% fossil-free product sales	2040	Volvo Group, 2023

13 Table 2 does not include ZE-only manufacturers as their targets are inherently ZE.

Increased model availability and production volumes allow these OEMs to grow their ZET business, enabling them to achieve their goals while meeting regulatory requirements.

EXPANSION OF REGULATIONS TO ADDITIONAL GEOGRAPHIES

The Unites States' commitment to decarbonize the trucking industry can be seen through the many regulations being put into place at both the federal and state levels. For example, in 2023, at the federal level, the U.S. Environmental Protection Agency (EPA) announced a proposal for more stringent standards to reduce GHG emissions from trucks. The proposed Phase 3 standards would reduce carbon dioxide emissions by approximately 1.8 billion metric tons from 2027 to 2035 and would provide significant climate and health benefits (EPA, 2023b). The EPA rule is expected to be finalized in early 2024.

Meanwhile, the most stringent policies regarding ZET deployments have been passed at the state level. For example, the Advanced Clean Trucks (ACT) rule requires truck manufacturers to sell an increasing number of ZETs as a percentage of their overall truck sales. First passed in California, seven additional states[14] had adopted ACT as of June 2023.[15] Though model year 2024 trucks are the first to be subject to the rule, the industry is already experiencing the effects of ACT, the anticipation of which has spurred more robust supply chains and increased production volumes. Though the eight ACT states combined represent approximately one in four trucks in the United States, they account for nearly 40 percent of ZET deployments through June 2023.

Many additional states are considering adoption of the ACT rule. Seventeen states plus the District of Columbia signed the Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding (MOU), agreeing to strive to make all sales of new MHD vehicles in their jurisdictions be ZE by 2050 (NESCAUM, 2022). The MOU also includes an interim goal of 30 percent ZE sales by 2030 and commits the states to consider adoption of ACT.

In April 2023, California also adopted the Advanced Clean Fleets (ACF) rule, requiring large fleets with operations in California to deploy an increasing number of ZETs as a proportion of their overall fleet. It also requires any new drayage trucks to be ZE. ACF complements ACT by ensuring customer demand for ZETs is there to match the increased supply from OEMs. ACF also includes a provision to cease the sale of combustion trucks entirely, necessitating all MHD vehicle sales be ZE by 2036 (CARB, 2023). ACT and ACF work in tandem to send a clear market signal to both truck manufacturers and purchasers.

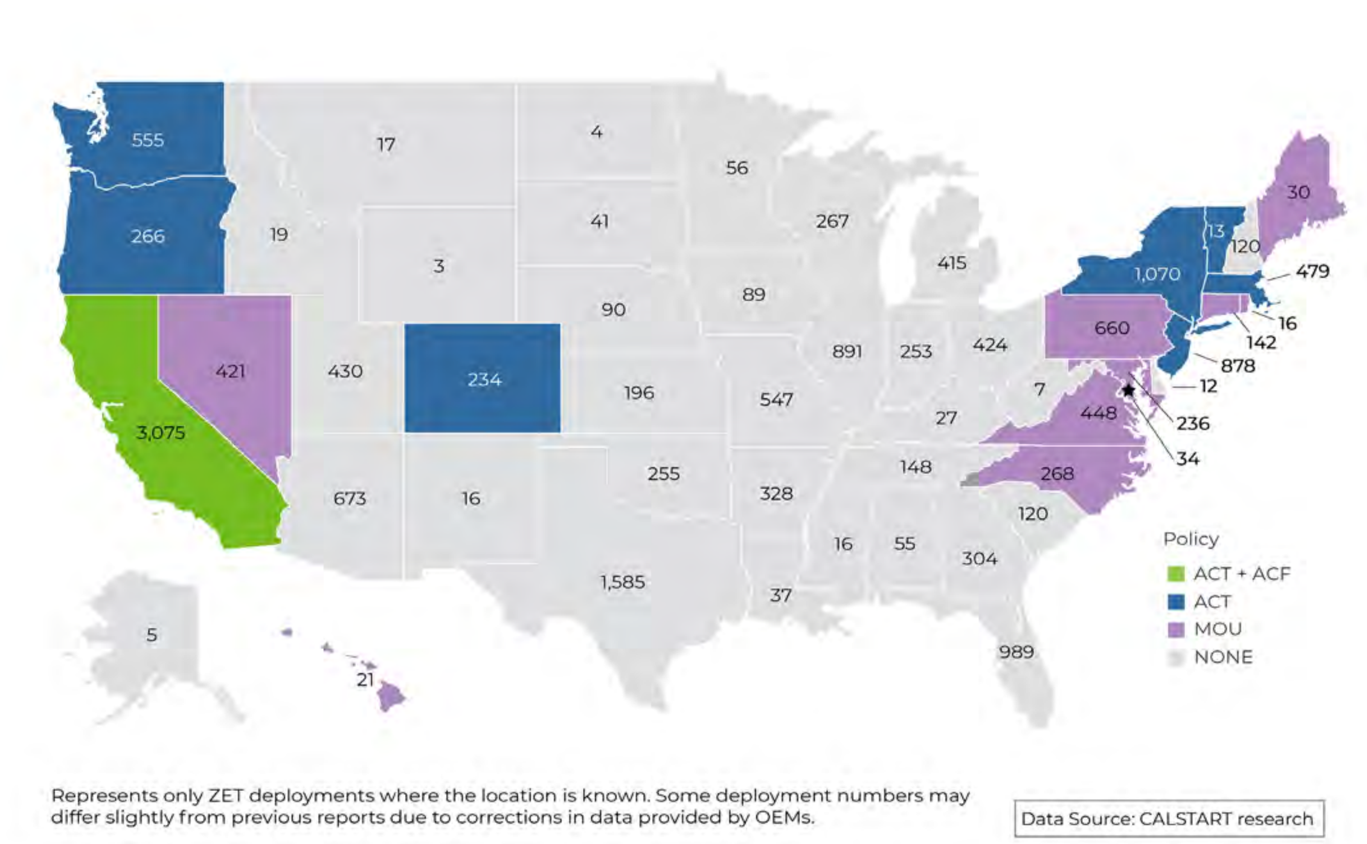
Taken together with local policies regulating emissions from warehouses and requiring streamlined permitting of electric vehicle charging, these regulations have without a doubt resulted in increased ZET deployments in leading geographies (South Coast Air Quality Management District, n.d.; GO-Biz, n.d.). Figure 12 presents the number of ZETs deployed by state (where the state can be identified) and shows

14 Other states that have adopted the ACT regulation as of June 2023 include Colorado, Massachusetts, New Jersey, New York, Oregon, Vermont, and Washington. New Mexico, Maryland, and Rhode Island adopted ACT later in 2023, after the data cutoff for this analysis.

15 Per its authority under section 209 of the Clean Air Act (CAA), California can set more stringent emissions standards than the federal government. Under Section 177 of CAA, other states can then adopt California's standards.

each state's policy status as of June 2023. The policy levels shown are states that have adopted both the ACT and ACF rules (green), states that have adopted only the ACT rule (blue), states that have adopted neither but have signed the MOU indicating intent to adopt the ACT rule (purple), and non-MOU states (gray).

Figure 12. State ZET Deployments and Policy Status (2017–June 2023)



California has announced that it hit its goal of 6 percent of new trucks sold in the state being ZE by 2024 two years early, exceeding the original goal in 2022 with 7.5 percent of trucks sold (including light-duty trucks) being ZE (Office of Governor Gavin Newsom, 2023).

HISTORIC LEVELS OF FUNDING AVAILABLE

Regulations are most likely to be successful when paired with a full ecosystem of supportive programs, including incentives. Though the total cost of ownership (TCO) of a ZET may already be lower than that of a combustion truck (due to the increased efficiency of ZE powertrains and lower operational costs from less maintenance and lower fuel costs), this is not yet true across all duty cycles (though ZETs are expected to achieve TCO parity by the end of the decade, across all standard duty cycles) (Argonne National Laboratory, 2023; Hunter et al., 2021). Even with the promise of lower TCO on the horizon, incremental purchase price—as well as the costs to install charging, upskill employees, and purchase insurance for these more costly vehicles—remains a barrier to ZET adoption for many fleets.

Fortunately, historic levels of funding are available to help U.S. fleets overcome the upfront price premium and deploy ZETs. Analysts estimate approximately $32 billion will be available on average per year for the next few years (Gladstein, Neandross, & Associates, 2023). This support represents an order of magnitude in growth from estimates just two years prior, highlighting the rapid increase in funding availability and overall momentum in the industry.

Similar to policy, this funding is a combination of state and federal programs. ZETs can cost upwards of two to three times the price of a similar combustion truck, so incentives that help lessen this upfront cost premium help make ZE technology more accessible for fleets. At the federal level, the Inflation Reduction Act (IRA)-authorized Commercial Clean Vehicle Credit helps cover the incremental cost of ZETs by providing a credit of up to $40,000 per truck (IRS, 2023). This credit, combined with the Alternative Fuel Refueling Infrastructure Credit, is expected to help ZETs achieve TCO parity with combustion-powered trucks approximately five years sooner than without IRA (Kahn et al., 2022).

At the state level, voucher incentive programs act as a tool to support ZET deployments by offering cash-on-hood funding toward a ZET at the time of purchase. States that offer upfront vehicle incentives, such as California, New York, and New Jersey, have seen greater adoption of ZETs across all vehicle segments. States with a statewide ZE MHD vehicle incentive program prior to 2023 make up 39 percent of all ZET deployments.[16] Some state-level incentive programs also offer funding for charging or refueling infrastructure. To date, there are 15 MHD vehicle incentive programs across 10 states. Additional states are able to take advantage of available federal programs to fund new ZET voucher programs (Mandel et al., 2023). See Appendix A for a list of known ZET incentive programs in the United States.

Additional funding to support ZET deployments is increasingly available from utilities and local government as well (Office of Energy Efficiency and Renewable Energy, n.d.). For example, numerous electric utilities offer "make-ready" programs that can cover the cost of electrical grid upgrades necessary to make the distribution system and/or charging site (i.e., fleet depot) capable of charging ZETs. These make-ready programs are approved by state public utility commissions and funded by ratepayers. Research based on real-world data shows that these programs can drive down electric rates over time for all electricity customers in a utility's territory due to the increased sales of electricity that these programs enable (Whited et al., 2023; MacDougall, 2023). See Appendix B for a list of known utility make-ready programs in the United States.

MORE ROBUST BATTERY SUPPLY CHAINS

For BETs, the battery comprises approximately 70 percent of the overall vehicle cost (Beaty, 2021). Because batteries represent such a large portion of overall vehicle cost, a decrease in their cost has an outsized impact on electric truck pricing. Therefore, another factor impacting overall cost and deployment

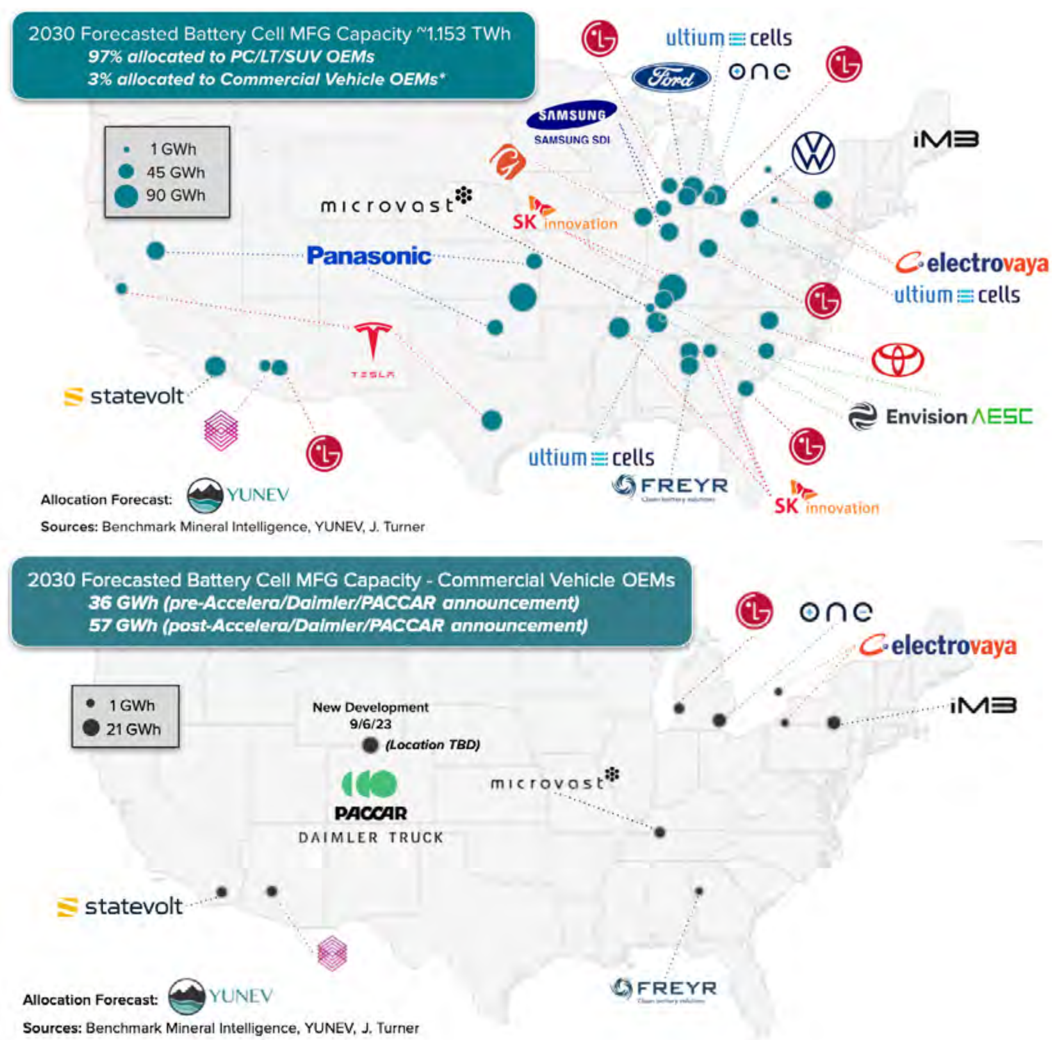
16 For more information about state incentive programs, see Appendix A.

feasibility for ZETs has been the declining cost of lithium-ion battery packs, which have reduced in price nearly 90 percent over the last 15 years (Vehicle Technologies Office, 2023). In just the last year, from 2022 to 2023, average lithium-ion battery pack prices fell 14 percent, due largely to declining raw material costs (Stoikou, 2023). Battery pack prices are expected to continue falling by an average of 11 percent per year from 2023 to 2030 (Goldman Sachs, 2023).

However, it is important to note that ZE commercial vehicles are not able to access batteries at passenger car prices, due in large part to lower production volumes and therefore higher and more volatile battery prices. For example, while global electric passenger car manufacturers reported an average battery pack price of $128 per kilowatt-hour (kWh) in 2023, the commercial vehicle sector (excluding China) saw prices 45 percent higher at around $186 per kWh (Stoikou, 2023).

The MHD commercial vehicle market represents approximately 10 percent of the U.S. vehicle market; however, as illustrated in Figure 13, only about 3 percent of the forecasted 1.2 terawatt-hour battery cell manufacturing capacity is allocated to the commercial vehicle sector.[17]

Figure 13. Maps of Overall and Commercial Vehicle Dedicated U.S. Battery Production Capacity



17 Battery capacity research, data, and infographic (Figure 13) provided by YUNEV.

This inequity is exacerbated by the fact that electric trucks require much larger battery packs than light-duty electric vehicles. Furthermore, the relatively small volumes of truck battery production are split by OEM market share and product differentiation. Some OEMs are realizing they need to partner up with competitors on batteries and fuel cell technologies to get pricing down.

Limited battery production not only has implications on vehicle cost but also impacts the number of ZETs that OEMs are able to produce. For example, GM had to temporarily shut down production of its all-electric BrightDrop delivery vans this past fall due to difficulties securing batteries (Noble, 2023). Production is expected to resume in Spring 2024 when GM opens a new battery-module line. Similarly, Romeo Power, which was bought by Nikola and then liquidated in less than a year, also negatively impacted OEM customer production volumes.

As they look to scale production and minimize price volatility, several other ZET OEMs have begun to make investments in commercial vehicle-focused battery manufacturing. For example, in September 2023, Accelera by Cummins, Daimler Truck, and PACCAR announced a joint venture to advance battery cell production in the United States (Daimler Truck, 2023). The planned joint venture will invest between $2–3 billion for a 21 gigawatt-hour factory. Two months later, the Volvo Group announced plans to purchase Proterra Powered, the bankrupt company's battery business unit, including a development center for battery modules and packs in California and an assembly factory in South Carolina (Volvo Group, 2023a).

IRA-funded subsidies for new U.S. battery manufacturing are available via the Advanced Manufacturing Production Credit (45X). These credits offer $35 per kWh of capacity for battery cells and $10 per kWh for battery packs or modules produced in the United States (McDaniel, 2023). These credits offer $35 per kWh of capacity for battery cells and $10 per kWh for battery packs or modules produced in the United States (McDaniel, 2023). These credits are expected to spur additional investments in domestic battery supply, though it will take a few years for the impacts of these investments to be felt by the industry. These developments are expected to create more than 102,000 U.S. jobs in battery manufacturing, spread across 31 states, with the highest concentration in the emerging Battery Belt (Olano, 2023). Projects spurred by IRA are expected to create an additional 38,000 U.S. jobs in electric vehicle manufacturing. In November 2023, the U.S. Department of Energy (DOE) also announced $3.5 billion for domestic battery manufacturing, prioritizing production and manufacturing for specialized, non-light-duty markets (DOE, 2023d). More investments are needed to expand and strengthen the domestic battery supply chain with dedicated battery manufacturing capacity for MHD vehicles.

IRA-funded subsidies for new U.S. battery manufacturing are available via the Advanced Manufacturing Production Credit (45X). These credits offer $35 per kWh of capacity for battery cells and $10 per kWh for battery packs or modules produced in the United States (McDaniel, 2023).

Meanwhile, fuel cell prices have been falling significantly over the past decade, with FCEVs experiencing a 65-percent reduction in prices (Pocard, 2012). As production volumes increase, cost is expected to continue to fall significantly (Deloitte and Ballard, n.d.).

UNPRECEDENTED INVESTMENTS IN CHARGING INFRASTRUCTURE

ZET deployments have also been spurred by historic investments in charging infrastructure. Many fleets have now installed charging at their depots to support truck electrification. Depending on the number of ZETs being deployed, their charging needs, and existing grid capacity at the site, this infrastructure can be put in place in as little as a few months. Sometimes, this buildout may take a few years, due largely to utility timelines and supply chain constraints. Policymakers, regulators, utilities, nonprofit organizations, and other stakeholders are working to identify opportunities to speed up this energization process.

To help bridge this temporary gap, fleets should consider solutions like the "3 M's"—mobile charging, managed charging, and microgrids—to support faster deployment of depot-based charging infrastructure. (Learn more in the *Accelerate Utility Processes* section below.)

Non-depot charging solutions are increasingly important as well. Shared and public charging solutions are critical for enabling many fleets to deploy ZETs, including those that:

- Do not have a depot at which they park the vehicle(s) overnight.
- Lease depots and whose landlords are unwilling to allow charging.
- Have depot charging but would like redundancy in case of downtime.
- Have depot charging but need en-route charging for longer routes.
- Cannot afford the capital expenditure for charging infrastructure.
- Do not have space/real estate at their depot for charging.
- Are planning to install depot charging but for whom permitting and/or energization will take longer than truck delivery timeline.
- Are considered over-the-road or long-haul.

Fortunately, these sorts of shared and public charging solutions are increasingly available. For example, Electric Island opened publicly accessible electric truck charging in 2021 in Portland, Oregon (Daimler Truck North America, 2021). The Port of Long Beach has offered free ZET charging since late 2022 (Port of Long Beach, 2022). Public ZET charging is also available at TruckNet's Otay Mesa location near the Port of San Diego, and the Los Angeles Cleantech Incubator (LACI) has funding and plans to open public truck charging at the Port of Los Angeles (Nikolewski, 2023; LACI, 2023).

Meanwhile, Charging-as-a-Service (CaaS) providers are opening shared charging sites. WattEV's depot near the Port of Long Beach opened in 2023, and the company has plans to open three more in California—Bakersfield, San Bernardino, and Gardena—in early 2024 (PR Newswire, 2023). WattEV has also received funding to open CaaS depots along I-5 in Sacramento, California, and Salem, Oregon (Hampel, 2023). CaaS company Forum Mobility has also opened its first charging depot for Hight Logistics and has plans to expand to serve many drayage fleets across California, with investments from CBRE, Amazon's Climate Pledge Fund, and Homecoming Capital to do so (Forum Mobility, 2023). Additional CaaS startups like Terawatt and Voltera also have ambitious plans to open charging depots to support electric trucks. And freight-forwarding companies are taking advantage of Zeem Solutions' "fleet-as-a-service" depot at Los Angeles International Airport in Southern California, enabling them to deploy electric box trucks (FleetOwner, 2022).

A conceptual rendering of Forum Mobility's FM Harbor electric truck charging depot at the Port of Long Beach. Image Credit: Forum Mobility

ZET OEMs are also investing in public charging. For example, Volvo and Pilot Company have announced a partnership to deploy truck charging at select Pilot and Flying J travel centers, ideally positioned along transportation corridors (Pilot Company, 2022). Volvo has also partnered with Volvo Financial Services, Volvo Technology of America, Shell Recharge Solutions, TEC Equipment, Affinity Truck Center, and Western Truck Center to develop a publicly accessible ZET charging network that connects several of California's largest metropolitan areas (Volvo Trucks North America, 2022). Daimler Trucks North America has partnered with NextEra Energy Resources and BlackRock to launch Greenlane, a $650 million joint venture to design, develop, install, and operate a U.S. nationwide, high-performance ZE public charging and hydrogen fueling network for MHD battery-electric and hydrogen fuel cell vehicles (Daimler Truck North America, 2023). Tesla has applied for $97 million in subsidies to build charging infrastructure for its electric Semi trucks from Texas to California (Hampel, 2023a). Billions of dollars have already been invested in building out this charging infrastructure, which will continue to come online in the coming years.

INCREASED SUPPORT FOR SMALL FLEETS

As noted above, charging infrastructure to support ZETs is particularly critical for smaller fleets that may not have their own depots and/or access to capital to build out private charging. In fact, small fleets face more barriers to implement ZETs into their operations overall, as they have fewer resources—financial, staff, and informational—than larger fleets and may also lack the ability to adapt to technological issues (Dream.org, 2022).

Yet, small fleets are the norm in the trucking industry. According to the American Trucking Association, 95.8 percent of fleets operate 10 or fewer trucks and 99.7 percent operate 100 or fewer (American Trucking Association, 2023). To ensure the many small fleets and independent owner-operators in this country are not left behind in the transition to ZETs, governments have created special fleet assistance programs like Cal Fleet Advisor and Mass Fleet Advisor[18] to provide concierge-style technical assistance tailored to specific fleets' needs. Advisors in each program can assist fleets with education on vehicles, fueling, and regulations, as well as provide technical assistance with TCO analysis, duty-cycle analysis, and fueling strategies. These assistance programs allow fleets to have a go-to contact that can help guide them to the correct resources, such as utilities, dealers, OEMs, and incentive programs to ensure a fleet's success in the ZET transition. Some special incentives are available for small fleets as well. For example, California's Clean Truck and Bus Voucher Incentive Project (HVIP) offers larger voucher amounts for small fleets. It also has a special carve-out known as the Innovative Small e-Fleet (ISEF) program, which allows trucking fleets with fewer than 20 trucks to access flexible financing, lease, rental, and packaged Truck-as-a-Service (TaaS) options that include enhanced incentives and fueling support. First launched in 2022, ISEF was very popular, having its $25 million budget quickly oversubscribed. ISEF reopened in 2023 with a budget of $83 million (CARB, 2023b).

Similarly, industry is also experimenting with innovative business models to better support small fleets in transitioning to ZETs. For example, as-a-service models like TaaS or CaaS offer fleets the ease and flexibility of an all-in-one package that can include the vehicle, charging, and maintenance for a monthly subscription. This enables fleets to forgo the high upfront capital expenses and allows them to trial vehicles for their operations with shorter-term subscriptions capable of recognizing lower TCO as affordable operational expenses. These solutions are great ways to expand access to ZETs for fleets that may not have the upfront capital or internal expertise to otherwise make the transition. New York is piloting these innovative as-a-service business models via the Clean Transportation Prize state-funded Freight Electrification-as-a-Service for Transformation (FEaST) project (CALSTART, 2022).

Since many small fleets typically purchase used trucks rather than new ones, the industry is also exploring opportunities to promote a more robust used ZET market.

INCREASED PUSH FROM SHIPPERS

Whether small or large, fleets are increasingly transitioning to ZETs to realize ambitious sustainability goals. As investor, employee, and regulatory pressure mounts to address climate change, companies are committing to transparently report on and reduce their carbon emissions. For larger private fleets, this may mean transitioning to ZETs to reduce their direct emissions from their owned vehicle assets. For smaller and/or for-hire fleets, this may mean responding to shippers' desires to reduce their indirect (Scope 3) emissions by transitioning to ZETs and reporting on emissions reductions to these customers.[19]

18 For more information on Cal Fleet Advisor and Mass Fleet Advisor, visit their websites at https://calfleetadvisor.org and https://www.massfleetadvisor.org, respectively.

19 Scope 1 refers to emissions that an organization owns or controls directly. Scope 2 refers to emissions that a company causes indirectly and come from the energy it produces or purchases. Scope 3 refers to emissions not produced by the company but for those that the company is indirectly responsible for up and down its value chain.

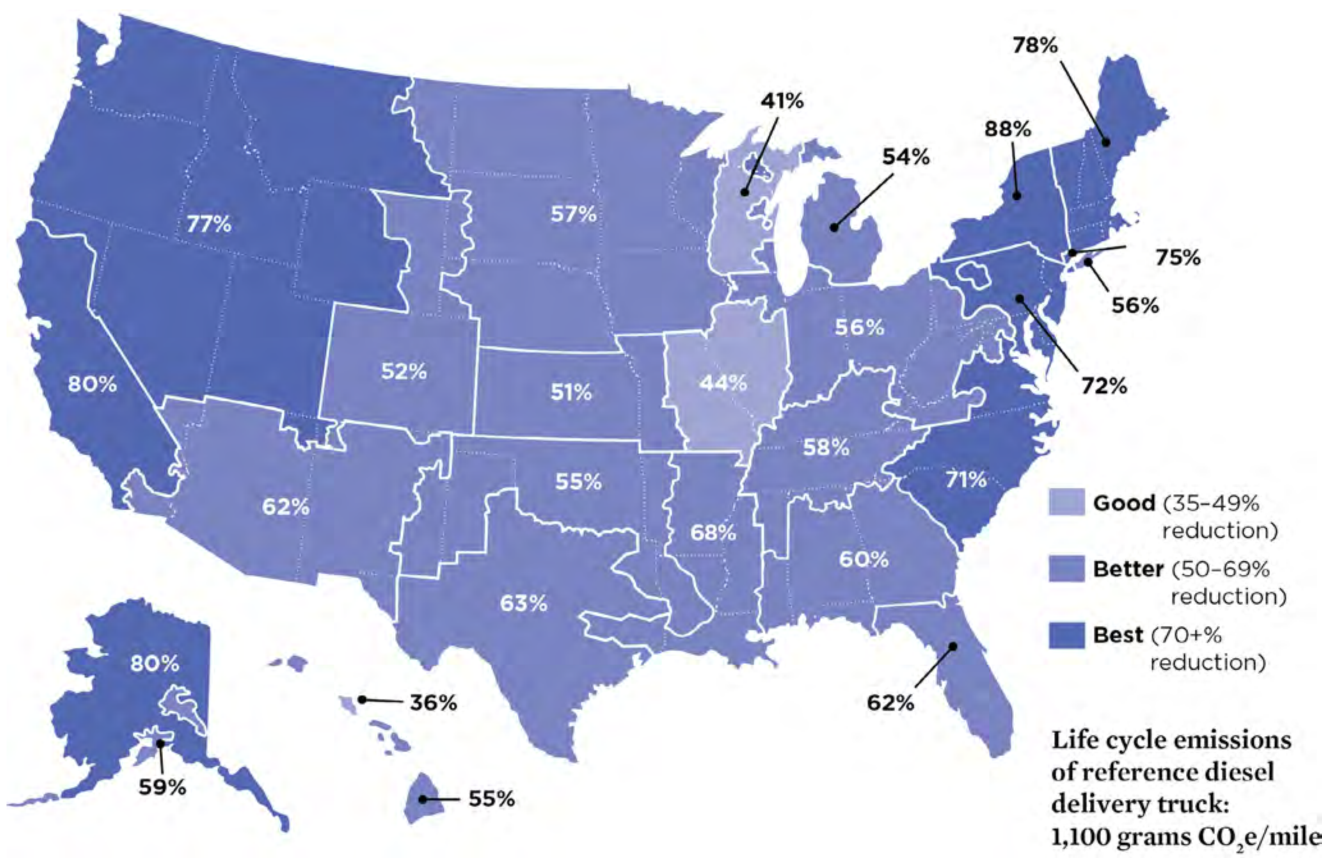
Companies will soon be required to report on their direct and indirect GHG emissions due to a group of landmark climate disclosure bills in California (PWC, 2023). Climate-related disclosures may also soon be required nationwide under a proposal from the U.S. Securities and Exchange Commission (Copley, 2023).

By deploying ZETs, fleets may be better positioned to win contracts from sustainability-minded shippers and/or to earn a premium from these contracts. Even private fleets can benefit by attracting top talent and increased investment thanks to their reduced climate risk. More than 100 fleets have already made commitments to reduce emissions and/or deploy ZETs (Environmental Defense Fund, 2023).

MOVING BEYOND TAILPIPE EMISSIONS TO TACKLE FULL VALUE CHAIN

While it is true that ZETs already offer lower lifecycle emissions than combustion trucks (Figure 14)—savings that will only grow as the electric grid integrates more renewable energy—it is crucial to continue to reduce emissions not just from the truck's tailpipe but from specific processes throughout the vehicle's value chain, such as mining, battery recycling, and manufacturing (O'Dea, 2019). Doing so acknowledges the interconnectedness of the entire lifecycle of a vehicle. A holistic approach can ensure a comprehensive reduction in transportation-related emissions and reinforce the commitment to combat climate change and build a more sustainable future.

Figure 14. Lifecycle GHG Emissions Reductions of ZETs Compared to Diesel Trucks Across the United States (O'Dea, 2019)



Mining battery minerals is vital for manufacturing ZETs, and the United States aims to bolster domestic mining production to meet rising ZET demand. Presently, the United States imports most battery minerals from global mining hubs like China, Chile, and Argentina. Estimates suggest sufficient capacity until 2030, but expansion will be necessary thereafter, partly due to IRA incentives favoring U.S. or allied country sourcing. A recent encouraging analysis from Lawrence Berkeley National Laboratory found that California's Salton Sea has even more lithium than previously thought: up to 18 million metric tons, enough for roughly the equivalent of 382 million electric vehicle batteries (Dobson et al., 2023).

Nonetheless, mining raises environmental and social concerns such as energy consumption, emissions, habitat loss, water contamination, and human rights. Outdated U.S. mining laws are under review, and the interagency Working Group on Mining Reform recently published recommendations to improve mining on public lands. The working group suggests significant reforms to the outdated General Mining Law of 1872 with 65 recommendations across six broad issue categories: improving mineral exploration and development planning and permitting, increasing engagement with stakeholders and potentially affected communities, expanding consultation and engagement with Tribes, obtaining fair compensation for taxpayers, protecting taxpayers from the cost of abandoned mine reclamation, and revitalizing domestic mining and other issues (Interagency Working Group on Mining Laws, Regulations, and Permitting, 2023). The Initiative for Responsible Mining Assurance (IRMA) offers third-party assessments for more responsible mining (IRMA, 2023). Encouraging IRMA certification for mining companies and advocating for its adoption in battery supply chains will enhance self-reliant and efficient battery production for ZETs.

Addressing the full environmental impact of ZETs involves more than upgrading the domestic supply chain; it requires consideration of the emissions associated with mining and manufacturing. While ZETs reduce tailpipe and lifecycle emissions, mining and battery manufacturing still produce substantial GHG emissions. To mitigate this, a focus on battery recycling and reuse is essential to promote a circular economy and lower ZETs' overall carbon footprint. Estimates suggest that if 50 percent of collected end-of-life batteries are recycled, and the other 50 percent are repurposed, mineral demand could be reduced by 28 percent by 2050, subsequently lowering mining emissions (The International Council of Clean Transportation, 2023). Furthermore, in some cases, recycled batteries have been shown to perform better than new ones (Wilkerson, 2022). Funding totaling $74 million to advance domestic battery recycling and reuse has already been awarded (DOE, 2022). While the current battery second-life and recycling market is small, it is due for a significant increase by 2030 as the number of battery-electric vehicles on the road increases. Advocating for supportive policy that encourages battery labeling and traceability requirements, recycling recovering rates and standards, and supporting the development of these markets will be crucial for a successful battery ecosystem. Creating a circular battery ecosystem now will enable the United States to reap the full benefits of a battery's lifecycle in the future.

After eliminating a vehicle's exhaust pipe with a ZE powertrain, producing the steel and aluminum used in vehicles is the second largest source of lifecycle emissions. Steel and aluminum make up roughly half of a vehicle's production emissions, with some estimates attributing as much as 80–85 percent[20] (Lie et al., 2021). Green steel—produced via more sustainable methods than traditional steel—offers a solution

20 Confidential interview with CALSTART member-company.

for reducing emissions from manufacturing. While the United States has seen less activity around green steel than in Europe, there are a few policies in place that impact U.S. steel and aluminum decarbonization. The Bipartisan Infrastructure Law and IRA granted DOE's Office of Clean Energy Demonstrations $6.3 billion for industrial decarbonization projects (Office of Clean Energy Demonstrations, 2023). This funding will target steel and other sectors. California's Buy Clean California Act run by the Department of General Services sets global warming potential limits on the procurement of steel and other materials used for state construction projects (Department of General Services, 2021). The federal government is also enacting a similar Buy Clean Initiative, again focusing on government construction (Office of the Federal Chief Sustainability Officer, 2023). These investments and regulations can better accelerate and create more opportunities to transition to near-ZE steel and aluminum procurement.

While regulations primarily target exhaust emissions in vehicle-related transportation, it is crucial to recognize that emissions also originate from components beyond the exhaust system. Tires and brakes, for instance, emit particulate matter at higher rates than newer model year truck tailpipes, posing potential health and environmental hazards. These non-exhaust emissions have historically been less regulated due to measurement and control challenges. Notably, BETs generate increased tire wear due to their weight and torque characteristics. Particulate matter, especially PM2.5, from these sources can directly enter the bloodstream and is associated with health issues (Carrington, 2022). Regenerative braking has promise to reduce brake wear and overall emissions from tires and brakes, but it is still unknown to what extent those reductions would be. As emissions standards become stricter, understanding and mitigating non-exhaust emissions will be imperative. California is leading efforts by requiring research into safer alternatives to tire chemicals like 6PPD (Department of Toxic Substances Control, 2023). Additionally, embracing alternatives in freight transportation, like electric cargo bikes for last-mile delivery, can further reduce tire and brake emissions. Although non-exhaust emissions are complex to regulate, investing in research can guide future technological advancements for emissions reduction.

HYDROGEN FUEL CELL DEVELOPMENTS

Compared to BETs, FCEV technology has the ability to offer longer ranges, faster fueling, and increased payload that are needed for demanding duty cycles seen in the HD long-haul segment. As such, FCEVs have seen increased interest from the trucking industry. As of June 2023, there have been approximately 15 FCEVs deployed in the United States, a number that is expected to grow rapidly with more OEMs committed to manufacturing and selling these vehicles. For example, Hyundai has brought the XCIENT FCEV to the United States, and other OEMs including Nikola, Kenworth, and Hyzon expect to increase FCEV production in the coming years.

However, with a new technology comes barriers to adoption, such as high upfront costs, an undeveloped refueling network, and complicated logistics, all of which have impeded the technology's adoption. Stakeholders are also hesitant to invest in fuel cell technology as a decarbonization tool due to the fact that the vast majority of hydrogen fuel produced today is made using a GHG-intensive process. The significant upstream emissions from production of this "grey" hydrogen are a challenge for sustainability-minded fleets. "Blue" or "green" hydrogen can be produced using more environmentally friendly methods like carbon capture and storage or electrolysis using renewable electricity, respectively. However, blue and green hydrogen are significantly more expensive than grey hydrogen.

That said, FCEV adoption is slowly progressing, as seen in record dollar amounts being committed to all phases of the hydrogen process. For example, incentive programs in California, New York, Nevada, and Massachusetts have all started to incentivize FCEVs by reducing the upfront costs by way of a voucher or rebate. In addition, the Biden-Harris Administration recently selected seven projects for regional hydrogen hubs that will receive $7 billion in funding to accelerate the domestic market for clean and low-cost hydrogen (The White House, 2023). DOE has also launched the Clean Hydrogen Electrolysis Program that has $1 billion to improve the efficiency and cost-effectiveness of clean hydrogen (Office of Energy Efficiency and Renewable Energy, 2022). This program allows for research, development, demonstration, commercialization, and deployment projects.

The Million Mile Fuel Cell Truck (M2FCT) consortium, which is DOE-funded, aims to improve the durability and efficiency challenges with FCEVs and has an initial focus on long-haul trucking (M2FCT, n.d.). Continuing and expanding on efforts like this will be important to continue the technological development of FCEVs to handle the demands of harder-to-decarbonize duty cycles like long-haul trucking. Continued investment, research, and partnerships to advance FCEVs are needed to meet climate goals.

DEPLOYMENTS MOVING FROM PILOTS TO SCALE

Most fleets have historically purchased only one or two ZETs at a time to pilot in their operations. However, as they gain familiarity and trust in the technology, some fleets are now beginning to deploy ZETs at scale.

For example, as part of its Climate Pledge, Amazon has deployed more than 10,000 electric delivery vans across the country in approximately 18 months (Amazon, 2023). These vans are now on the road in more than 1,800 cities across the country and have delivered more than 260 million packages to customers. To support these vans, Amazon has installed over 12,000 chargers at more than 100 delivery stations across the United States. These deployments are part of Amazon’s partnership with Rivian to put 100,000 electric delivery vehicles on the road by 2030.

A lineup of Amazon's electric delivery vans. Photo Credit: Amazon

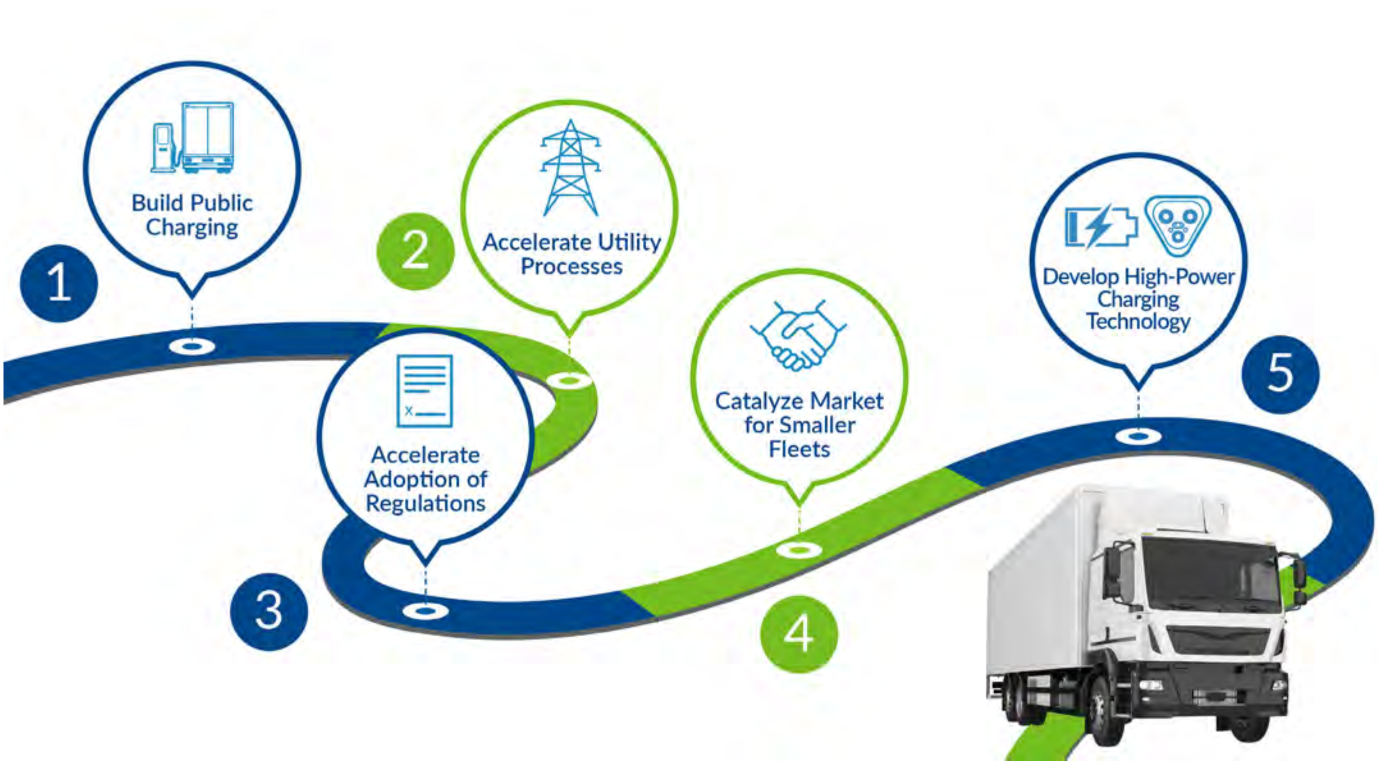
Meanwhile, the CARB-funded Joint Electric Truck Scaling Initiative (JETSI) is working with fleets to successfully deploy ZETs and infrastructure at scale. Fleet partners National Freight Industries (NFI) and Schneider will each operate 50 Class 8 ZETs in regional-haul and/or drayage operations in Southern California (CARB, n.d.). In fact, Schneider's HD electric truck fleet has already achieved the impressive milestone of hauling more than 1 million ZE miles of customer freight (Schneider, 2023). Also in California, Performance Team has ordered 110 VNR Electrics from Volvo Trucks to operate in its Southern California port drayage and warehouse operations, adding to the 16 VNR Electrics it deployed in 2021(Achelpohl, 2022). 4 Gen Logistics has ordered 20 Kenworth T680E electric Class 8 trucks as part of its commitment to becoming a ZE fleet by 2025—10 years before California requires drayage trucks operating in the state to achieve that standard.

In addition, the North American Council for Freight Efficiency's (NACFE's) 2023 Run on Less Electric DEPOT event profiled 10 fleet depots in the United States and Canada with at least 15 ZETs operating at each one (NACFE, n.d.). The 10 depots operated 291 electric trucks, 22 of which shared data throughout the three-week Run. Through the Run, NACFE was "able to show that adopters of battery electric vehicles have demonstrated that they work at scale in various segments of the trucking industry including vans and step vans, medium-duty box trucks, terminal tractors and heavy-duty regional haul," said NACFE's executive director, Mike Roeth (NACFE, 2023). Findings also highlighted the importance of the people involved—their diversity, passion, and capability—to scale the adoption of electric trucks. Data-sharing, such as the work done in Run on Less, is sorely needed in the industry so that others can learn from the successful and growing, but still mostly undocumented, real-world experiences.

NEXT STEPS TO ACCELERATE THE TRANSITION

Though ZET deployments continue to grow, more action is needed to spur the market growth justified by environmental justice considerations and climate science and to be ready to comply with existing and anticipated regulations. The following measures represent the top five opportunities for accelerating ZET deployments in the coming months and years (Figure 15).

Figure 15. Roadmap to Accelerate U.S. ZET Market



1. BUILD PUBLIC CHARGING

As noted in the *Unprecedented Investments in Charging Infrastructure* section above, billions of dollars have already been invested in building out charging infrastructure for ZETs. While there are few public chargers open to ZETs today, many are expected to come online in the coming years. And though significant additional investment is needed, it is important to note that not all of this infrastructure is needed at once—it can be phased in. CALSTART's *Phasing in U.S. Infrastructure* working paper outlines a modeled scenario of how to accelerate infrastructure buildout for MHD vehicles, starting in priority launch areas that have favorable policy, investment, industry concentration, and grid modernization, then building out toward key hubs and corridors that will create a national network through 2035 (Joseph et al., 2023). The infrastructure buildout meets the pace set forth by the Global MOU. This approach allows for cost-effective implementation while signaling to utilities, governments, and investors where they need to target their actions. The outlined roadmap (Figure 16) shows that change is possible through focused, intentional action and investment, and if followed, allows the United States to stay on track to meet climate and ZET sales goals.

Figure 16. Phase-in of Infrastructure to Meet Rapid ZET Adoption (Joseph et al., 2023)

The Biden-Harris Administration has also announced $7.4 million in funding for ZE MHD vehicle corridor projects to help accelerate the creation of an MHD charging network (DOE, 2023c). The federal government also offers funding for public truck charging via the Charging and Fueling Infrastructure discretionary grant program, which has an approved budget of $2.5 billion over five years (FHWA, 2023).

Public charging buildout will be critical to not only ensure overall ZET deployments increase but also small fleets are not left behind in the transition.

2. ACCELERATE UTILITY PROCESSES

As noted earlier in this report, antiquated utility processes designed for real estate development can result in necessary site upgrades taking years to complete before charging infrastructure can be deployed. Given the incredibly fast timeline for transitioning the nation's truck fleet to ZETs, utilities, regulators, policymakers, and industry must work together to update and hasten timelines for grid assessments, upgrades, and electric vehicle supply equipment energization.

As utilities and the electrical supply chain work to adapt to the rapid growth of the ZE MHD sector, fleets have been seeking interim and innovative solutions like the "3 M's" mentioned above: mobile charging, managed charging, and microgrids. There are an increasing number of mobile-charging hardware solutions on the market capable of charging ZETs without needing grid upgrades (CARB, 2023a). Often skid-based or containerized, these solutions are now offered by several OEMs, with some models available for purchase outright while others are available to customers via a lease program. In addition, managed charging software can help fleets limit electricity demand at any time, making grid upgrades less needed and saving money on electric bills by minimizing demand charges and time-of-use rates. Microgrids, including distributed energy resources like onsite solar panels and battery storage, can also minimize utility bills and needed upgrades, potentially even enabling fleets to charge vehicles completely independent of the local electric utility. Companies like Scale Microgrids can help fleets plan and execute optimized solutions (Scale Microgrid Solutions, 2022).

Changing utility regulations to enable them to proactively build no-regret infrastructure to support ZET charging (rather than simply being reactive to individual fleet customer requests) is also being considered as a way to minimize timelines for deploying charging infrastructure. Standardizing and streamlining permitting processes would also hasten this process.

3. ACCELERATE ADOPTION OF REGULATIONS

As noted above in the *Expansion of Regulations to Additional Geographies* section, regulations like ACT have been incredibly important drivers of ZET deployments to date. However, the majority of states have yet to adopt this regulation. Doing so would send a strong market signal to OEMs, fleets, utilities, and charging providers while promoting consistency and regulatory certainty. States may follow California's leadership by adopting ACF as well.

On the federal stage, the industry is awaiting EPA's final "Phase 3" standards to reduce GHG emissions from HD vehicles. These regulations will begin in model year 2027, and the proposed standards maintain the flexible structure created in EPA's Phase 2 GHG program, which is designed to reflect the diverse nature of the HD industry. EPA should finalize a strong Phase 3 standard as soon as possible to support the work of states, send clear nationwide market signals, and help unlock the investments necessary to support clean transportation. Investments in research, development, and production of ZETs will in turn drive innovation and economies of scale, ultimately resulting in more affordable and accessible ZET options for consumers.

Additional policies that should be pursued to accelerate ZET deployments include: enacting low carbon fuel standards that provide funding to fleets using electricity rather than diesel as a fuel, enabling utility make-ready programs to cover the cost of necessary grid-side upgrades to support charging and refueling infrastructure, and exempting HD ZETs from the federal excise tax that exacerbates the price premium challenge of ZETs and prolongs the timeframe for these vehicles to achieve cost parity with combustion trucks.

4. CATALYZE MARKET FOR SMALLER FLEETS

Though there have been significant effort and investments made to help small fleets access ZET technology, more are still needed. In addition to the technical assistance, financial incentives, and as-a-service business models mentioned above, small fleets will not be able to adopt ZETs at scale without a used ZET market, access to reasonable financing and insurance, and clear signals from customers.

The secondary market in the trucking industry plays a vital role in allowing fleets the opportunity to purchase cleaner yet affordable trucks. Smaller fleets often look to the used truck market to buy their vehicles, as this route is better financially for them and it allows larger fleets the opportunity to recoup value from their trucks. The used truck market is expected to grow at 9 percent CAGR (compound annual growth rate) from 2023 to 2032, and its current market size surpassed $40 billion in 2022 (Wadhwani, 2023). However, the used truck market is currently non-existent for ZETs. This is due in large part to the fact that most ZETs have not been on the road long enough to be resold. Seeding a secondary market by encouraging ZET deployment pioneers to turn over their first-generation ZETs will make ZETs more widely available and more affordable, but it will also provide valuable data to financers that currently have no information about the resale value of ZETs.

A current hindrance to ZET adoption has been the ability for fleets to secure loans from financial institutions. As of today, most leases of ZETs treat the residual value of the vehicle as zero, which in turn prompts higher monthly lease values that some fleets cannot afford. Having a robust used ZET market allows financial institutions to gather relevant data on ZETs and allows them to offer more affordable loans to fleets in need. A secondary market for ZETs and their components can also help bring down insurance premiums, which can be astronomically high today and are impeding ZET adoption.

Small fleets also need clear market signals and innovative collaboration with customers. For example, shippers can offer green premiums and/or preferential contracting with carriers that utilize ZETs. They may also require carriers to reduce and report on their carbon emissions by transitioning to ZETs, thereby helping shippers to reduce and report on their Scope 3 emissions.

5. DEVELOP HIGH-POWERED CHARGING TECHNOLOGY

For most ZETs on the market today, charging speeds currently max out around 350 kilowatts (kW), resulting in longer-than-optimal recharge times and/or reduced payload capacity and increased costs caused by the need for more batteries to meet the range requirements of a truck's duty cycle without having to stop to charge. Because of this tradeoff, there is a need for faster charging technology.

For example, the Tesla Semi can charge at much higher power levels, enabling it to recoup up to 70 percent of its 300- to 500-mile range in 30 minutes (Tesla, n.d.). Tesla has installed direct current (DC) fast chargers up to 750 kW at PepsiCo's Sacramento location (NACFE, n.d.a). With this fast-charging capability—on both the vehicle and charger side—PepsiCo was able to demonstrate more than 1,000 miles per day for a Class 8 electric truck operating in real-world regional-haul routes. This is about four times the average 250 miles per day from the competing Freightliner and Volvo Class 8 electric trucks (Wang, 2023).

The Megawatt Charging System (MCS) represents a significant leap forward in the realm of electric vehicle charging technology, particularly for ZETs. This groundbreaking standard emphasizes high-capacity charging solutions capable of delivering multiple megawatts of power to electric trucks rapidly, allowing for charging times less than 15 minutes to get from zero to 100 percent state of charge. By enabling faster charging at unprecedented power levels, MCS not only reduces downtime for commercial fleet operators but also enhances the practicality and competitiveness of electric trucks in HD applications. Led by CharIN, a task force was created in 2018 to create a common solution for charging electric HD vehicles within a reasonable timeframe. Since the task force formation, an MCS white paper has been released, requirements for an MCS system have been established, and a connector compatibility test was successfully completed, with more milestones ahead. This technology not only accelerates the transition to cleaner transportation but also underscores the growing synergy between innovative charging infrastructure and the broader goals of sustainable and efficient freight and logistics operations.

CHAPTER IV

CONCLUSION

ZETs are being deployed across the United States at an increasingly rapid pace due to increasing model availability, incentives, regulations, and available refueling infrastructure, among other developments. Yet, more action is needed to align the trucking industry's transition with the pace required by science and committed to by key U.S. policymakers.

In 2024, improvements are needed across the charging sector, with an emphasis on increasing the amount of public and shared charging available for ZETs, speeding up the energization and permitting processes, and making additional advancements into high-powered charging capabilities. Utilities, public utility commissions, charging developers, local governments, and states must all work together to achieve these needed improvements. States must also continue to adopt ZET sales mandates and implement incentive programs for vehicles and charging. Together, these policies will send a strong market signal, resulting in increased production volumes and lower prices from OEMs.

Further research and development are needed to advance battery and fuel cell technology and to create a more sustainable battery supply chain. Advances in clean hydrogen production and distribution will be required to meet growing demand for increasing options of fuel cell trucks. Market barriers must also be minimized—not just for large, well-resourced fleets but for small businesses and independent owner-operators as well. Shippers have an important role to play in de-risking ZET investments by their carriers.

The transition will no doubt be challenging, but by rapidly deploying increasing numbers of ZETs, the U.S. trucking industry will be able to continue its vital work while eliminating climate change- and disease-causing emissions, repairing relationships with the communities in which it operates, and doing its part to help the country achieve its climate, energy, and air quality targets.

This transition will require unprecedented collaboration from stakeholders across the industry, including fleets, OEMs, utilities, charging providers, shippers, regulators, policymakers, academia, nonprofits, and frontline communities. Everyone has a role to play to ensure the pace and success of this transition. This report will continue to be updated with ZET deployment statistics to provide a measure of progress, identify opportunities for further action and increased impact, and inspire collective action and investment.

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APPENDIX A

STATE INCENTIVE PROGRAMS

Table A-1. State Incentive Programs

State	Incentive Program	Incentive Type	Funding	Year Started
California	California's Clean Truck and Bus Voucher Incentive Project (HVIP)	Voucher	Vehicle	2010
California	Clean Off-Road Equipment (CORE) Voucher Incentive Project	Voucher	Vehicle	2021
California	Energy Infrastructure Incentives for Zero-Emission (EnergIIZE) Commercial Vehicles	Voucher	Infrastructure	2022
California	Implementation of MHD Vehicle Infrastructure	Grant	Infrastructure	2023
Colorado	Clean Fleet Vehicle Technology Grant Program	Grant	Vehicle	2023
Colorado	Fleet Zero	Grant	Infrastructure	2023
Delaware	EV Charging Equipment Rebates	Rebate	Infrastructure	2023
Federal	Commercial Clean Vehicle	Tax Credit	Vehicle	2023
Hawaii	Diesel Replacement Rebate	Rebate	Vehicle	2023
Maryland	MHD ZEV grant program	Grant	Both	2024
Massachusetts	Massachusetts Offers Rebates for Electric Vehicles (MOR-EV) Trucks Program	Rebate	Vehicle	2022
Massachusetts	MassEVIP	Grant	Infrastructure	2014
Nevada	Nevada Clean Trucks and Buses Program	Grant	Vehicle	2024

State	Incentive Program	Incentive Type	Funding	Year Started
New Jersey	New Jersey Zero Emission Incentive Program (NJ ZIP)	Voucher	Vehicle	2020
New Jersey	Clean Fleet Electric Vehicle Incentive Program	Grant	Both	2023
New York	New York Truck Voucher Incentive Program (NYTVIP)	Voucher	Vehicle	2011
New York	New York City Clean Trucks Program (NYCCTP)	Voucher	Vehicle	2012
Oregon	Rebate Program for Medium and Heavy Duty Zero-Emission Vehicles	Rebate	Vehicle	2024
Pennsylvania	Medium- and Heavy-Duty Zero Emission Vehicle Fleet Pilot Grant	Grant	Both	2023
Pennsylvania	Alternative Fuels Incentive Grants	Grant	Vehicle	2022
Washington	Clean Alternative Fuel Commercial Vehicles and Vehicle Infrastructure	Tax Credit	Both	2020
Washington	EV Charging Infrastructure Program	Grant	Infrastructure	2023
Washington	Infrastructure and Incentive Program for Medium and Heavy Duty Zero Emission Vehicles	TBD	Both	2024

APPENDIX B

UTILITY MAKE-READY PROGRAMS

Table B-1. Utility Make-Ready Programs

Utility	State	Program Name
Alabama Power	Alabama	Make Ready Program
Southern California Edison (SCE)	California	Charge Ready Transport
Pacific Gas & Electric (PG&E)	California	EV Fleet Program
San Diego Gas & Electric (SDG&E)	California	Power Your Drive for Fleets
Public Service of Colorado (Xcel Energy)	Colorado	Public Charging EV Solutions
United Illuminating	Connecticut	CT EV Charging Program
Eversource Energy	Connecticut	EV Charging Program
Georgia Power Company	Georgia	Make Ready Infrastructure Program
Hawaiian Electric	Hawaii	Charge Up Commercial
Entergy New Orleans	Louisiana	EVCS
DTE Energy	Michigan	eFleet
Consumers Energy	Michigan	PowerMIFleet
Entergy Mississippi	Mississippi	EVCI
Public Service Company of New Mexico	New Mexico	Transportation Electrification Program
Rochester Gas and Electric Cooperative	New York	MHD Make-Ready
New York State Electric and Gas	New York	MHD Make-Ready
Central Hudson	New York	MHD Make-Ready
National Grid	New York	MHD Make-Ready

Utility	State	Program Name
Orange and Rockland Utilities	New York	MHD Make-Ready
Portland General Electric	Oregon	Fleet Partner
Duquesne Light	Pennsylvania	EV Fleet Electrification
State of New Jersey Board of Public Utilities	New Jersey	Clean Fleet Electric Vehicle Incentive Program

APPENDIX C

STATE POLICY ADOPTION

Any states not listed in Table C-1 had not adopted any of the policies tracked in this report as of June 2023.

Table C-1. State Policy Adoption (As of June 2023)

State	MOU	ACT	ACF
California	Yes	Yes	Yes
Colorado	Yes	Yes	No
Connecticut	Yes	No	No
District of Columbia	Yes	No	No
Hawaii	Yes	No	No
Massachusetts	Yes	Yes	No
Maryland	Yes	No	No
Maine	Yes	No	No
North Carolina	Yes	No	No
New Jersey	Yes	Yes	No
Nevada	Yes	No	No
New York	Yes	Yes	No
Oregon	Yes	Yes	No
Pennsylvania	Yes	No	No
Rhode Island	Yes	No	No
Virginia	Yes	No	No
Vermont	Yes	Yes	No
Washington	Yes	Yes	No

APPENDIX D

DATA SOURCES

Sources in Table D-1 are in order from most to least prevalent within the data used to determine ZET deployments.

Table D-1. Data Sources

Data Source	Description	Specific Data Used
Private Correspondence	Author correspondence with OEMs	ZET deployments as of June 2023
IHS Markit	Global provider of information and analysis on world markets and industries	U.S. truck registrations as of June 2023
MarkLines	Information service that provides essential information about automotive production from countries around the world	ZET deployments as of June 2023
California CORE	California's Clean Off-Road Equipment Voucher Incentive Program	ZE yard tractor deployments as of June 2023
Public Press Releases	Press releases from OEMs announcing delivered sales	ZET deployments as of June 2023
California HVIP	California's Clean Truck and Bus Voucher Incentive Project	ZET deployments as of June 2023
NYTVIP	Truck voucher incentive program administered by the State of New York	ZET deployments as of December 2021

State of California
AIR RESOURCES BOARD

PUBLIC HEARING TO CONSIDER THE PROPOSED ADVANCED CLEAN TRUCKS REGULATION

STAFF REPORT: INITIAL STATEMENT OF REASONS

DATE OF RELEASE: October 22, 2019
SCHEDULED FOR CONSIDERATION: December 12, 2019

Location:

California Environmental Protection Agency
Air Resources Board
Byron Sher Auditorium
1001 I Street
Sacramento, California 95814

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LIST OF ACRONYMS AND ABBREVIATIONS

AB	Assembly Bill
ACC	Advanced Clean Car
ACT	Advanced Clean Truck
ASB	Airport Shuttle Bus
BAU	Business as Usual
BEV	Battery-Electric Vehicle
CAAQS	California Ambient Air Quality Standards
CARB	California Air Resources Board
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CPI	Consumer Price Index
DOF	Department of Finance
DMV	Department of Motor Vehicles
EER	Energy Efficiency Ratio
EIA	Energy Information Administration
EMA	Engine Manufacturers Association members
EMFAC	Emission Factor Inventory Model
EPA	Environmental Protection Agency
ER	Emergency Room
EVSE	Electrical Vehicle Supply Equipment
FCEB	Fuel Cell Electric Bus
FCEV	Fuel Cell Electric Vehicle
FY	Fiscal Year
GHG	Greenhouse Gas
GO-Biz	Governor’s Office of Business and Economic Development
GSP	Gross State Product
GVWR	Gross Vehicle Weight Rating
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive
ICCT	International Council on Clean Transportation
ICE	Internal Combustion Engine
ICT	Innovative Clean Transit
IPCC	Intergovernmental Panel on Climate Change
ISOR	Initial Statement of Reasons
IWG	Interagency Working Group
kWh	Kilowatt-Hour
LCFS	Low Carbon Fuel Standard
LHD	Light Heavy-Duty
MMT	Million Metric Tons
MY	Model Year
NHTSA	National Highway Traffic Safety Administration
NOx	Oxides of Nitrogen

NZEV	Near-Zero-Emission Vehicle
PHEV	Plug-In Hybrid Electric Vehicle
PM	Particulate Matter
SAE	Society of Automotive Engineering
SB	Senate Bill
SC-CO_2	Social Cost of Carbon
SRIA	Standardized Regulatory Impact Assessment
SIP	State Strategy for the State Implementation Plan
TCO	Total Cost of Ownership
tpd	Tons per Day
TTW	Tank-to-Wheel
WTW	Well-to-Wheel
ZANZEFF	Zero- and Near-Zero-Emission Freight Facilities
ZE	Zero-Emission
ZEB	Zero-Emission Bus
ZEP Cert	Zero-Emission Powertrain Certification
ZEP	Zero-Emission Powertrain
ZEV	Zero-Emission Vehicle

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EXECUTIVE SUMMARY

Purpose of Proposed Rulemaking

Mobile sources and the fossil fuels that power them are the largest contributors to the formation of ozone, greenhouse gas (GHG) emissions, fine particulate matter ($PM_{2.5}$), and toxic diesel particulate matter. In California, the transportation sector alone accounts for 41 percent of total GHG emissions (50 percent when upstream emissions from fuel is included) and is a major contributor to oxides of nitrogen (NOx) and particulate matter (PM) emissions. The Proposed Advanced Clean Trucks (ACT) Regulation will contribute to achieving the state's criteria pollutant and GHG reduction goals and cleaner technology targets also needed to protect communities.

The purpose of the Proposed ACT Regulation is to accelerate the widespread adoption of zero-emission vehicles (ZEVs) in the medium-and heavy-duty truck sector and reduce the amount of harmful emissions generated from on-road mobile sources. The primary objectives of the Proposed ACT Regulation include the following:

- Accelerate first wave of zero-emission (ZE) truck deployments in best suited applications;
- Achieve 100 percent zero-emission pickup-and-delivery in local applications by 2040;
- Support the Ports of Los Angeles and Long Beach Clean Air Action Plan for 100 percent zero-emission drayage trucks by 2035;
- Support AB 739 requiring California state government fleets to purchase ZEVs;
- Enable a large-scale transition to zero-emission technology;
- Maximize the total number of ZEVs deployed;
- Complement existing and future programs;
- Provide environmental benefits, especially in disadvantaged communities thereby supporting the implementation of AB 617;
- Ensure requirements are technologically feasible and cost effective; and
- Foster a self-sustaining zero-emission truck market.

The deployment of ZEVs meets goals identified in the State Implementation Plan (SIP), the 2017 Climate Change Scoping Plan, Sustainable Freight Action Plan, and the 2016 ZEV Action Plan that supports the Governor's Executive Orders B-16-12 and B-48-18. In 2018, Governor Brown issued Executive Order B-55-18, which sets a target to achieve carbon neutrality in California no later than 2045, and to achieve and maintain net negative emissions thereafter. The Proposed ACT Regulation directly supports achieving these goals through the required sale of ZEVs in California from all large medium- and heavy-duty manufacturers.

Background and Program Overview

Zero-emission truck and buses can meet the needs of most local and regional operations with technology that is available today. Studies have shown that most straight trucks (designed with all axles on a single chassis), particularly those used in local delivery applications, do not travel more than 100 miles per day. A wide assortment of zero-emission trucks and buses are commercially available today that exceed 100 miles of available range. In addition, several battery-electric and fuel cell models are being demonstrated that exceed 200 miles per day.

The Proposed ACT Regulation was first identified as the "Last Mile Delivery" measure in the 2016 Mobile Source Strategy, which is part of the SIP and the 2017 Climate Change Scoping Plan. This measure is a necessary component for California to achieve established near- and long-term air quality and climate mitigation targets. Last mile delivery fleets are well suited for introducing zero-emission technology because they operate in urban centers, have stop and go driving cycles, and are centrally maintained and fueled. Therefore, development of the Proposed ACT Regulation began with an initial focus on these pickup-and-delivery applications; however, as development progressed staff found that other vocational uses have similar operating characteristics that are well suited for electrification. Additionally, zero-emission technology continues to improve rapidly, and costs continue to come down so that zero-emission trucks and buses are now being offered in a wide variety of vehicle classes with varying electric range and utility. Today, nearly one hundred different ZEV models are commercially available in California, with more to come in the near future.

Zero-emission technology deployments are needed in the medium- and heavy-duty market to meet the state's emission reduction goals, but to date, the major truck manufacturers have been relatively absent in this space. For the past decade, smaller startup truck manufacturers have stepped in to fill market demand and have been designing and marketing zero-emission trucks. These startup companies have significantly advanced the technology. However, they do not have broad dealer networks or regional service facilities that can be leveraged quickly to provide support and maintenance services for zero-emission technology. At workshops, a number of fleets that own zero-emission trucks expressed concern about their experience in securing service and repairs to support their ZEVs in operation from smaller startups companies. In a few cases, large ZEV orders were placed that were not fulfilled. In addition, some of these fleets also had early experiences with ZEV products that were launched by large manufacturers that were also discontinued due to issues with their ZEV component suppliers. These experiences have hampered ZEV market expansion for early adopter fleets.

The Proposed ACT Regulation is focused on requiring large truck manufacturers to sell zero-emission trucks in California to broaden the market and to send a clear signal that medium- and heavy- duty ZEVs will be a major part of California's overall strategy to reduce criteria emissions, reduce climate impacts and reduce petroleum use. The Proposed ACT Regulation would also require one-time reporting from large entities to report information about their contracting practices in meeting their transportation needs and how truck and bus owners currently use their vehicles. Information collected from these companies would help CARB structure future end-user regulatory strategies including whether large entities that hire truck fleets could become the point of regulation, help ensure a level playing field, and help CARB determine any appropriate exemptions or flexibilities. This information would be used in developing future regulations designed to further accelerate the purchase and use of ZEVs in fleets. Using both a manufacturer ZEV sales requirement and a requirement for ZEVs to be used, in combination with early market support from funding programs will significantly accelerate the market for ZEV technology.

Summary of Proposal

The Proposed ACT Regulation includes two primary elements. First, it requires manufacturers to make a percentage of truck and bus sales zero-emissions. Second, it requires one-time reporting of information from large entities including retailers, manufacturers, and government agencies, about contracted services requiring the use of trucks and shuttles in addition to their medium- and heavy-duty vehicle fleet. Staff is also proposing to collect information about cars from these same fleets to inform similar strategies to accelerate light-duty ZEV adoption.

ZEV Sales Requirement

Applicability

- ZEV sales requirement applies to manufacturers that certify incomplete chassis or complete vehicles greater than 8,500 lbs. gross vehicle weight rating (GVWR)
- Manufacturers with less than 500 annual California sales are exempt, but may opt-in to earn credits for selling ZEVs

Sales Percentage

- Class 2b-3 group (consisting mainly of full size pickup trucks and vans) and Class 7-8 tractor group (consisting of on-road semi-trucks that haul trailers) ZEV sales begin at 3 percent of California sales in 2024 and increase to 15 percent by 2030 (Class 2b-3 pickups would be excluded until 2027)
- ZEV sales for all other vehicles in the Class 4-8 group begin at 7 percent of California sales in 2024 and increase to 50 percent in 2030
- The ZEV sales percentage requirements remain constant past 2030

Credits

- Manufacturers can earn credits starting with the 2021 model year (MY)
- Starting with the 2024 MY, ZEP Certification would be required, where applicable, for ZEVs to earn credits

- Compliance would be based on a credit and deficit system to provide flexibility for manufacturers to sell more ZEVs in one weight category and fewer in another and credits may be banked and traded
- Near-zero-emission vehicles (Plug-in hybrids with some all-electric range) would earn partial credits, and could be used to offset up to half of each manufacturer's annual deficits through the 2030 MY

Manufacturer Reporting

- Manufacturers would need to report annually to demonstrate compliance, to earn credits, and to report details about credit trade transactions

Large Entity Reporting Requirement

- Large entities are defined as a government agency or a private organization that met one of the following in calendar year 2019:
    - Received more than $50 million in total annual gross revenue and operated a facility in California
    - Owned 100 or more Class 2b and greater vehicles and operated a facility in California
    - Dispatched 100 or more Class 2b and greater vehicles
- Large entities would be required to report the following information in early 2021 about the following:
    - Their contracting practices with motor carriers and for services that require the use of shuttles or trucks, and
    - Those who own trucks and buses would need to report information about their fleets and how they are operated
- To streamline the process, affected entities would only be required to complete a one-time submittal of aggregated and approximate data for representative facilities, rather than detailed information about every facility.
    - Additionally, entities with vehicles would only be required to report approximate, representative information about the vehicle types owned, rather than reporting operational data for every vehicle.

Potential Impacts of Proposal

Environmental Benefits

The Proposed ACT Regulation is designed to assist in attaining air quality standards, reduce health risks to individuals living in California including protecting local communities from exposure to harmful pollutants, and meeting climate change goals. The emission reductions achieved by staff's proposal will contribute to the reduction of cumulative risk of mortality and morbidity from mobile source emissions in the State. The majority of these benefits will be in the State's most populated and impacted areas near ports and city centers. These areas include the South Coast, San Francisco Bay Area, San Joaquin Valley, San Diego County, and the Sacramento Air Basins.

The Proposed ACT Regulation is expected to result in significant NOx, $PM_{2.5}$, and GHG emission reductions due to replacing internal combustion powered vehicles with zero-emission technology. ZEVs produce no tailpipe emissions, reduce brake wear PM emissions, and have lower upstream emissions. Table ES-1 summarizes the expected criteria emission benefits in 2031 and 2040. These emission reductions contribute to the State SIP Strategy and Climate Change Scoping Plan.

Table ES-1: Expected Emission Reductions of Proposed ACT Regulation

Calendar Year	NOx (tpd)	$PM_{2.5}$ (tpd)	WTW GHG (MMT/yr)
2031	5.0	0.16	0.4
2040	16.9	0.46	1.7

Economic Impacts

Currently ZEVs are more expensive upfront but provide operational savings in terms of lower fuel and maintenance costs. The Proposed ACT Regulation is expected to result in a total cost saving of $4.9 billion to truck transportation in California compared to Business as Usual from 2020 through 2040, mostly due to fuel cost savings. This estimate includes infrastructure cost, higher cost of the vehicles, maintenance and fuel savings, and cost savings due to the Low Carbon Fuel Standard. It does not include vehicle or infrastructure incentives. Thus, incentive programs such as the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program (HVIP), utility investments, and other funding may be used to offset some potential upfront cost to consumers. Several hundred million dollars per year have become available recently, which would further increase savings to fleet owners. The estimated total statewide health benefits derived from criteria emission reductions are estimated to be an additional $5.7 billion in savings.

The Proposed ACT Regulation requires that manufacturers must build and sell more zero-emission trucks, certify their powertrain using the ZEP Certification procedure, and report information to CARB as part of their regulatory requirements. The research, manufacturing, certifying, and development of ZEVs by manufacturers will contribute to the compliance costs associated with the Proposed ACT Regulation. However, the required ZEV sales can also count towards compliance with the California and federal Phase 2 GHG regulations simultaneously. Reporting requirements for vehicle manufacturers are not expected to be significant since most of the information needed is already reported as part of Phase 2 GHG compliance. It is not straightforward to predict how these costs and cost-savings would be passed on to consumers. Vehicle pricing is complex, and different manufacturers could use different strategies to pass on these costs. It is possible that manufacturers may pass on incremental ZEV costs through the ZEVs themselves, through the rest of their ICE fleet, or some combination thereof.

The Proposed ACT Regulation also requires one-time reporting for large companies and government agencies who would need to report about their California locations, and how they and their contractors move freight and perform other services. Large fleet owners would also need to report information about what vehicles they own, and how they operate. The cost of complying with this one-time reporting requirement is not expected to be significant.

Challenges and Long-Term Benefits

Common challenges for deploying zero-emission technologies include high upfront capital costs for both vehicle purchase and fueling/charging infrastructure construction, fueling/charging infrastructure expansion and scalability, electricity rates, vehicle operation flexibility, and workforce training.

Although ZEV technology has advanced rapidly in recent years, there are still challenges both fleets and manufacturers have to address to successfully deploy ZEVs. Continued improvements in ZEV costs and performance are still needed to facilitate the full transition to zero-emission technology. However, the transition to zero-emission technology is essential for California to meet its long-term air quality and climate protection goals.

The Proposed ACT Regulation provides sufficient time for manufacturers to bring new ZEVs to the market, aided by several major funding programs to support early demonstrations and to kick start the market by reducing the incremental costs of commercial zero-emission technologies. Fleet owners can also benefit from lower operating and maintenance costs including LCFS credits to significantly reduce operating costs while supporting the low carbon fuel market. As ZEV sales increase, technology improves, and incremental costs decline a self-sustaining medium and heavy-duty ZEV market is achievable in a wide range of applications.

I. INTRODUCTION AND BACKGROUND

The California Air Resources Board (CARB or Board) is responsible for protecting the public from the harmful effects of air pollution and developing programs and actions to fight climate change. Meeting these public health goals necessitates the transition from internal combustion engines in both light and heavy-duty applications toward zero-emission vehicle (ZEV) technology.

Mobile sources and the fossil fuels that power them are the largest contributors to the formation of ozone, greenhouse gas (GHG) emissions, fine particulate matter (PM2.5), and toxic diesel particulate matter (CARB, 2016a). In California, the transportation sector alone accounts for 41 percent of total GHG emissions (50 percent when upstream emissions from fuel is included), and is a major contributor to oxides of nitrogen (NOx) and particulate matter (PM) emissions (CARB, 2019a). The Proposed Advanced Clean Trucks (ACT) Regulation will contribute towards achieving the state's criteria pollutant and GHG reduction goals and cleaner technology targets.

ZEVs available today are already capable of meeting the majority of the needs of local and regional trucking operations, and will improve over time. ZEVs have unique advantages that will eventually lead to paradigm shifts in fleet operational behaviors, such as quiet operations potentially enabling later shifts when noise would normally be a concern, and less time spent on maintenance or out-of-service time due to the mechanical simplicity of ZEV systems. Studies have shown that trucks used in local delivery applications do not travel more than 100 miles per day and most trucks travel 50 miles per day on average. The majority of zero-emission trucks available today are capable of exceeding a 100 mile daily range, but would need to refuel or charge at the end of the shift to be able to operate within that same range the following day. Therefore, truck delivery applications where the vehicle can return to base or utilize a spoke-and-hub operation are prime candidates for electrification. Over time, projected price reductions and continued zero-emission technology improvements will allow the ZEV market to expand broadly throughout the trucking sector.

The Proposed ACT Regulation was first identified as the "Last Mile Delivery" measure in the 2016 Mobile Source Strategy, which is part of the SIP and the 2017 Climate Change Scoping Plan. This measure is a necessary component for California to achieve established near- and long-term air quality and climate mitigation targets. Last mile delivery fleets are well suited for introducing zero-emission technology because they operate in urban centers, have stop and go driving cycles, and are centrally maintained and fueled. Therefore, development of this proposed rule initially focused on pickup-and-delivery applications.

The primary purpose of the Proposed ACT Regulation is to accelerate the market for zero-emission medium- and heavy-duty on-road vehicles in applications that are well suited for their use. The Proposed ACT Regulation sets clear requirements on manufacturers to sell zero-emission trucks and requires large entities including retailers, manufacturers, and government agencies to report information that would be used for developing future strategies that would require the use of zero-emission trucks.

Medium- and heavy-duty vehicle manufacturers would be required to start producing and selling a modest number of zero-emission vehicles beginning with the 2024 model year with ZEV sales increasing through the 2030 model year. The second part of the Proposed ACT Regulation would require one-time reporting for large companies and government agencies of information about how their facilities utilize local truck shipments and deliveries and how they contract for their transportation needs. Companies that operate a facility in California and have annual revenue above $50 million, government agencies, fleet owners with 100 or more trucks, and brokers that dispatch 100 or more trucks in California would also need to provide information about their vehicle operations and their contracts for motor carrier and other truck services. Information collected from these companies will help CARB structure future ZEV regulatory strategies, ensure a level playing field, and help staff determine any appropriate exemptions or flexibilities.

The Proposed ACT Regulation will result in reductions in criteria pollutants, toxic air contaminants, and GHG emissions at the statewide, regional, and local levels. It is part of California's holistic plan to address challenging Federal air quality mandates, to protect the public health of all Californians, and to meet sustainability goals.

A. Supporting Existing Policies

In developing the Proposed ACT Regulation, CARB staff reviewed and considered air quality attainment goals established by the Federal government, the laws imposed by the California State Legislature, the State Implementation Plans approved by the California Air Resources Board, and the executive orders issued by the Governors of California. The following is a chronological summary of key supporting and existing policies used to guide the development of the Proposed ACT Regulation.

In March 2012, Governor Edmund G. Brown issued Executive Order B-16-2012 directing California agencies to establish benchmarks for key milestones to help support and facilitate the ZEV market in California. One of those milestones include deploying over 1.5 million ZEVs and PHEVs on the road by 2025. As a result of this order, multiple state agencies, including CARB, worked to develop and release the 2013 ZEV Action Plan. The 2013 ZEV Action Plan identifies over 100 strategies to meet the milestones of the Executive Order and includes four broad goals to advance the overall ZEV market. These four goals are as follows:

- Complete needed ZEV infrastructure and planning;
- Expand consumer awareness and demand of ZEVs;
- Transform fleets; and
- Grow jobs and investment in the private sector.

In October 2015, California adopted the Senate Bill 350, the Clean Energy and Pollution Reduction Act (SB 350), which, among other major goals, established GHG reduction targets and ordered the CPUC to direct the six investor-owned utilities in the state to “accelerate widespread transportation electrification.” The resulting programs developed by the electric utilities promote the deployment of medium- and heavy-duty ZEVs through incentivizing infrastructure upgrade projects that offset most or all of the costs for electrical service upgrades.

In July 2015, Governor Edmund G. Brown issued Executive Order B-32-15 directing California state agencies to develop an integrated freight action plan. In July 2016 The Sustainable Freight Action Plan established the strategy of using zero-emission technology where feasible, and “near-zero” with renewable fuels everywhere else, to meet California’s long-term air quality goals. The three primary statewide targets of the plan are:

- Improve freight system efficiency by 25 percent by 2030
- Deploy over 100,000 freight vehicles and equipment capable of zero-emission operation and maximize near-zero emission freight vehicles and equipment powered by renewable energy by 2030
- Minimize negative economic impacts to the freight industry as the efficiency of the freight transport system improves

In 2016, the California legislature passed and California’s Governor Brown signed, Senate Bill 32 (SB 32), which requires CARB to ensure that California’s GHG emissions are reduced to at least 40 percent below the 1990 GHG level, by 2030.

In March 2017, CARB adopted the Revised Proposed 2016 State Strategies document as part of the SIP which identified several sectors that are key to launching heavy-duty zero-emission technology in the on-road heavy-duty sector: transit buses, delivery trucks, and airport shuttles (CARB, 2017a). The Proposed ACT Regulation continues implementation of these strategies to increase the first wave of heavy-duty ZEV deployments. The SIP includes the “Last Mile Delivery” measure which focuses on deploying zero-emission Class 3-7 heavy-duty vehicles in well suited applications. Based on continued assessment of technological readiness, the Proposed ACT Regulation expands in scope to include Class 2b and 8 medium and heavy-duty vehicles in well suited applications.

In January 2018, Governor Brown issued Executive Order B-48-18 building on past efforts to increase ZEVs by increasing California’s goal to 5 million ZEVs on the road by 2030, and setting a target of 250,000 chargers by 2025. Also in 2018, Governor Brown issued executive order B-55-18, which sets a target to achieve carbon neutrality in California no later than 2045, and achieve and maintain net negative emissions thereafter. The Proposed ACT Regulation directly supports achieving these goals through the required sale of ZEVs in California from all large medium- and heavy-duty manufacturers.

In August 2018, Governor Brown sent a letter to Chair Nichols of CARB directing the agency to pursue conversion of public and private fleets to zero-emission vehicles in categories including large employers, delivery vehicles, and transportation service fleets (Governor Brown, 2018). In response, staff proposed adding a reporting requirement to the Proposed ACT Regulation, to collect additional information from large employers, retailers, brokers and fleets. The information collected would inform CARB staff on how to develop future strategies to ensure ZEVs would be placed in service where suitable to meet individual fleet needs and would continue to accelerate progress towards meeting state goals.

In September 2019, Governor Gavin Newsom issued Executive Order N-19-19 which required every aspect of state government to redouble efforts to reduce GHG emissions and mitigate the impacts of climate change while building a sustainable, inclusive economy. Governor Newsom's EO specifically called for CARB to propose new strategies to increase demand in the primary and secondary markets for ZEVs, and to consider strengthening existing regulations or adopting new regulations to achieve necessary GHG reductions in the transportation sector. The Proposed ACT Regulation will support these goals by achieving GHG reductions, gathering information to develop future ZEV regulations which will drive additional GHG reductions in the transportation sector, and expand the primary and secondary ZEV markets.

To accelerate the introduction and deployment of zero-emission technologies, CARB has developed a portfolio of incentive programs that fosters early commercialization and demonstrations to reduce emissions and increase access to clean transportation. Each incentive program comes with its own statutory requirements, emission reduction goals, and eligible projects making the portfolio diverse and far reaching. Together, these projects address multiple goals, including:

- Turning over the legacy fleet to achieve cost-effective, near-term emission reductions in support of State Implementation Plans, air toxics, and community air protection goals,
- Accelerating the introduction and deployment of zero-emission technologies to meet California's longer-term air quality and climate change goals,
- Improving access to clean transportation and mobility options for low-income households and investing in the disadvantaged and low-income communities most impacted by pollution,
- Supporting the transition to and adoption of more sustainable transportation modes to reduce GHG emissions, and
- Expanding the supply chain for advanced technology components, the number of manufacturers choosing California as a home for manufacturing, and leveraging private investment to support the commercial viability of advanced technology.

B. Medium- and Heavy-Duty Vehicle Market

Heavy-duty trucks operate throughout California in numerous vocations and are an essential part of the state's economy. Medium and heavy-duty vehicles over 8,500 pounds gross vehicle weight rating include passenger vans, buses, pickups, vocational trucks, box trucks, and tractor trailer combinations used locally and for long-haul applications.

Traditionally, trucks have been manufactured in a variety of ways that differ significantly from typical light-duty vehicle manufacturing practices. The majority of class 3 through 8 vehicles (except for tractors) are manufactured by a manufacturers that are not vertically integrated (i.e., the manufacturer that produces the drivetrain and chassis likely does not produce the body). Figure I-1 illustrates the fragmented nature of typical truck manufacturing.

Figure I-1: Decentralized Medium- and Heavy- Duty Truck Manufacturing

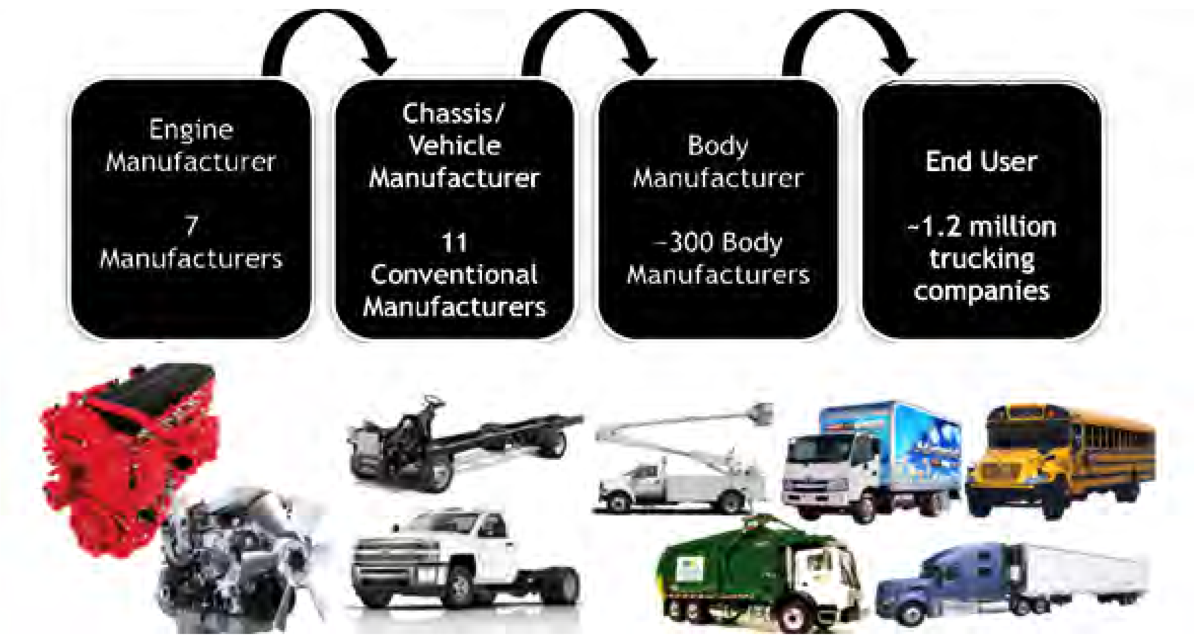
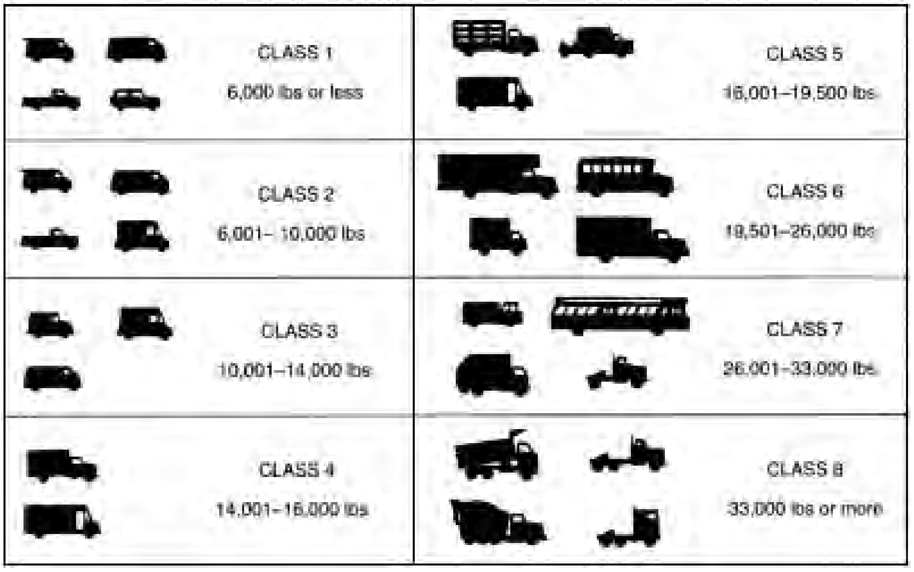


Figure I-2 illustrates the wide variety of body types for medium- and heavy-duty vehicles produced in each class. Class 2a and 2b are subsections of Class 2; Class 2a refers to vehicles with a GVWR of 6,001-8,500 lb. and Class 2b refers to vehicles with a GVWR of 8,501-10,000 lb.

Figure I-2 Vehicle Classes and Body Types



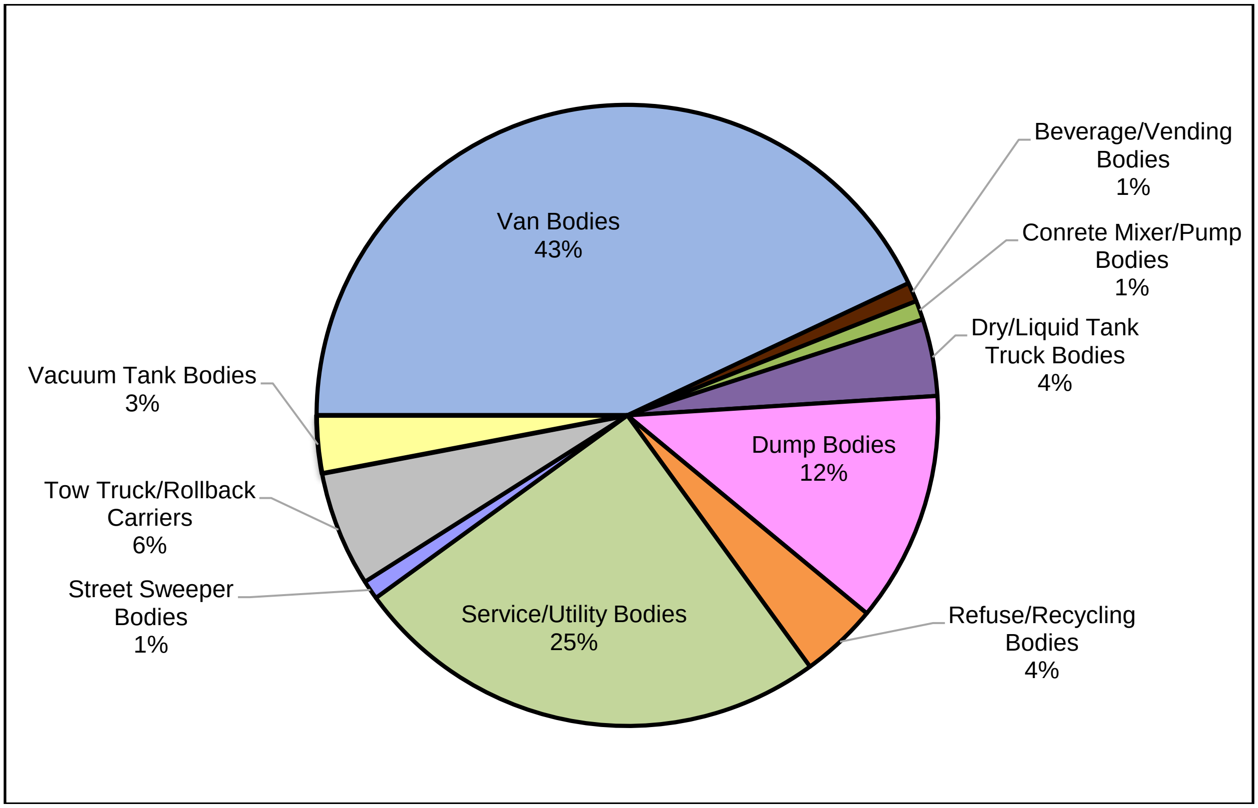
Truck Manufacturing

The majority of Class 2b and some Class 3 medium-duty trucks and vans are manufactured as complete vehicles with fully integrated bodies. Full size vans, chassis-cabs and cutaways, and heavy-duty pickup trucks comprise most of the Class 2b sales. Examples of full size vans include the Ford Transit, Mercedes Sprinter, and Chevrolet Express, and examples of heavy-duty pickup trucks include the Ford F250 and RAM 2500. Class 3 includes the same types as Class 2b with a higher payload, but also includes a higher fraction of incomplete vehicles and stripped chassis (with a frame and engine but has no cab or body) that often become walk-in vans and box trucks with final assembled by a body manufacturer. This market is primarily served by many of the same manufacturers of lighter duty vehicles including Fiat Chrysler of America, Ford, General Motors, Mercedes, and Nissan.

Class 4-8 trucks mainly function in vocational applications as urban delivery vehicles, as work-site trucks, and numerous other fields. The majority of these trucks are manufactured in segments and not in a vertically integrated process. Some manufacturers such as Hino, Navistar, Ford, and GM produce the powertrain and chassis of the vehicles in a vertically integrated process, but do not produce or assemble the final body to the vehicle. The top three manufacturers in Class 4-8 are Ford, Freightliner, and International (CARB, 2016b).

Manufacturers typically work with up fitters and dealers that install vocational bodies to meet the customer’s needs. A single chassis can be configured as a flatbed, box truck, a passenger shuttle or a wide range of other configurations. The body elements are manufactured by a variety of companies and assembled based on the specifications of the end user. Thus, the number and types of vocational bodies are highly varied. Figure I-3 shows the market share by body type in 2011 for vocational trucks and does not include tractors (ST, 2012). Chassis and engine manufacturers would not typically know exactly what type of vehicle the truck will become after the vehicle is delivered to a dealer or up fitter.

Figure I-3: Vocational Truck Body Types by Market Share 2011



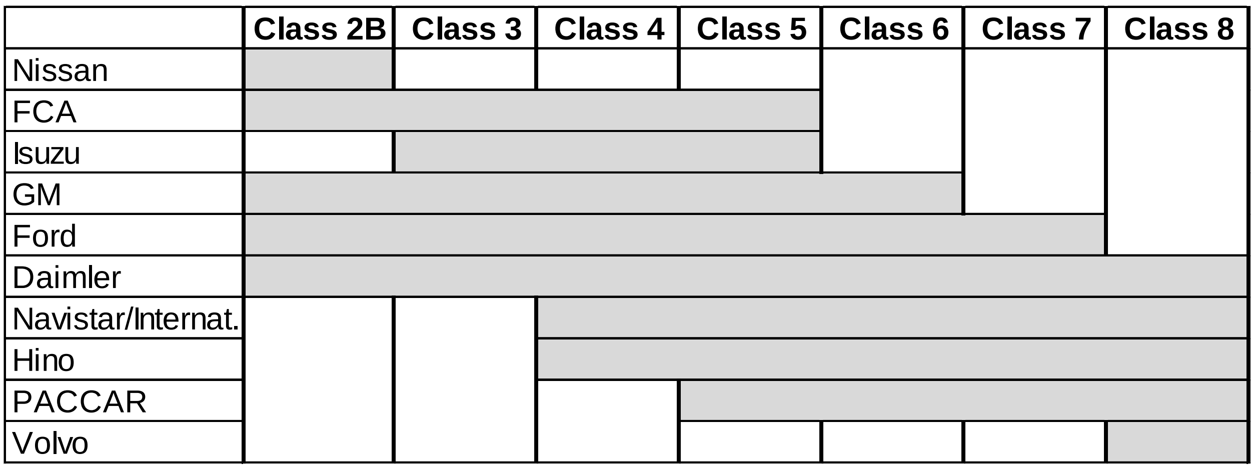
There are over 280 individual body manufacturers engaged in the production of truck bodies in North America. The industry is highly disaggregated with hundreds of small body manufacturers competing in the same market as large national body manufacturers. Most body manufacturers produce less than 1000 body units annually, with 74 percent manufacturing less than 500 body units annually (ST, 2012).

Class 7-8 tractors are typically manufactured as complete vehicles, though like most heavy duty trucks, are assembled as custom orders to customer specifications with parts from a variety of parts suppliers, which can often be mixed-and-matched for a given truck model depending on the customer needs. Several manufacturers supply their own engines, but also accept engines from other manufacturers, most commonly from Cummins (ORNL, 2017). Most major parts suppliers support a variety of manufacturers.

Traditional Manufacturers

Ten major original equipment manufacturers and their subsidiaries make the majority of Class 2b through 8 vehicles, and the classes of vehicles they are involved in producing are highlighted in Figure I-4. In the United States, PACCAR offers both the Kenworth and Peterbilt line of products. Large manufacturers have largely been absent from the ZEV market until recently.

Figure I-4: Truck and Engine Manufacturers by Class

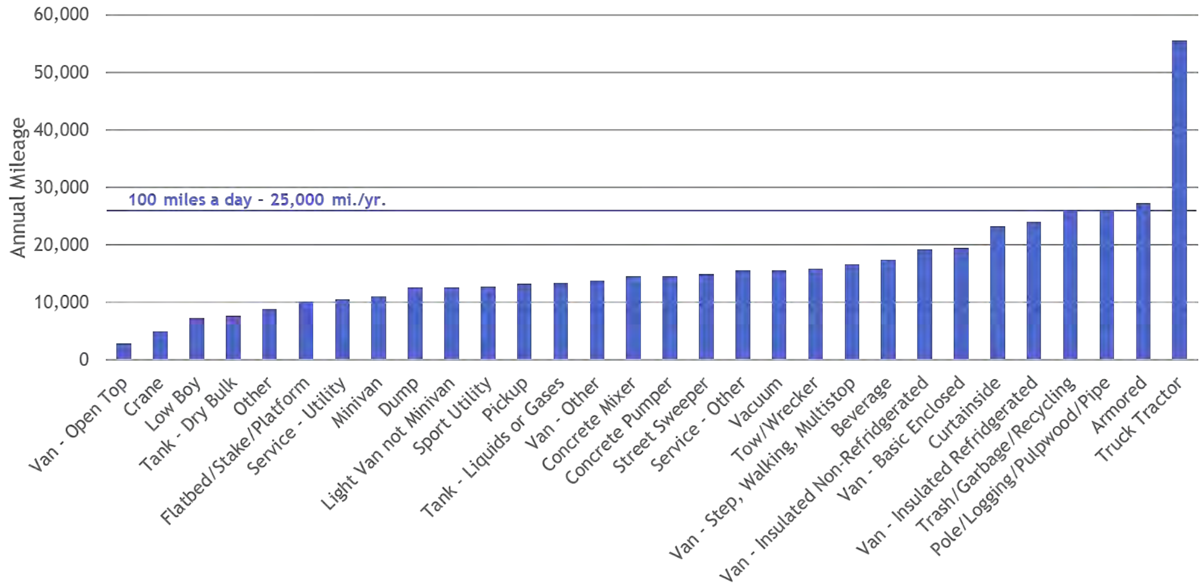


Vehicle Operations

Fleets operate their medium- and heavy-duty vehicles in a wide range of business models. Some fleets that provide the exact same service may operate the same trucks differently. Some may return to base daily, while others may go home with drivers. Some uses may be at the limits of weight, towing or available cargo volume, while others are not. While there is a wide variety of vehicle use cases, there are commonalities amongst all vehicle classes which are favorable for electrification with existing technology that is commercially available today.

The California Department of Transportation, through a contractor, conducted the California Vehicle Inventory and Use Survey (CA VIUS) in 2018 to gather updated information on how commercial vehicles are operated on California roadways to support various California transportation related planning efforts. The 2018 CA VIUS data showed that most "straight trucks" in Class 3-8 travel less than 100 miles per day. The results are consistent with data collected in the 2002 US Census Vehicle Inventory (US VIUS) where more details about truck body types were included. Figure I-5 is a chart of mileage data compiled from the 2002 US VIUS, which includes body types. Available data is limited and dated, but we can effectively piece together information which shows that almost 90 percent of Class 2b to 7 vehicles among a wide variety of body types travel less than 100 miles per day whereas 80 percent of Class 8 vehicles operate at less than 100 miles per day (U.S. Census, 2004).

Figure I-5: 2002 US VIUS Truck Type Daily Mileage



Class 4 through 8 vocational vehicles have general operational characteristics that are more favorable for electrification, typically with predictable routes, less concerns about payload, short daily range needs, stop-and-go operations, and often return to a centralized location daily where they could be charged or fueled with hydrogen. For example, parcel delivery vehicles operate on regular routes, with more than 100 stops per day, and return to a depot at the end of the shift. Delivery trucks often travel short distances from a distribution center to stores where unloading takes 30 minutes to an hour keeping total daily miles relatively low. Similarly, a Class 8 refuse truck may operate from a central location, make thousands of stops in a day, and have low total daily mileage needs, though power take-off loads need to be considered. While the results show the majority of trucks travel less than 100 miles per day on average, additional information is necessary to better understand individual fleet needs.

Stakeholders have indicated payload and towing needs are significant for many fleets that purchase Class 2b-3 vehicles, especially those that purchase heavy duty pickup trucks. ZEVs may not be suitable for periodic towing of heavy loads which could be a problem for a vehicle with limited range capability. Routes and range needs are less predictable for pickup trucks in this category but are less of a concern for vans that are typically not purchased to tow loads. More detail is needed about individual fleets and how they dispatch pickups to determine whether this concern about variable loads and towing could be managed when the percentage of ZEVs in the fleet is relatively small.

Tractors can be used in operations ranging from yard work where they never leave a premises to long-haul, cross country operations. Typically tractors are purchased new to be used in longer-haul operations, then sold on the secondary market for regional or local operations. Drayage trucks that frequently visit the ports typically operate less than 100 miles from the ports (NREL, 2016). Similarly, food and beverage delivery trucks as well as tractors that operate in hub-and-spoke operations do not travel long distances each day, and return to a base of operations daily where infrastructure can be installed, which are favorable characteristics for electrification.

Because of the variability in individual fleet operations, staff need better information on the individual business models for a breadth of industries operating or contracting for the operation of Class 2b-8 trucks to better target effective and appropriately flexible future ZEV strategies.

C. Zero-Emission Vehicle Technologies

ZEVs produce no exhaust emissions of any criteria pollutant under any and all possible operational modes and conditions. The most common ZEVs are battery-electric vehicles (BEVs) and fuel-cell electric vehicles (FCEVs). BEVs utilize batteries to store energy needed to power electric motors and FCEVs use hydrogen stored on board to power a fuel cell in combination with a traction battery that produces electricity to power the electric motor(s). These electric vehicles have instant torque response, low noise, regenerative braking that greatly reduces brake wear and generally have a relatively simple mechanical drivetrain, often having no transmission. Other ZEV powertrains, such as catenary systems and electric rail, are currently being demonstrated for truck applications.

Centralized depot charging is currently the primary BEV charging strategy, and is characterized by drawing electricity at a relatively slower rate over several hours overnight when vehicles are parked in the yard. Lighter trucks up to Class 6 that operate less than 100 miles per day can be charged overnight using Level 2 chargers and greater vehicles or those that travel further may need larger chargers or rely on faster direct current charging. Currently, medium and heavy-duty ZEVs are commonly available with a nominal range of 100-150 miles per charge. Longer range ZEVs are expected to become available as technology continues to improve. Smaller BEVs are already available commercially and larger BEVs (Class 8) are currently being demonstrated at ports and a variety of other applications throughout California. Longer range vehicles require a larger battery where weight becomes more of a concern that must be considered.

The ZEV truck market is beginning to grow in a similar pattern to what we saw in the transit bus market. In 2015, CARB initiated a proposal to partner with California Transit Agencies with a goal to transition to zero-emission buses as part of their normal replacement cycle. There are about 12,600 transit buses in California, and, at that time, there were 22 battery-electric and 17 fuel cell electric buses in operation statewide. As of mid-2018, there were over 150 zero-emission buses (ZEBs) in operation with over 400 ZEBs on order, and over 700 planned purchased in the next few years. By that time, at least 16 transit agencies committed to making a full transition to zero-emission technologies, the majority well before 2040. This market expansion was incentivized, in part, by funding made available from Federal, State, and local sources which resulted in growth of zero-emission bus offerings by bus manufacturers.

With current funding programs, a similar pattern is beginning to take shape for zero-emission trucks as more ZEVs are being sold commercially, and new demonstrations are establishing proof-of-concepts in a variety of applications, and nearly all truck manufacturers have announced zero-emission technology options for their product lines.

The range and fueling time of FCEVs are comparable to conventional internal combustion engine technologies. FCEV technology in ports is being demonstrated as part of the Zero- and Near-Zero Emission Freight Facilities (ZANZEFF) program after successful proof-of-concept by some manufacturers (CARB, 2018a). The hydrogen fuel used in these demonstration projects is delivered from central production facilities or produced on-site. Transit agencies, including Alameda-Contra Costa Transit District (AC Transit) and SunLine Transit Agency, use fuel-cell electric buses (FCEBs) the same way as their diesel or compressed natural gas (CNG) buses without having to dedicate a special route. Eight of the 13 FCEBs operated by AC Transit have surpassed the 25,000 hour target set by the United States Department of Energy (DOE) and the Federal Transit Administration (FTA) and 4 of these FCEBs have surpassed 30,000 hours of operation. This demonstrates the potential for fuel cells to meet the equivalent life cycle expectancy similar to a diesel engine (AC Transit, 2017). FCEVs have demonstrated the feasibility of being integrated into regular fleet operation as they can provide similar capacity, range, or fueling capabilities as conventional vehicles; however, they also tend to have higher curb weight compared to conventional vehicles and near-term costs are still high.

D. Near-Zero Technology

For the purpose of this regulation, near-zero-emission vehicles (NZEV) are plug-in hybrid electric vehicles powered by both an internal combustion and battery-electric powertrain that are capable of operating like as a zero-emission vehicle for some distances. NZEVs are considered a bridge technology which will help the development of the full ZEV market. They provide flexibility to meet applications that are not well suited for full ZEVs and promote the development of zero-emission component supply chains, training, education, and provide an opportunity for fleets to gain experience with electric drivetrains without range anxiety. Vehicles that cannot operate part-time as a pure ZEV are not considered to be “near-zero.”

Most vehicle manufacturers have already announced plans to focus on pure ZEVs and have stated that they are not planning to make additional models available as PHEVs. However, there is an exception. Cummins Inc. unveiled a Class 6 electric plug in hybrid utility truck in 2018 and has plans for commercialization of the drivetrain solution in the near future (InsideEVs, 2018) and it is capable of some all electric range.

E. Cleaner Combustion Technology

Cleaner technology combustion engines that operate on diesel or alternative fuels have the potential to reduce emissions significantly but are not being considered as part of this rulemaking effort. Both the California and federal Phase 2 GHG regulations have been enacted and will make incremental improvements in GHG emissions from 2021 MY and subsequent medium- and heavy-duty vehicles. The GHG emission benefits from the potential use of renewable fuels including biodiesel and renewable natural gas are already attributed to the LCFS regulation and are being enforced through its implementation. In a separate effort, CARB is developing the Heavy-duty Low-NOx Omnibus regulation which is a multi-pronged, holistic approach to decrease emissions of new heavy-duty engines. These requirements will go into effect at the same time the Proposed ACT Regulation will begin to require ZEV sales. Through these existing and pending regulations, CARB is already reducing emissions from combustion engines to protect public health, but transformative change to ZEVs where feasible is still needed to eliminate localized pollution, especially in disadvantaged communities, and to maximize GHG emissions reductions from transportation.

F. Status of Medium and Heavy-Duty ZEV Market

California is leading the way for the introduction of ZEVs in the medium- and heavy-duty space. Today, 15 manufacturers are offering more than 50 different ZEV truck and bus configurations, other than transit buses, from Class 3 through Class 8 through the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program (HVIP), (HVIP, 2019). HVIP has provided funding for 2,456 zero-emission trucks and buses and 2,593 hybrid trucks since 2010 to support the long-term transition to zero-emission vehicles in the heavy-duty market. These commercially available zero-emission trucks and buses cover a wide variety of vocations and duty cycles; some vehicles available today include delivery vans, school buses, refuse trucks, cutaway shuttles, terminal tractors, and passenger vans.

CARB has also funded a number of demonstrations and pilot projects to accelerate development and early commercial deployment of zero-emission technologies. Most recently, the ZANZEFF project solicitation awarded $205 million to grantees to reduce GHG and criteria pollutants in freight facilities. The approved projects include deployment of 160 battery-electric trucks including 42 truck tractors, 43 yard goats, 46 Class 8 trucks, and 29 medium duty trucks, and 31 fuel-cell electric trucks including 10 truck-tractors, 2 yard goats, and 19 delivery vans. For these projects, CARB has outfitted the zero-emission vehicles and corresponding conventional internal combustion engine (ICE) counterparts with data-loggers. The data on vehicle operations are being collected and will be published periodically. Other public agencies including the California Energy Commission, South Coast Air Quality Management District, and the Department of Energy are funding zero-emission technologies.

California is now home to a number of medium and heavy-duty ZEV manufacturers and suppliers who are creating high-quality employment opportunities. These companies include BYD, Dana Electrified, Efficient Drivetrains, Inc (recently purchased by Cummins), GreenPower, Motiv, Phoenix Motorcars, TransPower, and XOS Trucks (formerly Thor). Figure I-6 shows the location of California's ZEV manufacturers. Other out of state manufacturers producing ZEVs today include Blue Bird, Chanje, Kalmar Ottawa, Lighting Systems, Lion Electric, Orange EV, The Workhorse Group, and Zenith Motors.

Figure I-6: California Medium & Heavy-Duty ZEV Manufacturers and Suppliers as of August 2019 (excludes transit buses)

At this point, nearly every established truck manufacturer has announced plans for zero-emission vehicles ranging from vans to tractors in the early 2020s. While these announcements do not guarantee that enough ZEVs will be produced to meet the Proposed ACT Regulation's requirements, they show that the technology is commercially viable and manufacturers are anticipating market demand for medium- and heavy-duty ZEVs. To date Bollinger Motors is the only manufacturer that has announced plans to produce a ZEV medium duty pickup. Several other manufacturers including, Chevrolet, Ford, Rivian, and Tesla have announced plans to manufacture light-duty zero- emission pickup trucks which will enable technology transfer into medium-duty pickups.

This emerging ZEV market segment is being supported by technology transfer from other, more developed markets. Manufacturers including Volvo and Proterra have developed electric powertrains in the transit bus sector which will soon be utilized in Class 8 trucks and school buses (Volvo, 2018),(Proterra, 2018). Navistar's upcoming electric school bus has been designed using technology from Volkswagen light-duty passenger cars (Trucks, 2018). Daimler is leveraging its light-duty battery investments to power its Mitsubishi Fuso eCanter truck (CARB, 2017b). Motiv is using batteries from the BMW i3 in some of its commercial trucks (Motiv, 2019). Tesla is using electric motors and other components from the Model 3 in its demonstration tractor and Toyota is using two Mirai fuel cells in its demonstration tractor (Tesla, 2019), (Toyota, 2019).

New charging and hydrogen refueling standards are currently being developed for medium- and heavy-duty applications. Existing standards allow for electric vehicle charging up to 350 kW and hydrogen refueling up to 10 kg. In February 2019, CharIn, a consortium of vehicle manufacturers, electric vehicle supply equipment (EVSE) manufacturers, charging networks, fleets, and other parties, announced development of a new working group tasked with developing a standard for high-powered charging above 1 MW (CharIn, 2019). Also in February 2019, an industry group consisting of heavy-duty truck manufacturers and hydrogen suppliers signed a memorandum of understanding to develop a unified refueling protocol for fuel cell electric trucks (Green Car Congress, 2019).

G. Potential Challenges for ZEV Deployment

ZEV technology is in the early stages of commercial development in the medium and heavy-duty space and must overcome challenges before it can become widely accepted by fleets. Notable challenges include the incremental cost of ZEVs, infrastructure investment cost and availability, matching vehicle capability with fleet needs, and potential diverging standards. This section will discuss these four main challenges.

1. Upfront Cost of ZEVs

Today and for the foreseeable future, battery-electric and fuel-cell electric trucks will cost more than their diesel or gasoline counterparts. This is due to a combination of low volume production and more expensive components, including batteries. The incremental cost difference between ZEV and ICE vehicles is expected to decline over time but the ZEV is expected to continue to cost more for a fleet to purchase.

In addition to vehicle prices, fleets purchasing ZEVs must also install refueling infrastructure. Both battery-electric and fuel cell electric vehicles require significant infrastructure installations at the depot in order to operate. Considering that most fleets today either have on-site fueling or fuel off-site, the installation of chargers and the associated infrastructure work or hydrogen refueling stations is a significant expense above business as usual conditions.

As with any new technology, there could also be additional upfront costs associated with ZEV deployment, such as professional services for site assessment and infrastructure buildout and planning, additional procurement processes, as well as operator and technician training.

These initial costs can be a barrier to business and fleets, especially those with limited access to capital. While BEVs cost more initially due to their large upfront investments, they tend to payback over time due to their lower operating costs resulting in a positive total cost of ownership. Financing the vehicles and infrastructure can spread out the payments to be offset with ongoing reductions in operating costs. Additionally, incentive programs for vehicles or infrastructure may allow fleets to lower or eliminate these higher upfront costs. Educating fleets about the lifecycle costs and payback opportunities will be an important part of accelerating the ZEV market.

2. Infrastructure Investment and Fuel Cost

The initial adoption of ZEVs for any fleet requires either dedicated infrastructure onsite or publically available retail stations, the cost of which are dependent on a number of site-specific variables. As such, cost of installing fueling infrastructure and their ongoing maintenance costs may significantly affect the payback period for the transition to ZEVs. Infrastructure expenses are an upfront capital cost necessary prior to vehicle deployment, but may last multiple vehicle lifetimes and can be paid off over time.

The cost of charging infrastructure varies by site. Some locations will need minimal to no electrical site upgrades for deploying a few ZEVs and as a result the fleet will only need to pay for the charger. For larger deployments, in most cases, electrical infrastructure (e.g. trenches, transformers, switchboards, and conduit) will need to be upgraded or installed in order to accept the high-power service necessary to support multiple chargers in a depot or yard. As the number of regulations requiring electric infrastructure continues to expand, CARB must work with the Public Utilities Commission, California Energy Commission, and utilities on holistic long-range planning.

The amount of space or footprint and capital cost of a hydrogen station is usually determined by the method to produce hydrogen and throughput or capacity of the station (Linde Group, 2016). Similar to charging infrastructure, construction and operation of hydrogen stations also involves different agencies in issuing permits, such as land use and air permits (Arnold and Porter, 2015). Hydrogen stations at fleet facilities are often built to be scalable. For example, a station can increase its capacity from supporting 40 to 400 trucks by upgrading the compression and storage equipment, and adding dispensers at a relatively modest cost compared to the initial investment.

The most significant contributor to the payback period of ZEV adoption is the fuel cost savings compared to conventional fuels. Unlike diesel, electricity prices have been stable, but electricity costs are determined by time-of-use, and how charging is done. There is uncertainty over electricity and hydrogen costs for fleet deployments that may deter fleet owners from transitioning to ZEVs. Guarantees of price stability by utilities and hydrogen suppliers as ZEV fleets are built out would provide greater confidence.

The price of hydrogen fuel currently fluctuates depending on a number of factors such as location, supply, and method of generation due to a fledgling supply network with currently low throughput. As the supply chain of hydrogen fuel matures, it is expected that hydrogen fuel prices will drop and offer competitive value with conventional fuels. However, further progress is needed on total cost of ownership, and the landscape footprint in regards to hydrogen fueling costs (CTE, 2016).

The electricity cost varies with factors such as electric utility, number of vehicles deployed in a depot, and charging strategy. Electric utilities typically charge commercial customers in three ways: usage-independent fee as a fixed fee for each electricity meter ($/month), usage charges in terms of cost per kilowatt-hours ($/kWh), and demand charges in terms of cost per kilowatts ($/kW). Whether a truck fleet is charged during daytime or nighttime to avoid on-peak usage charges, and whether the trucks are charged at the same time or sequentially to reduce demand charge can affect the total cost of electricity significantly. A company may experience higher electricity cost when charging a small number of trucks at a depot and will have lower average electricity costs as more BEVs are charged at the site. However, electricity is a relatively inexpensive and efficient way to fuel a vehicle and significant savings can be achieved especially when the LCFS credits are considered. For fleets that charge for extended periods overnight, the LCFS credits can offset all or nearly all of the electricity costs.

Significant infrastructure investments will also be necessary for California's goal of 5 million ZEVs by 2030. The California Public Utilities Commission (CPUC) is collaborating with CARB and California Energy Commission (CEC) to implement requirements set forth by SB 350 to support widespread transportation electrification, as discussed in Section C of Chapter III. The three major investor owned utilities (IOUs) have been approved to invest $686 million in medium- and heavy-duty infrastructure projects to support transportation electrification over a 5-year period (CPUC, 2018). The approved programs offset nearly all of the costs of making electrical service upgrades for a fleet and may offset part of the cost of installing charging infrastructure.

3. ZEV Operational Characteristics

ZEV technologies have inherent characteristics that benefit certain applications and may be a detriment to others. In order to successfully transition to ZEVs, truck fleets will need to consider which zero-emission technology or technologies are best suited to meet their needs. It is essential to work with technology and fuel providers as early as possible regardless of which technology to deploy. Recognition of vehicle specifications is also necessary to identify suitable route/blocks.

BEVs can be less flexible than internal combustion engine vehicles due to their range limitation and needed access to charging. Initially, this may make it difficult to incorporate them into those operations with long daily ranges or long running hours. BEVs in Class 3 through 8 are already commercially available with a nominal range of 100 miles per day and survey data show that most vehicles operate less than 100 miles per day. However, real-world range may be lower due to the use of heating, air conditioning, and other accessories. In time, suitability is expected to improve as some manufacturers are already demonstrating models with ranges over 200 miles per charge or greater.

Future expansion of the medium- and heavy-duty ZEV market must take into account applications that suit current and future ZEV technology. As part of the workgroup process, CARB staff worked with stakeholders, including the Truck and Engine Manufacturer Association (EMA) to identify 87 unique market segments, and to determine where the operational nature of ZEVs would be most beneficial. The most suitable market segments for electrification are ones where weight or space utilization are not overly constrained with relatively short, predictable routes operated from a centralized location. The "Advanced Clean Truck Market Segment Analysis" (CARB, 2019b) spreadsheet identified that just over 70 percent of Class 4-7 vehicles are good fits for electrification today while roughly 30 percent of Class 2b-3 and Class 8 vehicles are good fits. Further advances in technology will increase this portion of the medium- and heavy-duty truck population that is suitable for electrification. Additional details on this analysis may be found in Appendix E.

4. Risk of Differing Charging and Fueling Standards

The Society of Automotive Engineering (SAE) is developing heavy-duty vehicle charging standards. However, currently different charging standards are being used by manufacturers. This is a challenge for BEV adoption as they increase the likelihood of stranded assets for the fleet or additional costs to modify the charging system if a standard is dropped for another. The large-scale deployment of BEVs will benefit from a common charging standard. Applicable standards commonly implemented for buses and other medium- and heavy-duty vehicles include the SAE J1772 Combined Charging Standard. SAE standard J3068 for plug-in (conductive) charging of heavy-duty vehicles has recently been finalized (SAE, 2018), (Truckinginfo, 2018) while J3105 for overhead (conductive) charging may be available soon and J2954 for wireless (inductive) charging is planned to be available in a year or two. As standards for the industry are developed, deployment costs will decrease.

Scaling up hydrogen fueling infrastructure is challenging but feasible. Currently there is no uniform fueling standard for hydrogen into tanks larger than 10 kg, but an industry group consisting of heavy-duty truck manufacturers and hydrogen suppliers signed a memorandum of understanding in February 2019 to develop a unified refueling protocol for medium- and heavy-duty fuel cell electric trucks.

H. Summary of Public Outreach

For the Proposed ACT Regulation, CARB created a technical workgroup that comprises interested stakeholders including manufacturers, fleets, environmental groups, utilities, technology providers, and fuel providers. In addition to coordinating public workgroup meetings, CARB staff has conducted more than 100 individual meetings with more than 50 stakeholders. Some of these key stakeholders include but are not limited to Truck and Engine Manufacturers Association members (EMA), the California Electric Transportation Coalition (CalETC) and electric vehicle manufacturers, fleet representatives, the California Trucking Association, the American Trucking Association, environmental groups, and nonprofit organizations.

Since 2016, CARB staff held seven workshops, and four workgroup meetings to provide information to the public and solicit feedback. CARB staff posted information regarding these events and any associated materials on the ACT website and distributed notice of these meetings through two public list serves; "actruck" and "zevfleet" that include 3,092 and 1,356 recipients, respectively. The majority of the meetings were available by webcast and teleconference. At the meetings, CARB staff solicited stakeholder feedback on the Proposed ACT Regulation and overall regulatory process. In addition to continued efforts to solicit feedback from stakeholders about the Proposed ACT Regulation, CARB staff solicited for alternatives during the May 31, 2018 workshop.

Staff has reached out to the proposed regulated parties throughout the regulatory development. In the April 2017 workshop, staff asked fleets to submit answers to a draft fleet survey questionnaire in an effort to gather detailed information about everyday operations of local fleets. This survey was sent to roughly 500 addresses through mail and 1,500 email addresses through the "actruck" list serve on CARB's website. Staff also mailed notice letters to the 11,000 large entities and fleets that would be required to report under the Proposed ACT Regulation. Further, staff has met with the proposed ten regulated manufacturers (Daimler, FCA, Ford, GM, Isuzu, Navistar, Nissan, PACCAR, Hino/Toyota, and Volvo) on a group and individual basis throughout the regulatory development process.

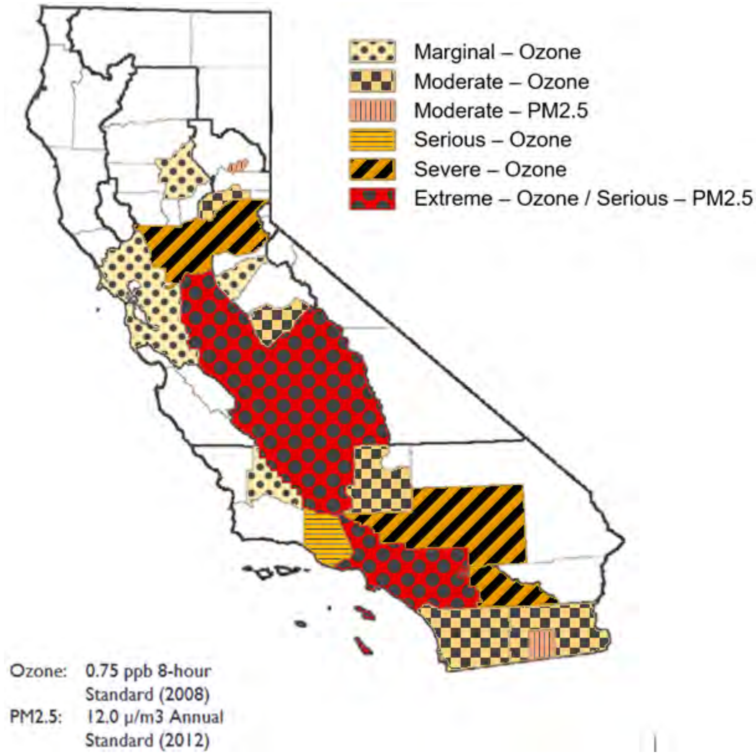
CARB staff also held two joint meetings with the California Governor's Office of Business and Economic Development (GO-Biz) in which fleets, manufacturers, and utilities discussed medium-and heavy-duty electrification. Additionally, staff has engaged in frequent discussions with ZEV technology providers, electric utilities, fuel providers, and non-governmental environmental organizations during various outreach events such as technology symposiums and expositions.

II. THE PROBLEM THAT THE PROPOSAL IS INTENDED TO ADDRESS

A. Need for Emission Reductions

The federal Clean Air Act requires areas that exceed the health-based national ambient air quality standards to develop State Implementation Plans (SIP) that demonstrate how they will attain the standards by specified dates. Despite efforts to date, significant portions of the state remain in non-attainment with ozone and particulate matter standards, as shown in Figure II-1 (U.S. EPA, 2012). In March 2017, the Board adopted the State SIP Strategy to bring California into attainment.

Figure II-1- California Ozone and $PM_{2.5}$ Non-Attainment Areas



In December 2017, the Board adopted the Scoping Plan Update, known as California's 2017 Climate Change Scoping Plan (CARB, 2017c), building on the state's successes to date. The 2017 Scoping Plan proposes to strengthen major programs that have been a hallmark of success while further integrating efforts to reduce both GHG and air pollution. California's climate efforts will:

- Lower GHG emissions on a trajectory to avoid the worst impacts of climate change;
- Support a clean energy economy which provides more opportunities for all Californians;

- Provide a more equitable future with good employment opportunities and less pollution for all communities;
- Improve the health of all Californians by reducing air and water pollution and making it easier to bike and walk; and
- Make California an even better place to live, work, and play by improving our natural and working lands.

To date, California has made significant progress towards reducing GHG emissions standards and is currently on track to meet the goals of Assembly Bill 32 (AB 32) (Nuñez, Chapter 488, Statutes of 2006), the California Global Warming Solutions Act of 2006. AB 32 requires California to reduce GHG emissions to 1990 levels by 2020 and maintains that level afterwards. But more needs to be done. In 2016, the California legislature adopted SB 32 (Pavley, Chapter 249, Statutes of 2016) which amended the California Global Warming Solutions Act to require the statewide GHG emissions target to be at least 40 percent below 1990 levels by 2030 and maintains that level afterwards. Accomplishing these goals requires a transformation from the inefficient fossil fueled conventional vehicles in use today to the more efficient zero-emission vehicles powered by lower carbon intensity fuels.

The Proposed ACT Regulation, under the title "Last Mile Delivery", is identified in the SIP and the 2017 Scoping Plan as a necessary component for California to achieve established near- and long- term air quality and climate mitigation targets (CARB, 2017a). Zero-emission technologies are needed to achieve the maximum GHG and NOx emissions reductions simultaneously and meet our long-term air quality and climate goals. To meet these and other goals, the Proposed ACT Regulation has the following primary objectives:

- Accelerate first wave of zero-emission (ZE) truck deployments in best suited applications.
- Achieve 100 percent zero-emission pickup-and-delivery in local applications by 2040.
- Support Port's Clean Air Action Plans for 100 percent zero-emission drayage trucks by 2035.
- Support AB 739 requiring California state government fleets to purchase ZEVs.
- Enable a large-scale transition to zero-emission technology.
- Maximize the total number of ZEVs deployed.
- Complement existing and future programs.
- Provide environmental benefits, especially in disadvantaged communities thereby supporting the implementation of AB 617.
- Ensure requirements are technologically feasible and cost effective, and
- Foster a self-sustaining zero-emission truck market.

1. Oxides of Nitrogen Emissions

Oxides of nitrogen (NOx) are a group of highly reactive gases including nitrogen dioxide (NO_2), nitrogen oxide, nitric acid, and others. Breathing air with a high concentration of

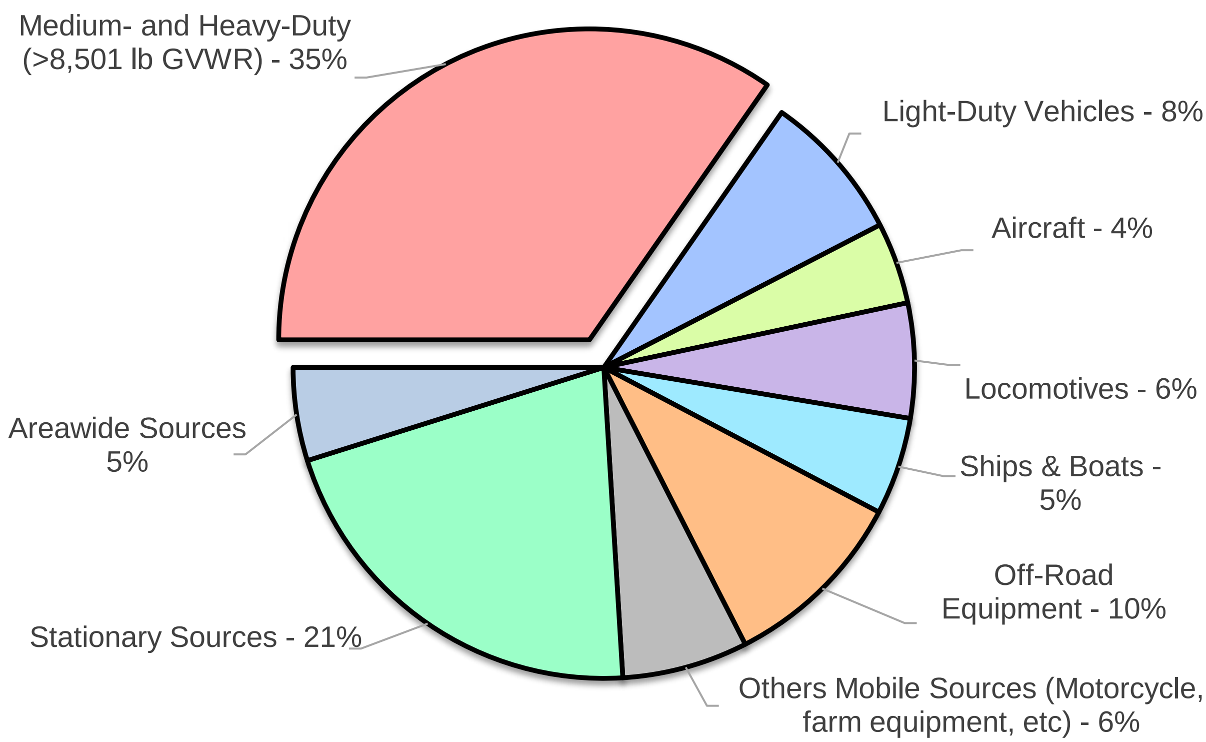
NO_2 can irritate airways in the human respiratory system. Such exposures over short periods can aggravate respiratory diseases, particularly asthma, leading to respiratory symptoms (such as coughing, wheezing or difficulty breathing), hospital admissions and visits to emergency rooms. Longer exposures to elevated concentrations of NOx may contribute to the development of asthma and potentially increase susceptibility to respiratory infections. People with asthma, as well as children and the elderly are generally at greater risk.

NOx reacts with other chemicals in the air to form both ozone and particulate matter. Both of these are also harmful when inhaled due to their effects on the respiratory system. Ozone is a criteria pollutant identified in the federal Clean Air Act and can trigger a variety of health problems including chest pain, coughing, throat irritation, and airway inflammation. It also can reduce lung function and harm lung tissue. Ozone can worsen bronchitis, emphysema, and asthma, leading to increased medical care.

Substantial progress has been achieved in reducing NOx emissions through implementation of CARB's existing mobile source programs, and it is expected that these programs will continue to provide further reductions through 2031, contributing significantly to meeting air quality standards. However, challenges still remain in meeting the ambient air quality standards for ozone in two areas of the state with the most critical air quality challenges: the South Coast Air Basin and the San Joaquin Valley Air Basin (CARB, 2016c), (CARB, 2017e). The South Coast Air Basin has the highest ozone levels in the nation. Since NOx is also a precursor to secondary $PM_{2.5}$ formation, reductions in NOx emissions will also provide benefits for meeting the $PM_{2.5}$ standards. To meet the 2023 and 2031 ambient air quality standards for ozone, the South Coast Air Basin will require an approximate 80 percent NOx reduction by 2031.

Mobile sources are the largest source category of NOx emissions and medium- and heavy-duty vehicles are the largest source of mobile source NOx emissions as displayed in Figure II-2.

Figure II-2: 2019 NOx Emissions by Source



In addition, in October 2015, U.S. EPA adopted a more stringent 70 parts per billion ozone standard with an attainment date of 2037 (U.S. EPA, 2015). This ozone standard will result in additional areas being classified as nonattainment areas, as well as require even further emission reductions in California's existing nonattainment areas.

2. Particulate Matter Emissions

Particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) is small enough to penetrate into the lungs and airways where it may produce harmful health effects such as the worsening of heart and lung diseases (NYDH, 2018). The International Agency for Research on Cancer identified diesel exhaust as a probable human carcinogen, and in 1990, California's Proposition 65 determined that diesel exhaust is a chemical known to cause cancer. In 1998, the Board identified diesel PM as a toxic air contaminant. This resulted in CARB staff developing and the Board approving the Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles in 2000. CARB staff estimated that diesel PM emissions were responsible for about 70 percent of the total ambient air toxics risk to individuals living in California, and subsequently established a target goal of reducing statewide diesel PM exposure by 85 percent by the year 2020 (CARB, 2000).

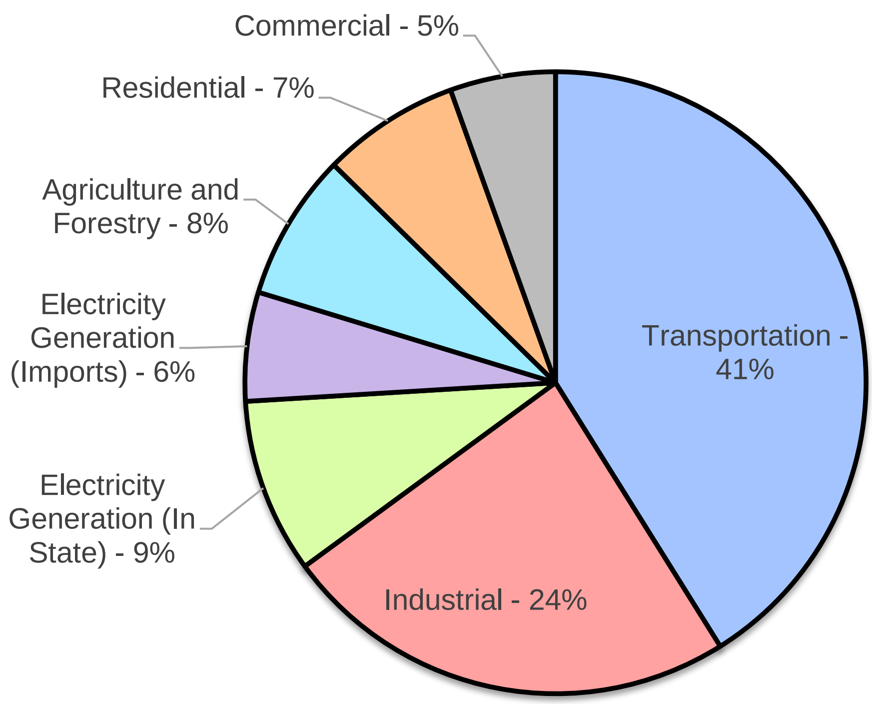
Major portions of California are not in attainment with the federal particulate matter emissions standards including the South Coast Air Basin and the San Joaquin Valley Air Basin. The San Joaquin Valley has the highest $PM_{2.5}$ levels in the nation. Despite regulations such as the Truck and Bus rule that accelerate turnover and require the installation of diesel particulate filters, HD on-road vehicles still account for over 25 percent of statewide diesel PM emissions while making up only a small proportion of California's on-road vehicle fleet. In particular, individuals living near highly impacted trucking corridors, such as near major highway arteries or near major seaports, are at greater risks from diesel vehicle PM emissions than the average individual due to their inherit close proximity to diesel vehicles and equipment.

Furthermore, diesel PM is a major source of black carbon. Black carbon absorbs sunlight and generates heat in the atmosphere which warms the air and can affect regional cloud formation and precipitation patterns. As such, black carbon plays a critical role in global climate change (C2ES, 2010).

3. Greenhouse Gas Emissions

Carbon dioxide (CO_2) is the primary GHG emitted in California, accounting for 83 percent of total GHG emissions in 2017 (CARB, 2019c). The GHG emissions inventory further shows that the transportation sector, primarily comprised of on-road travel, is the single largest source of CO_2 in California as illustrated in Figure II-3. Transportation emissions account for over half of the state's GHG emissions when including upstream emissions.

Figure II-3. 2017 GHG Emissions by Economic Sector

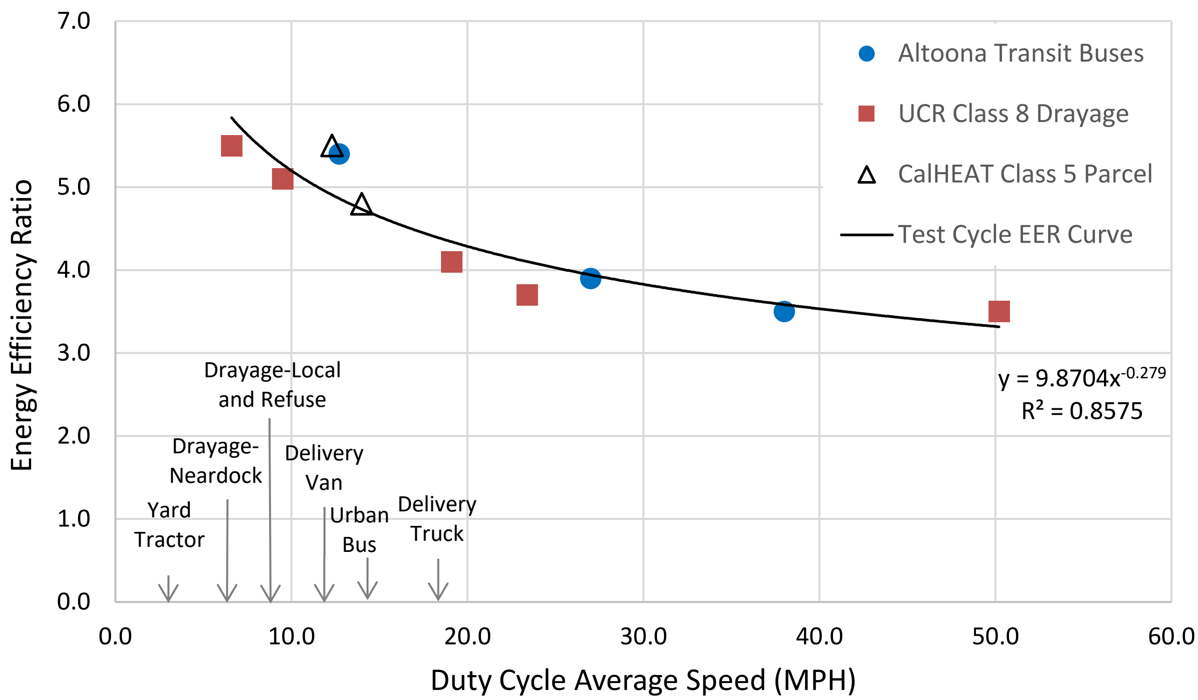


B. Need to Reduce Petroleum and Energy Consumption

Through his 2015 inaugural address and EO B-30-15, Governor Brown established six pillars for California's climate change strategy. One of these key pillars was to reduce petroleum reduction from cars and trucks by 50 percent by 2030. California can meet this ambitious goal by building on existing efforts to improve vehicle efficiency, reduce lifecycle fuel emissions, decreasing vehicle miles traveled, and supporting ZEV deployment. Meeting this goal will reduce pollution, strengthen the state's economy, and will put the state on a path to meet its GHG goals.

ZEVs consume no petroleum and use less energy than conventional internal combustion engine trucks for the same distance travelled. Staff performed an analysis on the relative efficiencies of diesel and battery-electric vehicles (BEVs) and found that in BEVs are two to five times as efficient as a conventional vehicle (CARB, 2018b). The results from the analysis are displayed in Figure II-4 and the discussion paper is included in Appendix G.

Figure II-4. Battery-Electric Vehicle Energy Efficiency Ratio at Different Average Speeds



Due to their higher efficiency, ZEVs lower energy consumption, reduce dependence on petroleum, and reduce emissions substantially because ZEVs have no tailpipe emissions and as of 2017, the majority of California's electricity comes from sources with no criteria pollutant emissions. As more electricity is sourced from renewable sources, upstream emissions from electricity will continue to decline.

C. Need to Foster Zero-Emission Technology

Zero-emission technology deployments are needed in the medium- and heavy-duty market to meet the state's emission reduction goals, but to date, the major truck manufacturers have been relatively absent in this space. At workshops and in meetings, some of these manufacturers stated that customers are not asking for ZEVs. Up to this point, smaller startup truck manufacturers have stepped in to fulfill market demand and have been designing zero-emission trucks for a number of years. The majority of these startup companies do not have broad dealer networks or regional service facilities that can be leveraged quickly to provide support and maintenance services for zero-emission technology. They also may lack the ability to deliver very large orders for major fleets. This has hampered ZEV expansion for early adopter fleets. Over the last decade, a number of fleet owners have purchased zero-emission trucks from smaller startups companies and have expressed concern about their experience in securing service and repairs to support their ZEVs in operation. In some cases ZEV orders were placed that were not fulfilled. In addition, some products launched previously by large manufacturers were also discontinued due to issues with their ZEV component suppliers.

Today, many established manufacturers have announced plans to launch commercially available ZEVs in the next few years. While these announcements indicate the general direction the industry appears to be going, they do not guarantee vehicles will be produced or stay in production. The Proposed ACT Regulation would provide certainty for manufacturers to make the investments today to produce increasing numbers of ZEVs.

D. Need to Gather Information on Vehicle Operations

In August 2018, Governor Brown sent a letter to CARB Chair Mary Nichols directing the agency to assess the viability of new regulations to increase ZEV adoption in California fleets. While CARB has sufficient information for the proposed manufacturer ZEV sales requirement, more fleet specific information is needed to properly assess which strategy would be most effective to require the use of ZEVs to accelerate the market for medium- and heavy-duty ZEVs in a wide range of fleet applications.

As part of the Proposed ACT Regulation rulemaking process, in 2018, CARB staff worked with stakeholders to develop a voluntary Fleet Operation Survey and sent it to about 500 addresses by mail and 1,500 email addresses through the “actruck” list serve on the CARB website. CARB received 20 completed survey responses indicating a less than 1 percent response rate. Staff are planning to develop additional strategies to complement the Proposed ACT Regulation that would be implemented by 2024 as part of the overall strategy to meet state goals. The large entity reporting requirement included in the Proposed ACT regulation will provide key information staff needs to explore alternative methods to further increase the use of ZEVs where they are suitable while incorporating the appropriate flexibilities where needed.

III. OVERVIEW OF PROPOSED ACTIONS AND RELATED PROGRAMS

A. Summary of Proposed Action

The Proposed ACT Regulation is part of a holistic approach to transform the transportation sector to the cleanest possible technologies. It is a technology forcing measure to accelerate the deployment of zero-emission trucks and buses everywhere feasible. The Proposed ACT Regulation also provides a strong market signal for zero-emission technology deployment and would foster a self-sustaining zero-emission truck market through increasing sales of medium and heavy-duty zero-emission trucks and buses in California.

The Proposed ACT Regulation includes two primary elements. First, it requires a percentage of truck and bus sales to be zero-emission. Second, it requires large entities including retailers, manufacturers, government agencies, and large truck fleets to report information to be used for future regulations to increase the use of ZEVs.

B. ZEV Sales Requirement

The proposed manufacturer ZEV sales requirement applies to all manufacturers that certify vehicles for sale in California in weight Classes 2b through 8—that is, with a gross vehicle weight rating (GVWR) greater than 8,500 lbs. Small manufacturers with fewer than 500 annual sales in California would be exempt but may opt-in to the regulation to claim ZEV credits.

Affected manufacturers would incur deficits for each vehicle sold into California starting with the 2024 MY that must be met with credits generated from producing and selling ZEVs or NZEVs into California starting in 2021 MY. Pickup truck sales would be excluded from Class 2b-3 ZEV sales requirement until the 2027 model year due to concerns raised by manufacturers about potentially highly variable towing needs and associated impacts on range. The requirements increase annually until the 2030 MY, and are detailed in Table III-1.

Table III-1: ZEV Sales Percentage Schedule

Model Year (MY)	Class 2b-3 Group*	Class 4-8 Group**	Class 7-8 Tractor Group
2024	3%	7%	3%
2025	5%	9%	5%
2026	7%	11%	7%
2027	9%	13%	9%
2028	11%	24%	11%
2029	13%	37%	13%
2030 and beyond	15%	50%	15%

*Excludes pickups until 2027 MY
**Excludes Class 7-8 Tractors, Includes Yard Tractors

Credit value is based on vehicle weight class to account for higher emissions associated with larger vehicles and to provide manufacturers flexibility in meeting compliance requirements. The proposed weight class modifiers are adjustment factors that were selected to keep credits and deficits approximately equitable from an emissions standpoint and are shown in Table III-2.

Table III-2: Weight Class Modifiers

Weight Class	Class 2b-3	Class 4-5	Class 6–7*	Class 7 Tractors and All Class 8
Weight Class Modifier	0.6	1	1.5	2

*Excludes Class 7 tractors

This approach provides flexibility for manufacturers to produce more ZEVs in one group to avoid making a small number of ZEV sales in other groups. However, to ensure ZEV tractors will be available to reduce emissions at ports and other areas with high tractor concentrations, only Class 7 and 8 tractor credits may be used to satisfy Class 7 and 8 tractor ZEV deficits. For example, if a manufacturer sells 300 Class 4 trucks and 500 Class 6 trucks in the 2024 MY, they would accumulate a deficit of 73.5 credits. A manufacturer can offset this deficit by producing and selling 74 Class 4 ZEVs, or alternatively they could sell 49 Class 6 ZEVs.

Staff are proposing that NZEVs would earn partial credits based on their all-electric range up to 75 percent of an equivalent ZEV. All-electric range would be determined by using the same test methods set forth by the California Phase 2 GHG rules. NZEV credits may only account for up to one half of the total annual weighted deficits to ensure that full ZEVs are produced and sold in California.

Staff are proposing that credits may be generated, banked, and traded by manufacturers starting with the 2021 MY. Staff are also proposing to set a limited lifetime for credits to guarantee actual ZEV production and sale. However, beginning with the 2024 MY, staff are proposing manufacturers must certify using the ZEP Certification procedures where it applies to continue to earn ZEV credits.

Finally, staff are proposing to specify that Class 2b-3 ZEV sales may not be counted in the Proposed ACT Regulation if the same ZEV sales are claimed in the ACC regulation to avoid double counting.

Manufacturers that are subject to the ZEV sales requirement and those who sell ZEVs and want to earn credits must report sales information and credit trade information annually to CARB to demonstrate compliance. Manufacturers must report details of credit trade transactions so CARB can determine and track compliance.

C. Large Entity Reporting Requirement

Under the Proposed ACT Regulation, large entities that operate in California would be subject to a one-time reporting requirement in early 2021. The data collected would be used to inform decisions on what regulatory mechanism is most appropriate to ensure ZEV purchases are made where they are suitable, and to determine the appropriate flexibilities and off-ramps where they are not an appropriate fit. The questions were selected to collect information needed to determine if entities that hire truck fleets could become the point of regulation and to better understand how trucks are used by individual fleets. To streamline the process, affected entities would only be required to complete a one-time submittal of aggregated and binned data for representative facilities, rather than detailed information about every facility. Additionally, entities with vehicles would only be required to report binned, representative information about the vehicle types owned, rather than reporting operational data for every vehicle. The reporting requirement applies to a wide range of large businesses and government agencies, whether or not they own trucks and buses. A large entity is any of the following:

- Any entity with annual revenue greater than $50 million in the U.S. and does business in California including all subsidiaries, subdivisions, or branches.
- Any entity that owns more than 100 vehicles with a GVWR greater than 8,500 lbs. and operated at least one of those vehicles in California in 2019.
- Any entity that dispatched more than 100 vehicles with a GVWR greater than 8,500 lbs. in California in 2019.
- Any California government, including all state and local municipalities.
- Any Federal government agency operating in California.

Large entities can include; retailers, manufacturers, refiners, accounting firms, hotels, drayage terminal operators, utility providers, refuse companies, federal, state, and local government agencies and other types of large employers.

The information that large entities would be required to report includes information about different types of facilities operated in California, contracting practices, and vehicle usage information for those who own trucks. In general, regulated entities would be required to report information regarding any facility category they operate. Facility categories include grocery store (grocery, restaurant, and other), warehouse, distribution center, manufacturer/factory/plant, multi-building campus/base, service center, hotel/motel/resort, medical/hospital/care, administrative/office building, truck yard, and all other properties. Regulated entities would also be required to report information for a single representative facility for each category. Additionally, any regulated entities that own vehicles would be required to report vehicle usage information per facility, grouped by vehicle body type.

Facility information reporting consists of categorizing each physical address an entity operates in California into the facility categories provided, and answering questions for each of those categories for the group of facilities. The facility categories include store, restaurant, warehouse/distribution center, manufacturer/factory/plant, multi-building campus/base, service center, hotel/motel/resort, medical/hospital/care, administrative/office building, truck/equipment yard, and a category for all other properties. Facility information reporting also includes answering questions for a single representative facility for each applicable category. Vehicle usage information reporting consists of answering questions about the vehicles domiciled or assigned at each facility. The vehicle information would be grouped by body type and by weight class. The ability to group information and bins for general responses were selected to simplify reporting and were intended to reduce concerns about providing detailed information that could be considered business confidential.

To provide clarity, a sample reporting response can be found in Appendix J that illustrates what information might be collected and how a regulated entity can submit this information in tabular form.

D. Crossover with Other Programs

California faces challenging goals for public health and climate protections. To achieve these goals, a number of actions have been initiated by the legislature, CARB, and other state agencies. These various actions and directives work together to ensure the State achieve its goals and meets federal mandates. The Proposed ACT Regulation complements existing programs by providing certainty for the ZEV market and setting the stage for a full transition to ZEVs in certain applications.

The Innovative Clean Transit (ICT) regulation, adopted December 2018, requires that California transit agencies purchase zero-emission buses beginning 2023 and ramps up to 100 percent of purchases starting 2029. Larger buses used by transit agencies are typically built as complete vehicles by dedicated bus manufacturers. Nearly every bus manufacturer is offering ZEBs today. These bus manufacturers are distinct from truck manufacturers and are excluded from the Proposed ACT Regulation. However, cutaway shuttle buses are built as incomplete vehicles and are sold by truck manufacturers for a wide range of applications. It is challenging to determine whether a cutaway chassis will become a shuttle bus or a box truck and who the ultimate purchaser will be; therefore, all zero-emission cutaway vehicle sales may still be counted toward compliance with the Proposed ACT Regulation. To avoid double counting of costs and emissions, staff excluded the estimated sales of ZE cutaway shuttles needed to comply with the ICT regulation when estimating costs and emission benefits.

The Zero-Emission Airport Shuttle Bus (ASB) regulation, adopted July 2019, requires that public and private airport shuttle bus operators transition their fleets to fully zero-emissions by 2035. These regulations will require the purchase of ZEBs, cutaway shuttles, and passenger vans. To avoid double counting, staff excluded the estimated sales of zero-emission cutaway shuttles and zero-emission passenger vans needed to comply with the Zero-Emission ASB regulation when estimating costs and emission benefits.

AB 739, signed October 2017, requires California state-owned fleets to purchase 15 percent ZEVs at or over 19,000 lbs. GVWR starting in 2026, and increasing to 30 percent by 2030. This could be met with a wide range of zero-emission truck types. To avoid double counting, staff excluded the estimated sales of ZEVs required to comply with AB739 when estimating costs and emission benefits.

The Low Carbon Fuel Standard (LCFS) is a California regulation that achieves GHG reductions by requiring fuel producers to reduce the carbon intensity of their fuels or purchase credits from low carbon fuel suppliers. In September 2018, the regulation was amended to require that transportation fuel carbon intensity decrease 20 percent by 2030 and maintain that level afterwards. By creating a market mechanism for low carbon transportation fuels, the LCFS program incentivizes alternative fuels including electricity, hydrogen, natural gas and biofuels.

Electricity and hydrogen are both low carbon fuels with high Energy Efficiency Ratios (EER) meaning they can generate LCFS credits. For non-residential EV charging, the EVSE owner is directly eligible to receive LCFS credits which can be sold to regulated deficit generators to offset fuel costs. The LCFS program specifies that emission reductions associated with low carbon fuels are attributed to any regulation that requires the usage of an alternative technology, so the emission benefits of medium- and heavy-duty electrification are attributed to the Proposed ACT Regulation (CARB, 2018c).

In July 2019, CARB adopted the Zero-Emission Powertrain Certification procedures which established new, alternative certification procedures for heavy-duty battery-electric and fuel-cell vehicles and the zero-emission powertrains they use. ZEP Certification establishes a process that can be used to provide additional transparency, consistency, and stability in heavy-duty zero-emission market segments targeted by CARB's technology-forcing regulatory measures or incentives geared to deploying more-commercialized zero-emission vehicles. The Proposed ACT Regulation would make ZEP Certification mandatory starting with the 2024 model year for medium-and heavy-duty ZEVs. The costs associated with mandatory ZEP certification requirements are included in the economic impacts assessment.

In October 2016, U.S. EPA adopted the Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2 (Federal Phase 2 GHG) which requires manufacturers to produce more fuel efficient vehicles with lower CO_2 emissions beginning in 2021 Model Year (MY) and increasing in stringency through 2027 MY. In February 2018, CARB adopted the California Phase 2 GHG regulation that largely harmonizes with the federal regulation with a few separate provisions. Manufacturers can meet the Phase 2 GHG standards through a variety of technologies including improved aerodynamics, low rolling resistance tires, engine and accessory optimization, weight reduction, idle reduction systems, hybridization, powertrain electrification, and more. In addition, Phase 2 GHG has an Advanced Technology Multiplier which gives a credit multiplier until the end of 2027 MY to PHEV, BEV, and FCEV technologies of 3.5, 4.5, and 5.5 respectively.

The Proposed ACT Regulation and the Phase 2 GHG regulations complement each other. Both regulations require the production of cleaner, lower CO_2 emitting vehicles and manufacturers can comply with both regulations simultaneously by building ZEVs. Manufacturers using ZEVs to comply with the Proposed ACT Regulation can use those towards Phase 2 GHG compliance which includes the Advanced Technology Multiplier. By allowing this flexibility, manufacturers can identify low-cost compliance pathways that will achieve real emissions benefits. For the purpose of GHG benefit accounting, only ZEVs sold in excess of the California Phase 2 GHG regulation's requirements are included in the tank-to-wheel portion of GHG calculations to avoid double-counting. For the cost analysis there are overlapping cost considerations that are discussed in detail in chapter IX.

The Advanced Clean Cars (ACC) ZEV Program is an existing California regulation that requires light-duty manufacturers of Class 1 and 2A vehicles to offer for sale specific numbers of the very cleanest cars available. These vehicle technologies include full battery-electric, hydrogen fuel cell, and plug-in hybrid-electric vehicles. The ZEV regulation is part of the broader Advanced Clean Cars package of regulations, a set of tailpipe regulations put in place to limit smog-forming and GHG emissions from light-duty vehicles.

The Proposed ACT Regulation applies to larger vehicles, but interacts with an optional credit provision for Class 2b and 3 ZEVs that is included in the Advanced Clean Cars (ACC) ZEV Program, specifically title 13 CCR §1962.2(g)(3). The ACC ZEV Program does not require manufacturers to produce and sell Class 2b and 3 ZEVs, but it does give credits if they do. The Proposed ACT Regulation avoids double counting with ACC by specifying that manufacturers may not use credits from the same Class 2b and 3 vehicles in both rules.

The San Pedro Bay Ports, consisting of the Port of Los Angeles and the Port of Long Beach, released their updated 2017 Clean Air Action Plan (CAAP) which aims to reduce air pollution over the upcoming decades and support the statewide vision for more sustainable freight movement (SPBP, 2017). This plan calls for significant reductions in NOx, diesel PM, sulfur oxides, and GHGs from all sectors including trucks, off-road equipment, ships, and trains. On-road drayage trucks are the second largest source of NOx at the ports and the largest source of GHG emissions, so reducing their emissions is vital to meeting the ports' goals. The CAAP proposes to establish a new Clean Truck Program with a goal to have a fully zero-emission drayage truck fleet by 2035 by using fees and other policy levers. In 2024 the plan will require trucks entering the port to be zero-emission, meet the upcoming Low-NOx standard, or pay a fee, and by 2035 the trucks would need to be zero-emission or would have to pay the fee. The CAAP creates demand for zero-emission trucks as drayage truck operators have an incentive to adopt ZEV technology and avoid fees, and the Proposed ACT Regulation supports the CAAP by ensuring zero-emission tractors are available for drayage truck operators to purchase.

SB 350 supports widespread transportation electrification. The implementation of SB 350 reduces barriers to cost for infrastructure for fleets that act before the regulation begins in 2024 and supports early ZEV deployments. On May 31, 2018, the California Public Utility Commission (CPUC) unanimously approved transportation electrification projects proposed by three major investor-owned utilities including $236 million from Pacific Gas and Electric and $343 million from Southern California Edison on medium and heavy-duty infrastructure installation. On August 15, 2019, the CPUC unanimously approved a $107 million proposal for San Diego Gas and Electric's transportation electrification of medium- and heavy-duty vehicles. All three investor-owned utilities have either proposed or been approved to establish new electricity rates for commercial ZEV deployments. These programs support the Proposed ACT Regulation by lowering electricity and infrastructure costs to fleets. In addition, the Proposed ACT Regulation supports the utility's SB350 efforts by ensuring that ZEVs will be available to take advantage of these programs.

Assembly Bill 2061 (AB 2061) is a complementary piece of legislation that mitigates vehicle weight concerns for ZEVs required by the Proposed ACT Regulation. AB 2061, to the extent expressly authorized by federal law, authorizes a near-zero-emission vehicle or a zero-emission vehicle to exceed the weight limits on the power unit by up to 2,000 pounds. Today, ZEVs can weigh more than their ICE counterparts so AB 2061 gives ZEVs additional flexibility to fleet needs in higher weight applications.

CARB staff are concurrently developing the Heavy-duty Low-NOx Omnibus rulemaking to further reduce emissions from combustion engines which is scheduled for Board consideration in early 2020.[1] The Heavy-duty Low-NOx Omnibus rulemaking is a multi-pronged, holistic approach to decrease emissions of 2022 MY and subsequent new heavy-duty engines. This rulemaking will lower NOx emissions by lowering tailpipe NOx standards, establishing a new low-load test cycle to ensure emissions reduction are occurring in all modes of operation, strengthening durability, lengthening warranty and useful life, and in-use testing provisions, along with other measures. This effort will complement the Proposed ACT Regulation by ensuring that the portion of a manufacturer's production that will remain combustion powered will be using the cleanest possible technology.

[1] More details on the Heavy-duty Low-NOx rulemaking are discussed on the program website at https://ww2.arb.ca.gov/our-work/programs/heavy-duty-low-nox

IV. THE SPECIFIC PURPOSE AND RATIONALE OF EACH ADOPTION, AMENDMENT, OR REPEAL

The Proposed ACT Regulation language can be found in Appendix A and includes two primary elements. First, it requires manufacturers to make a percentage of truck and bus sales zero-emissions. The manufacturer sales requirements are in title 13, California Code of Regulations, sections 1963 throughout IV to 1963.5. Second, it requires large entities including retailers, manufacturers, and government agencies, to report information about services they contract for that require the use of trucks and shuttles and to provide information about their fleet of vehicles. The large entity reporting requirements are in title 13, California Code of Regulations, sections 2012.0 to 2012.3.

The Proposed ACT Regulation will adopt new sections 1963, 1963.1, 1963.2, 1963.3, 1963.4, 1963.5, 2012.0, 2012.1, 2012.2, and 2012.3, title 13, California Code of Regulations.

A. Manufacturer ZEV Sales Requirement

Section 1963.0 Advanced Clean Trucks Purpose, Applicability, Definitions, and General Requirements.

Purpose

The purpose of this section is to describe the general purpose of the Proposed ACT Regulation, to identify the regulated entities, to set forth definitions for various terms used through the regulation text, and the general requirements.

Rationale

This section is necessary to identify the general purpose of the regulations is to accelerate the market for medium- and heavy-duty ZEVs as part of California’s strategy to reduce emissions. The section also is necessary to identify the scope of the regulation and who is subject to its requirements, and to set forth definitions for various terms used in the regulation. Additionally, the section is needed to identify the basic compliance requirements and to whom the requirements apply.

Section 1963(a) Purpose.

Purpose

This subsection describes the purpose of the regulation, which is to accelerate the market for medium- and heavy-duty ZEVs to reduce criteria pollutants, toxic contaminants, and GHG emissions from the medium- and heavy-duty vehicle sector.

Rationale

This subsection is necessary to identify the purpose of these regulations and is part of the state's overall strategy to reduce emissions. The primary objectives of the Proposed ACT Regulation include the following:

- Accelerate first wave of zero-emission (ZE) truck deployments in best suited applications;
- Achieve 100 percent zero-emission pickup-and-delivery in local applications by 2040;
- Support the Ports of Los Angeles and Long Beach Clean Air Action Plan for 100 percent zero-emission drayage trucks by 2035;
- Support AB 739 requiring California state government fleets to purchase ZEVs;
- Enable a large-scale transition to zero-emission technology;
- Maximize the total number of ZEVs deployed;
- Complement existing and future programs;
- Provide environmental benefits, especially in disadvantaged communities, thereby supporting the implementation of AB 617;
- Ensure requirements are technologically feasible and cost effective; and
- Foster a self-sustaining zero-emission truck market.

Section 1963(b). Scope and Applicability.

Purpose

The purpose of this subsection is to identify manufacturers that certify vehicles over 8,500 lbs. GVWR for sale in California as the regulated parties for the specified sections.

Rationale

This subsection is necessary to establish which parties are the regulated parties. This regulation is intended to reduce emissions from vehicles manufactured and sold into California, and to accelerate the adoption of zero-emission technologies in the medium- and heavy-duty vehicle sectors, which are vehicles over 8,500 lbs. GVWR. ZEV sales are already required by other regulations for vehicles at or below 8,500 lbs. GVWR.

Section 1963(c). Definitions.

Purpose

The purpose of this subsection is to set forth definitions for terms used in the proposed regulation order and identifies the sections for which the definitions apply.

Rationale

This subsection is necessary to define terms and to provide clarity as to what is required and how the regulation's requirements must be met.

Section 1963(c)(1). All-Electric Range.

Purpose

The purpose of this subsection is to define all-electric range as having the same meaning and test procedures as the established California Phase 2 GHG regulation.

Rationale

This subsection is necessary to set forth the meaning and test procedures by which NZEVs must be tested to determine the all-electric range needed to receive NZEV credit for this regulation. Making this definition consistent with what is already required in the California Phase 2 GHG regulation simplifies reporting and compliance tracking and avoids added costs from applying a different method to serve the same purpose.

Subsection 1963(c)(2-10). Class 2b-3, Class 2b-3 Group, Class 4, Class 4-8 Group, Class 5, Class 6, Class 7, Class 7-8 Group, Class 8.

Purpose

The purpose of these subsections is to define each vehicle weight class category by gross vehicle weight rating and to define vehicle groups for purposes of simplifying the description of how the requirements differ for each group.

Rationale

These weight class and group category definitions establish boundaries to ensure manufacturers can determine the number of ZEVs and NZEVs needed to meet the compliance requirements for a wide range of vehicles sold. Weight class is also an indicator of vehicle size and associated emissions needed for establish different credits for larger vehicles than smaller vehicles to provide flexibility for manufacturers without compromising the expected emissions benefits of the regulation.

Yard tractors are included in the Class 4-8 Group as their low speed operation, low range needs, and central operation, are suitable for electrification in-line with the other Class 4-8 vocational vehicles. They are also commonly used in ports and distribution centers in disadvantaged communities that need localized emission reductions.

Subsection 1963(c)(11)(A-D). Excluded Bus

Purpose

The purpose of this subsection is to define which types of buses are excluded from being counted in a manufacturer's sales volume and are excluded from earning credits.

Rationale

This subsection is necessary to ensure more ZEVs are manufactured and to avoid giving credits for producing buses that are already required by other CARB zero-emission regulations and are widely commercially available. Transit buses, double-decker buses, 60-foot articulated buses, and motor coach buses are all examples of passenger- carrying vehicles with a GVWR over 14,000 lbs. that would be excluded from the annual sales requirement because these ZEBs are already required to be purchased due to the ICT and Zero-Emission ASB regulations.

This definition does not include buses that are typically manufactured as cutaway or cab-and-chassis incomplete vehicles and may be equipped with a shuttle body that is added after initial manufacture. Staff recognize that these vehicles may ultimately be sold as ZEVs to comply with the ICT and ASB regulations and has excluded ZEV sales that are already required when estimating costs and emissions for the Proposed ACT Regulation. Staff are not proposing to exclude ZEV sales of these cutaway or cab-and-chassis incomplete vehicles from being counted by manufacturers, because it would be challenging for the manufacturer and CARB to determine whether the incomplete vehicle becomes a transit bus, school bus, or shuttle in final assembly, or whether a shuttle would be used at an airport. In this way, the Proposed ACT Regulation will increase the sale of these incomplete vehicles which will also benefit fleets that need to purchase ZEVs, including transit agencies subject to the ICT regulation and those subject to the Zero-Emission ASB regulation.

Subsection 1963(c)(12). Gross Vehicle Weight Rating (GVWR)

Purpose

The purpose of this subsection is to define GVWR as having the same meaning as the California Vehicle Code Section 350.

Rationale

This subsection is necessary to ensure all manufacturers will use the same criteria to determine a vehicle's weight class and how it will be counted to comply with the regulation.

Subsection 1963(c)(13). Manufacturer

Purpose

This subsection defines manufacturer to mean those entities or persons engaged in manufacturing or assembling new motor vehicles or engines, and includes importers, glider kit manufacturers, and glider kit assemblers in the definition.

Rationale

This definition is needed to describe what a manufacturer is in order to limit the scope of the regulations to only affect intended parties. The definition closely aligns with California Phase 2 GHG for consistency. Dealers are excluded because they do not manufacture vehicles but may be construed as representing a manufacturer, and are a point of sale. Importers of vehicles for resale are included to minimize the potential for importers to gain a competitive advantage and to guard against manufacturers from circumventing the requirements by passing vehicles for sale in California through another entity to artificially reduce compliance obligations or inappropriately claim the small manufacturer exemption.

Subsection 1963(c)(14). Model Year

Purpose

This subsection defines model year as meaning the same as the California Phase 2 GHG definition of Model Year.

Rationale

This is needed to clearly define model year and to avoid potential confusion with differing model year definitions for the same vehicle sold in California that may be counted when determining compliance with different regulations that apply to the manufacturer. Using the same definition as the Phase 2 GHG regulations allows the same information to be used in reporting compliance with both regulations without adding additional reporting burden and it already includes limits on the manufacturer model year designation to prevent circumventing rule requirements.

Subsection 1963(c)(15)(A-B). Near-Zero-Emission Vehicle

Purpose

The purpose of this subsection is to define near-zero-emission vehicle as having the same meaning as a plug-in hybrid electric vehicle as defined in the California Phase 2 GHG regulation with a minimum all electric range regardless of how the battery would be charged from an external electricity source.

Rationale

This subsection is necessary define which vehicles may be counted to claim NZEV credits to comply with the regulation what is meant when the term NZEV is used in the regulation. Using the same definition for PHEV and the minimum all-electric range as the California Phase 2 GHG regulation allows the same information to be used in reporting compliance with both regulations without adding additional reporting burden. The federal definitions are also included in Appendix B. However, this definition is broader than the California Phase 2 GHG definition for PHEV because it also includes vehicles with the same minimum all electric range but can be charged without a plug from an external source such as wireless charging or catenary systems.

Subsection 1963(c)(16). NZEV Credit

Purpose

The purpose of this subsection is to define NZEV credits as meaning the weighted credits that are generated by producing and selling vehicles with NZEV drivetrains in California.

Rationale

This subsection is necessary to establish what is meant when the regulation language references NZEV credits and how they are calculated. NZEV credits are treated different than ZEV credits and will need to be tracked separately.

Subsection 1963(c)(17). Pickup Truck

Purpose

The purpose of this subsection is to define pickup trucks as having the same meaning as the California Code of Regulations section 150.04.

Rationale

This subsection is necessary to ensure consistent definitions between State regulations. It is also necessary to enable manufacturers to identify the types of vehicles that are excluded from the annual sales volume for Class 2b-3 vehicles when determining the ZEV deficits accrued.

Subsection 1963(c)(18)(A-B). Tractor

Purpose

The purpose of this subsection is to define tractor as having the same meaning as the California Phase 2 GHG regulation and to include the definitions of vocational tractor as defined in the California Phase 2 GHG.

Rationale

This subsection is necessary to clearly identify which vehicles are counted in the Class 7 and 8 Tractor weight class category of the proposed regulation. This definition includes the same definition of tractor and vocational tractor in the California Phase 2 GHG regulation to minimize reporting burden.

Subsection 1963(c)(19)(A-D). Vehicle

Purpose

The purpose of this subsection is to define the term vehicle to mean equipment with a GVWR over 8,500 lbs. that is intended for use on highways, and that otherwise meets the definition of vehicle provided in California Phase 2 GHG regulation. This subsection also specifically excludes trailers, which have the same meaning as trailers in the California Phase 2 GHG regulation, and excluded buses as previously defined in the proposed Advanced Clean Trucks regulation.

Rationale

This subsection is necessary to inform regulated entities as to which subset of vehicle sales are included in the scope of the regulation and which are not. It is also necessary to narrow the scope of the proposed regulation to heavier vehicles that are not trailers, as trailers are not self-propelled equipment and are not within the scope of this regulation.

Subsection 1963(c)(20). Yard Tractor

Purpose

The purpose of this subsection is to define yard tractor as an on-road vehicle that operates a hydraulic fifth wheel and is used in moving and spotting trailers and containers at locations or facilities, and provides some common industry terminology by which yard trucks are more commonly referenced.

Rationale

It is also necessary for manufacturers to identify these vehicles in the scope of the regulation and how they will be counted for determining credits and deficits. On-road yard trucks are commonly used in off-road applications and therefore can be mistaken as off-road vehicles that are not subject to the proposed regulation.

Subsections 1963(c)(21). Zero-Emission Vehicle (ZEV)

Purpose

The purpose of this subsection is to define zero-emission vehicles as having drivetrains with zero exhaust emissions of criteria pollutants, precursor pollutants, or GHGs.

Rationale

This subsection is necessary to simplify the language by grouping all ZEV types in this definition. This allows the language to address all ZEVs together rather than needing to describe each type of ZEV separately each time it is needed.

Subsections 1963(c)(22). ZEV Credit

Purpose

The purpose of this section is to define ZEV credit to mean a numerical value that is generated by producing and selling a ZEV in California. .

Rationale

The definitions are needed to establish what is meant where the regulation language references ZEV credits and how they are calculated and how they count towards compliance.

Subsections 1963(d)(1)(A-B). General Requirements: Credits must match or exceed deficits.

Purpose

The purpose of this subsection is to identify the conditions that a manufacturer must meet to be determined in compliance with the ZEV sales requirement. Class 7-8 Tractor Group deficits must be met with credits from selling Class 7-8 vehicles.

Rationale

This subsection is necessary to establish the compliance structure. This section identifies the types of credits acceptable to satisfy each type of deficit and the necessity for the credits to exceed deficits for a manufacturer to be in compliance.

Section 1963(e). Low Volume Exemption

Purpose

The purpose of this subsection is to identify low volume manufacturers as those that never exceed 500 average annual sales of Class 2b and greater vehicles in California, and to exempt those manufacturers from the ZEV sales requirements.

Rationale

This subsection is necessary to make smaller manufacturers exempt from the ZEV sales requirement due to investment costs to design and build ZEVs and limited sale volume. The threshold includes a majority of the largest manufacturers who are in a better position to recoup their investment than small manufacturers. Staff selected 500 vehicles as the appropriate threshold with the input of stakeholders and staff analysis of the manufacturing industry and number of ZEVs required to be produced each year.

Small manufacturers may generate credits for ZEV and NZEV production and sale, which will help support the existing market, will further develop the market supply chain, service and maintenance networks, help drive down the costs of zero-emission drivetrain components, and ultimately accelerate the adoption of zero-emission technologies in California.

Section 1963(f). Voluntary Credit Generation

Purpose

The purpose of this subsection is to establish that manufacturers that are exempt from the general requirements due to their low sales volume can still earn, bank, and trade ZEV or NZEV credits. This subsection also establishes that these manufacturers are subject to the other provisions that apply to all large manufacturers for credit generation, reporting and recordkeeping requirements, and enforcement.

Rationale

This subsection is necessary to set forth the same limitations on credit generation, banking, and trading as the large manufacturers to ensure a level playing field, and establish reporting requirements for CARB to assess compliance and ensure transparency in the credit market. Additionally, this subsection is necessary to reduce barriers to entry in the ZEV and NZEV markets for small volume manufacturers, which may allow for more innovative ground-up vehicle designs and will pave the way for small manufacturers to transition to ZEV manufacturing as the ZEV market matures.

Section 1963.1. Advanced Clean Trucks Deficits

Purpose

This section identifies the method of assigning deficits to manufacturers based on the vehicles sold into California each year.

Rationale

This section is necessary to establish the number of deficits a manufacturer generates based on total vehicle sales. The deficits must be offset with credits to comply with the regulations.

Section 1963.1(a)(1). Deficit Generation

Purpose

This section sets forth the requirement that manufacturers generate deficits based on annual sales volume, starting with the 2024 model year. It also identifies the requirement for deficits to be matched with ZEV or NZEV credits.

Rationale

This section is necessary to establish a reasonable lead time for manufacturers to develop new product lines to meet the requirements of the regulation. Additionally, this section is needed to set forth that deficits must be met by credits.

Section 1963.1(a)(1)(A) Pickup Exclusion

Purpose

The purpose of this subsection is to exclude pickup trucks from the calculation of annual sales volume until the 2027 model year when determining annual deficits.

Rationale

This subsection is necessary to recognize stakeholder concerns about unique challenges to electrifying the pickup truck segment. At workshops and meetings, manufacturers indicated that medium- and heavy-duty pickup trucks have highly variable towing needs and could result in limited range for battery-electric platforms until the technology matures. To date there are no commercially available zero-emission pickups although several manufacturers have announce plans to produce light duty pickups in the near future. Providing additional three years provides sufficient time to gain experience with early models, including light-duty ZEV models, and still ensures technology advancement and emission reduction from all medium- and heavy-duty vehicle categories.

Section 1963.1(a)(1)(B). Deficit Calculation

Purpose

This subsection describes the method by which manufacturers are required to calculate annual deficits. The required method is detailed in Equation A-1 of the Proposed ACT Regulation, and identifies the deficit for a weight class category as equal to the weight class modifier multiplied by the annual sales volume and the sales percentage requirement for the weight class in a given model year.

This subsection also describes the percentage of ZEV sales required in each model year for each weight class category and how the weight class modifiers are used to convert sales percentages into weighted deficits. The proposed percentage schedule is detailed in Table A-1 of the proposed regulation. The Class 2b-3 group and the Class 7-8 Tractors group have the same phased in requirements, starting from 3 percent in the 2024 model year and increasing to 15 percent in the 2030 model year. Vehicles in the Class 4-8 group would begin with a 7 percent requirement in the 2024 model year and increase to 50 percent in the 2030 model year. All class category percentage requirements remain constant beyond the 2030 model year.

Finally, this subsection also identifies the weight class modifiers used to weight the annual deficits and credits. Staff are proposing Class 2b-3 vehicle to have a modifier of 0.6, Class 4 to 5 vehicles to have a modifier of 1, all of Class 6 and Class 7 vehicles except for Class 7 tractors to have a modifier of 1.5, and Class 7 tractors and all Class 8 vehicle to have a modifier of 2.

Rationale

This section is needed to establish a method of calculating annual deficits, set forth the required minimum annual percentage of ZEVs that manufacturers must produce and sell for each model year and weight class category, and to identify the modifier needed to convert sales into weighted deficits based on vehicle efficiency.

The required ZEV sales percentages increase gradually with time to reflect continued technology improvements, availability of longer ranges of ZEVs, and to allow time for fleets and manufacturers to expand infrastructure and train more technicians.

Today, the Class 2b-3 group and Class 7 and 8 tractors group have more limited commercial availability, and have operational characteristics that are not as suitable for electrification over the next 5 years when compared to other medium- and heavy-duty vehicles. Many tractors engage in long haul operations where limited battery-electric range may be a concern, and public hydrogen fueling or fast charging for these vehicle is not yet available.

The Class 4-8 group is comprised of straight trucks and shuttles that are widely available with zero-emission technology, and generally have operating characteristics that are suitable for electrification with technology that exists today. Most of these vehicles return to a central yard where infrastructure can be installed, have stop and go operations, predictable daily routes and relatively low daily range needs

The weight class modifiers selected account for higher emissions associated with larger vehicles while preserving expected emissions reductions. The weight class modifiers are necessary to keep the Proposed ACT Regulation as simple as possible while providing flexibility for manufacturers to allow for the transfer of credits between weight classes except as specified in the next section.

Section 1963.2. Advanced Clean Trucks Credit Generation, Banking, and Trading

Purpose

The purpose of this section is to set forth the methods by which a manufacturer may generate ZEV and NZEV credits, requirements for certification and test procedures, and limitations on the lifetime of credits and limits on the amount of NZEV credits that manufacturers can use to meet their deficit obligations. More detail is provided for each subsection following.

Rationale

This section is necessary to establish the calculations used to determine ZEV and NZEV credits, to specify how manufacturers shall maintain and transfer credits, and to describe how credits may be used. More detail is provided for each subsection below.

Section 1963.2(a). ZEV Credit Calculation

Purpose

The purpose of this subsection is to define how ZEV credit generation shall be calculated. ZEV credits would be calculated by multiplying the number of ZEVs sold into California by the applicable weight class modifier.

Rationale

This subsection is necessary to establish the calculation by which CARB will determine the number of ZEV credits earned in a model year by a manufacturer and to establish a weighting factor for credits earned to account for higher emissions associated with larger vehicles. This method applies to both credits and deficits and provides flexibility for manufacturers to produce more ZEVs in one weight class to meet deficits from vehicle sales in another weight class category while keeping expected emission about the same.

Section 1963.2(b). NZEV Credit Calculation & NZEV Factor Value

Purpose

The purpose of this subsection is to define how NZEV credit generation shall be calculated. NZEV credits would be calculated by multiplying the number of NZEVs sold into California by the applicable weight class modifier and NZEV Factor Value. The NZEV factor value would be equal to 0.01 times the vehicle's all-electric range by the same method required in the California Phase 2 GHG regulation. The NZEV factor would not exceed 0.75 so that the maximum credit a NZEV could earn would be up to 75 percent of a ZEV credit for an equivalent vehicle. The NZEV credit would be zero if the NZEV is not certified to achieve a minimum all-electric range. NZEV credits would no longer be generated after the 2030 model year.

Rationale

This subsection is necessary to establish the calculation by which CARB will determine the number of NZEV credits earned in a model year by a manufacturer and to establish weighting factor for credits earned to account for higher emissions associated with larger vehicles. The NZEV factor limitations are designed to ensure that this proposed regulation meets its goals of accelerating the deployment of zero-emission technologies; NZEV s have the potential for zero-emission operations, and are a bridge technology that support the ZEV market, but they have internal combustion engines and thus do not fully meet the goals of the regulation. To reflect this, staff discounted credit values for NZEV s, while providing opportunity for manufacturers to earn credit based on all-electric range which should encourage higher zero-emission range for NZEV s. This provides flexibility for manufacturers to meet customer applications that are not well suited for full ZEVs, and promotes development of the zero-emission component supply chains, training and education.

NZEV credit generation ends with the 2030 model year because NZEV s do not fully meet CARB's zero-emission technology goals. They are a bridge technology which will help the development of the full zero-emission vehicle market, but should no longer be needed by 2030 as ZEVs and fuel cell stations or public fast charging station deployments are expected to be developed enough to meet the needs of all or nearly all applications. NZEV credits can provide flexibility that may support the early ZEV market for applications that are more challenging to be ZEVs, but it is unclear whether manufacturers are likely to utilize this option. NZEVs can avoid range anxiety issues, but still require the use of a conventional engine in combination with an electric drivetrain and may not result in significant cost reductions compared to making a full ZEV; additionally, they may not result in significant maintenance savings for potential buyers. Most manufacturers have already announced plans for full ZEVs and have stated that they are not planning to make additional models available as NZEVs.

Section 1963.2(c). Rounding

Purpose

The purpose of this subsection is to identify how calculated credits for the model year shall be rounded if the number of earned credits is not equal to a whole number, by rounding up to the nearest tenth when the fractional part of the required number of credits is equal to or greater than 0.05, and round down if less than 0.05.

Rationale

This subsection is necessary to establish the rounding practice that shall be used by CARB staff in determining the number of credits a manufacturer shall have generated during the model year. Additionally, the use of the conventional rounding method is consistent with that used in the Advanced Clean Cars ZEV Regulation.

Section 1963.2(d). Credit Banking

Purpose

The purpose of this subsection is to describe how manufactures may bank credits for future use.

Rationale

This subsection is necessary to establish the flexibility options for banking credits. Banking is necessary to allow manufacturers flexibility to prepare for anticipated market fluctuations and to correct for deficits if not enough credits were generated.

Section 1963.2(e). Credit Trading and Transfer

Purpose

The purpose of this subsection is to describe how manufactures may trade credits to other manufacturers.

Rationale

This subsection is necessary to establish the flexibility options trading credits. Trading is necessary to allow manufacturers flexibility to prepare for anticipated market fluctuations and to correct for deficits if enough credits were not generated. Additionally, some manufacturers may desire to over comply with the regulation to generate revenue with credit sales.

Section 1963.2(f). Credit Accounting

Purpose

The purpose of this subsection is to identify how manufacturers must account for credits in accounts separated by drivetrain type (NZEV vs ZEV), model year, and whether the credits are in the Class 7-8 tractor group or in the Class 2b-3 group or Class 4-8 group.

Rationale

The accounting subsection is necessary to identify when and from which categories the credits are generated so that the credits and associated deficit accounts can be appropriately tracked for compliance.

Section 1963.2(g)(1-2). Limited Credit Lifetime

Purpose

The purpose of this subsection is to set limits on the period that credits will be usable by manufacturers to meet deficits. It establishes the end of 2030 as the expiration date for credits generated in the 2021 to 2023 model years, and sets an expiration of the current model year plus four model years on credits earned in 2024 and after.

Rationale

This subsection is necessary to ensure that credits earned in excess of the minimum requirements do not get banked indefinitely and undermine goals to maximize the use of ZEVs everywhere feasible if the ZEV market grows faster than required. The credit life period provides flexibility to manufacturers in introducing new ZEV models and in using banked credits to manage annual truck sales fluctuations. Additional time would be provided to ZEVs manufactured prior to the 2024 model year to encourage early action.

Section 1963.2(h). Zero-Emission Powertrain Certification Requirement

Purpose

The purpose of this subsection is to establish the requirement that ZEVs sold into California must meet the requirements of the Zero-Emission Powertrain Certification regulation starting with the 2024 model year.

Rationale

This subsection is necessary to establish certification requirements for zero-emission vehicles that are sold into California as a result of this regulation. The Zero-Emission Powertrain Certification regulation is not applicable to complete vehicles with a GVWR from 8,501 through 14,000 lbs. GVWR. This requirement is necessary to establish minimum criteria for the quality and reliability of ZEVs, ensure information regarding ZEVs and their powertrains are effectively and consistently communicated to purchasers, and to accelerate progress towards greater vehicle reparability. Adding market transparency, consistency, and stability is critical for broad market adoption of zero-emission technology in the heavy-duty sector.

Section 1963.2(i). No Double Counting for Advanced Clean Cars ZEVs

Purpose

The purpose of this subsection is to avoid double counting credits from selling a medium-duty ZEV into California for both the Proposed ACT Regulation and the Advanced Clean Cars Light Duty ZEV regulation. This subsection also sets a requirement for manufacturers to declare the regulation for which the ZEV sold into California would generate credits to be used for compliance with that regulation.

Rationale

This subsection is necessary to prevent expected emissions benefits already claimed by the Advanced Clean Cars Light Duty ZEV program. The Advanced Clean Cars Light Duty ZEV includes a provision that gives the manufacturer the option to count Class 2b-3 ZEVs towards compliance. This provision gives the manufacturer the choice as to how a ZEV that could be used to comply with either regulation would be counted and ensures the ZEV sold into California would only be counted once.

Section 1963.3. Advanced Clean Trucks Compliance Determination

Purpose

This section describes how compliance is determined, how outstanding deficits may be made up, details the order of ZEV and NZEV credit retirements and establishes a maximum limit for the number of NZEV credits that can be used to meet annual compliance requirements.

Rationale

This section is needed to establish the methods to be used to determine compliance, to specify how credits may be used, and the order in which credits will be retired as detailed in the subsections.

Section 1963.3(a). Annual Compliance Determination

Purpose

The purpose of this subsection is to describe how deficit and credit accounts for manufacturers shall be calculated annually for determining compliance.

Rationale

This subsection is necessary to establish the method and period of determining compliance for each manufacture by calculating deficit and credit accounts based on reported information.

Section 1963.3(b). Requirement to Make Up a Deficit.

Purpose

The purpose of this subsection is to describe the amount of time a manufacturer has to fulfill a ZEV deficit obligation if ZEV deficits were not offset with credits at the end of a model year, and specifies that the deficits must be made up with solely with ZEV credits

Rationale

This subsection is necessary to allow for flexibility in the annual compliance determination to account for unforeseen market fluctuations that may affect a manufacturer's ability to comply in any one year. Manufacturers would have the option to satisfy the outstanding deficit with additional ZEV sales or by purchasing and retiring ZEV credits.

Section 1963.3(c)(1-3). Credit Retirement Order

Purpose

The purpose of this subsection is to establish the order in which CARB will debit credit accounts to meet deficit accounts. First, tractor credits are used to meet tractor deficits before the other deficit category. Second, the credits expiring first in any category shall be used first. Last, NZEV credits will be retired up to the maximum cap for NZEV, then ZEV credits, for each category.

Rationale

This subsection is necessary for three reasons. First, it ensures tractor credits satisfy a tractor deficit before they can be used to offset other deficits. This is to ensure that tractors are manufactured to support the goal of transitioning drayage trucks to zero-emissions by 2035 and in beginning the transition to ZEVs from tractors that operate locally or regionally. Second, using credits that expire first allows flexibility for manufacturers to bank early action credits while preventing, to the extent possible, credits from expiring due to age. Last, because NZEV credits have a cap, the NZEV credits would be used before ZEV credit to allow the more flexible ZEV credits to remain in a manufacturers account to be used when needed and continues to ensure that ZEVs must still be manufactured to meet the goals for maximizing the use of ZEVs where feasible.

Section 1963.3(d). NZEV Credit Limit

Purpose

The purpose of this subsection is to establish a limit to the usage of NZEV credits to satisfy a manufacturer's incurred deficits.

Rationale

This subsection is necessary to ensure ZEVs are produced and NZEVs are not the only vehicles produced. However, allowing NZEV credits to meet up to half of the obligation provides flexibility for manufacturers and promotes the state goal of "zero-emission wherever possible, near-zero everywhere else" in hard-to-electrify market segments.

Section 1963.3(e). Tractor Deficits Must Be Met With Tractor Credits

Purpose

The purpose of this subsection is to set a limit on the type of credits needed to satisfy deficits in the Class 7-8 tractor group.

Rationale

This section is necessary to ensure the development and deployment of zero-emission technologies in tractors which represent one of the largest on-road emissions categories and to support broader CARB strategies to reduce emissions in disadvantaged communities and areas with high concentrations of truck traffic such as ports, railyards, and warehouses.

Section 1963.4. Advanced Clean Trucks Reporting and Recordkeeping

Purpose

The purpose of this section is to establish what information manufacturers are expected to report to CARB. Manufactures must report vehicle sales into California for each model year, credit transfers each year, and to declare which regulation medium-duty ZEV credits are to be applied. Additionally, this subsection establishes reporting deadlines each calendar year for all information required.

Rationale

This section is necessary to establish a reporting deadline for manufacturers and identify the types of information a manufacturer must report to CARB and to identify how long records must be kept.

Section 1963.4(a)(1-7). Sales Reporting

Purpose

This subsection proposes that every manufacturer shall report sales information to CARB annually beginning with the 2021 model year by March 31 of the following calendar year toward meeting the requirements of sections 1963 through 1963.3. This section also proposes that manufacturers report the weight class and number of vehicles sold into California and whether the vehicle type is a tractor or not the type of drive train.

Rationale

This subsection is necessary as it identifies the starting date of the reporting requirements and clarifies all manufacturers that incur deficits or earn credits must report annually.

The reporting deadline of March 31 is necessary to align with the initial reporting date for the California Phase 2 GHG regulation, which already has a reporting system established that staff can leverage to limit the burden of reporting by preventing affected manufacturers from having to report the same information to CARB twice. It also provides time for manufacturers to gather information after the end of the model year to be able to report accurate information to CARB.

Reporting is necessary to facilitate enforcement of the regulation. This section also identifies the information required to establish compliance with the regulation as well as for verification of reported information in case of audit.

The VIN number of the vehicle sold is necessary for CARB to be able to verify whether the vehicle is sold into California.

The VIN code for Class 2b-3 vehicles is necessary for CARB to be able to identify whether the vehicle is sold as a complete pickup truck or an incomplete vehicle, as it relates to the pickup exemption for the Class 2b-3 group from 2024 to the 2027 model year.

The vehicle type weight class of the vehicle type sold is necessary to determine the category the vehicle type applies to regarding the ZEV sales percentage requirement as well as which weight class modifier is applicable to determine compliance.

The vehicle type as a tractor, non-tractor, or pickup is necessary to determine both the ZEV sales percentage requirement and transferability between vehicle weight class groups required to determine compliance.

The vehicle type as a ZEV, NZEV, or other is necessary to determine the vehicle type sales contribute to credit deficit or generation as well as restrictions in use and transferability between vehicle weight class categories required to determine compliance.

The vehicle production volume sold into California per vehicle type is necessary to determine deficits and ZEV credit generation required to determine compliance.

Section 1963.4(b) Credit Transfer Reporting

Purpose

The purpose of this subsection is to establish that manufacturers that either receive or transfer credits must report such transactions annually to CARB, and that CARB will not recognize claimed transfers until the report is received.

Rationale

This subsection is necessary to set forth a reporting requirement for manufacturers that have traded or received credits so that CARB may be made aware of and properly account for and track credit trades between entities.

Section 1963.4(b)(1) Transfer Reporting Deadline

Purpose

The purpose of this subsection is to identify March 31 as the reporting deadline for credit transfer reports.

Rationale

This subsection is necessary to establish a deadline by which manufacturers are expected to report their credit transfer information that is consistent with the sales reporting deadline. This date aligns with the initial reporting date for the California Phase 2 GHG regulation, which already has a reporting system established that staff can leverage to limit the burden of reporting by preventing affected manufacturers from having to report the same information to CARB twice. It also provides time for manufacturers to gather information after the end of the model year to be able to report accurate information to CARB.

Section 1963.4(b)(2)(A-E) Required Credit Transfer Information

Purpose

The purpose of these subsections are to detail the required information that must be included as part of the credit transfer report, which shall include the corporate name of the credit transferor(s) and transferee(s) as well as the number of credits transferred for each model year, whether the credits transferred are ZEV or NZEV credits, and the whether the transferred credits are Class 7-8 Tractor group credits or other credits from other weight class groups. The report must be a letter or other document signed by authorized agents of both parties to the transaction.

Rationale

These subsections are necessary to establishes the information required to keep track of the credit transfer between manufacturers should it be required to demonstrate compliance as well as verification in case of audit.

The corporate name of the credit transferor is necessary to identify the specific manufacturer from which the credit is transferred.

The corporate name of the credit transferee is necessary to identify the specific manufacturer to whom the credit is transferred.

The number of credits transferred for each model year is necessary to identify the quantity of credits transferred between the transferor and transferee.

The identity of credits as ZEV or NZEV credits is necessary to identify the credit type.

The identity of credits as belonging to the Class 7-8 tractors category or other credits category is necessary to identify the credit type.

Section 1963.4(c)(1-2). Class 2b-3 Credit Declaration

Purpose

This subsection proposes that if a specific manufacturer generates credits in the Class 2b-3 weight class category, that specific manufacturer must submit a report by March 31 of each calendar year to CARB's Executive Officer identifying credits generated in accordance with the Proposed ACT Regulations of section 1963 and credits generated in accordance with the ACC regulations of 13 CCR section 1962.

Rationale

This section is necessary to identify the regulation under which credits are generated by a specific manufacturer in the Class 2b-3 weight class category so as to avoid a single generated credit demonstrating compliance for multiple regulations under which Class 2b-3 vehicles are affected.

Section 1963.4(d). Retention of Records

Purpose

The purpose of this subsection is to establish a timeline of 8 years past the model year during which manufacturers must keep reporting records for vehicles produced and sold in California during the model year.

Rationale

This subsection is necessary to ensure records are available for audit and enforcement of the regulation. Additionally, 8 years is consistent with the record retention timeframe of California Phase 2 GHG regulation, and aligns the timeframes to reduce confusion and burden of record retention requirements.

Section 1963.5(a)(1-3). Advanced Clean Trucks Enforcement

Purpose

The purpose of this section is to set forth the rights of CARB to audit a manufacturer's records, the authority of CARB to invalidate credits deemed to be obtained based on falsified information, and a notice to manufacturers of the type of information provided to CARB may be made public.

Rational

This section is necessary to establish that manufacturers must keep and make available records to prove vehicle California sales numbers to ensure accuracy of reported information and enforceability of this regulation. CARBs right to suspend, revoke, or modify credit balances is necessary to establish a pathway by which CARB may deem invalid credits claimed by a manufacturer. The notice of public disclosure is necessary to identify the specific information that is subject to disclosure as public records.

B. Large Entity Reporting Requirement

Section 2012. Purpose, Scope and Applicability, Definitions, Exemptions, and General Requirements.

Purpose

The purpose of this section is to describe the purpose of the Large Entity Reporting Requirement, to identify which entities would be required to report and which entities would be excluded, to set forth definitions for various terms used throughout the regulation text, and to describe the general reporting requirements.

Rationale

This section is necessary to identify the general purpose of the Large Entity Reporting Requirement, which is to collect transportation related information from regulated entities. This section is also necessary to clearly identify who would be regulated, who would be exempt, and to set forth definitions for various terms used in the proposed language to avoid misinterpretation. Additionally, the section is needed to identify the basic reporting requirements and how this information will be collected.

Section 2012(a) Purpose.

Purpose

This section describes the purpose of the regulation, which is to collect information from regulated entities to assess suitability of zero-emission vehicles and to inform strategies on how to accelerate the use of zero-emission vehicles in California to reduce emission from vehicles.

Rationale

This section is necessary to identify the purpose of the Large Entity Reporting Requirement and to inform the public that the information collected will be used to determine strategies for future strategies to maximize the use of zero-emission vehicles in California where suitable. The information would be used to identify common characteristics for different entities that compete in the same sector and would help answer questions about different strategies to accelerate the use of ZEVs

Section 2012(b)(1-5) Scope and Applicability.

Purpose

The purpose of this section is to identify the regulated entities that are subject to the Large Entity Reporting Requirement.

Rationale

This section is necessary to clearly identify the regulated parties that would be subject to the Large Entity Reporting Requirement. The definition was selected to include a wide range of entities because nearly all rely on services that use trucks and buses, and all are likely to be directly or indirectly affected by a future ZEV requirement because a general goal established in the mobile source strategy and the SIP and is to accelerate the use of ZEVs everywhere feasible. The revenue threshold was selected as a way to exclude small businesses from the reporting requirement to reduce the number of entities that report and the expectation that the large entities would provide a representative data set of the wide range of business models and vehicle operations in California. Large entities have adequate resources to respond to questions about their existing operations and are more likely to keep information electronically than smaller entities which means their reporting burden would be less significant. Information from large entities is expected to provide a robust data sample to help answer questions about sector-by-sector variations in vehicle usage and contracting for transportation services. The 2019 tax year was selected as a baseline year so that regulated parties would know whether they are in the scope of the regulation when the regulation is considered by the Board. Federal agencies are necessary to include because they represent a significant portion of government fleet emissions in California, and Governor Brown's directive indicated that government should lead the electrification efforts in California.

Section 2012(c)(1-3) Exemptions.

Purpose

This section identifies entities who would be exempt from the Large Entity Reporting Requirement.

Rationale

This section is necessary to identify the entities that are outside the scope of the large entity reporting requirement and would not be required to report. K-12 schools and school districts comprised of school buses would be exempt because sufficient information about the school bus fleet and its operation has already been collected. Additionally, staff do not anticipate including school buses in a near-term future ZEV fleet regulation. Transit agencies would be exempt because the ICT regulation already requires them to transition their buses to ZEBs. Transportation network companies would be exempt because staff is currently developing a regulation consistent with SB 1014 to require the use of light-duty ZEVs, and would require transportation network companies to report information to CARB.

Section 2012(d) Definitions.

Purpose

This section sets forth definitions for terms used in the proposed regulation order and identifies the sections for which the definitions apply.

Rationale

This section is necessary to define key terms used within the regulation to provide clarity and specificity to regulated entities.

Subsection 2012(d)(1) Definition of Assigned.

Purpose

The purpose of this subsection is to define “Assigned.”

Rationale

The definition for “Assigned” is necessary to ensure that vehicles are accounted for at the correct facilities. Some fleets may not have vehicles domiciled at any particular location so “assigned” allows more flexibility for fleets with variable operations.

Subsection 2012(d)(2) Definition of Broker.

Purpose

The purpose of this subsection is to define “Broker.”

Rationale

The definition for “Broker” is necessary to identify entities that direct truck movements without owning the assets that compete for the same business as motor carriers that own their own trucks. This definition is based on the “broker” definition in the Truck and Bus Regulation for consistency.

Subsection 2012(d)(3) Definition of Corporate Parent.

Purpose

The purpose of this subsection is to define “Corporate Parent.”

Rationale

The definition for “Corporate Parent” is necessary to specify a clear definition of the term and allows for regulated entities to accurately identify their corporate parent if they have one.

Subsection 2012(d)(4) Definition of Facility.

Purpose

The purpose of this subsection is to define “Facility.”

Rationale

The definition for “Facility” is necessary in order to specify the types of properties that are included. This helps narrow the scope as to what to include when reporting.

Subsection 2012(d)(5) Definition of Facility Category.

Purpose

The purpose of this subsection is to define “Facility Category.”

Rationale

The definition for “Facility Category” is necessary to establish common facility categories to ensure consistency in how facilities are grouped. These facility categories were chosen as they represent a variety of common business and operations and simplify reporting by allowing the respondent to summarize facility information by responding to questions about all facilities as a group. Within this definition is additional detail to define each facility category in subsections 2012(d)(5)(A-K).

Subsection 2012(d)(5)(A) Definition of Administrative/Office Building.

Purpose

The purpose of this subsection is to define “Administrative/Office Building.”

Rationale

The definition for "Administrative/Office Building" is necessary to identify the type of facility at which an entity primarily uses for administrative day-to-day tasks. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(B) Definition of Distribution Center/Warehouse.

Purpose

The purpose of this subsection is to define “Distribution Center/Warehouse.”

Rationale

The definition for "Distribution Center/Warehouse" is necessary to identify the type of facility at which an entity primarily stores goods intended for subsequent shipment. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(C) Definition of Hotel/Motel/Resort.

Purpose

The purpose of this subsection is to define “Hotel/Motel/Resort.”

Rationale

The definition for "Hotel/Motel/Resort" is necessary to identify the type of facility from which an entity offers lodging to travelers and/or permanent residents. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(D) Definition of Manufacturer/Factory/Plant.

Purpose

The purpose of this subsection is to define “Manufacturer/Factory/Plant.”

Rationale

The definition for "Manufacturer/Factory/Plant" is necessary to identify the type of facility at which an entity has equipment for assembling parts, producing finished products, intermediate parts, or energy products. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(E) Definition of Medical/Hospital/Care.

Purpose

The purpose of this subsection is to define “Medical/Hospital/Care.”

Rationale

The definition for "Medical/Hospital/Care" is necessary to identify the type of facility from which an entity provides inpatient diagnostic and therapeutic services or rehabilitation services, by or under the supervision of physicians. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(F) Definition of Multi-Building Campus/Base.

Purpose

The purpose of this subsection is to define “Multi-Building Campus/Base.”

Rationale

The definition for "Multi-Building Campus/Base" is necessary to identify the type of facility typically operated by a single entity with several buildings that typically serves multiple purposes. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(G) Definition of Restaurant.

Purpose

The purpose of this subsection is to define “Restaurant.”

Rationale

The definition for "Restaurant" is necessary to identify the type of facility from which entities serve meals or refreshments. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(H) Definition of Service Center.

Purpose

The purpose of this subsection is to define “Service Center.”

Rationale

The definition for "Service Center" is necessary to identify the type of facility from which respondents support business operations that generate revenue through specific service or products. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(I) Definition of Store.

Purpose

The purpose of this subsection is to define “Store.”

Rationale

The definition for "Store" is necessary to identify the type of facility from which entities primarily sell goods or services to the general public. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(J) Definition of Truck/Equipment Yard.

Purpose

The purpose of this subsection is to define “Truck/Equipment Yard.”

Rationale

The definition for "Truck/Equipment Yard" is necessary to identify the type of facility from which trucks and equipment are primarily stored or dispatched. This will enable respondents to clearly identify and group information reported for this type of facility.

Subsection 2012(d)(5)(K) Definition of Any Other Facility Type.

Purpose

The purpose of this subsection is to define "Any Other Facility Type."

Rationale

The definition for "Any Other Facility Type" is necessary to allow fleets to identify and report information about less-common facility types that are not included in the prior list of facilities. This will enable staff to gather information about facilities that were not listed as the most common.

Subsection 2012(d)(6)(A-B) Definition of Fleet.

Purpose

The purpose of this subsection is to define "Fleet."

Rationale

The definition for "Fleet" is necessary for usage in specific information reported and other definitions. This definition is based off of the "fleet" definition currently being used in CARB's Truck and Bus Regulation for consistency.

Subsection 2012(d)(7)(A-B) Definition of Fleet Owner.

Purpose

The purpose of this subsection is to define "Fleet Owner."

Rationale

The definition for "Fleet Owner" is necessary to define which fleets are subject to the Large Entity Reporting Requirements. This definition is based on the "fleet owner" definition currently being used in CARB's Truck and Bus Regulation for consistency.

Subsection 2012(d)(8) Definition of Government Agency.

Purpose

The purpose of this subsection is to define "Government Agency."

Rationale

The definition for “Government Agency” is necessary to minimize confusion as to which government agencies are subject to the Large Entity Reporting Regulation. This definition was chosen to ensure that local, state, and federal government entities would all be included.

Subsection 2012(d)(9) Definition of Gross Annual Revenue.

Purpose

The purpose of this subsection is to define “Gross Annual Revenue.”

Rationale

The definition for “Gross Annual Revenue” is necessary in order to determine which large entities are subject to the Large Entity Reporting Requirement. This definition was chosen as a single point of reference that can be used across a variety of industries and business types.

Subsection 2012(d)(10) Definition of Gross Vehicle Weight Rating.

Purpose

The purpose of this subsection is to define “Gross Vehicle Weight Rating.”

Rationale

The definition for “Gross Vehicle Weight Rating” is necessary to define vehicle weight classes used elsewhere in the regulation order. The GVWR definition in the California Vehicle Code was chosen to be consistent with commonly used definitions of GVWR.

Subsection 2012(d)(11) Definition of Motor Carrier.

Purpose

The purpose of this subsection is to define “Motor Carrier.”

Rationale

The definition for “Motor Carrier” is necessary because some questions and definitions that are only applicable to motor carriers. The motor carrier definition in the California Vehicle Code was chosen to be consistent with commonly used definitions of motor carrier.

Subsection 2012(d)(12) Definition of Municipality.

Purpose

The purpose of this subsection is to define “Municipality.”

Rationale

The definition for “Municipality” is necessary to clearly define what government entities within California are included. This definition is based on the “municipality” definition currently being used in CARB’s Public Agency and Utility Regulation for consistency.

Subsection 2012(d)(13)(A-C) Definition of Responsible official.

Purpose

The purpose of this subsection is to define “Responsible official.”

Rationale

The definition for "Responsible official" is necessary to establish the types of individuals affiliated with the reporting entity that have the authority within the organization to report on behalf of or for the purposes of complying with these requirements.

Subsection 2012(d)(14) Definition of Subsidiary.

Purpose

The purpose of this subsection is to define “Subsidiary.”

Rationale

The definition for "Subsidiary" is necessary to establish the type of corporate entity or subdivision that staff are requiring to report information for this regulation.

Subsection 2012(d)(15) Definition of Subcontractor.

Purpose

The purpose of this subsection is to define “Subcontractor.”

Rationale

The definition for "Subcontractor" is necessary to define a term that has different meanings in different situations and identify entities that are mutually exclusive from "subhaulers" in order to prevent confusion from the use of similar terminology in responding to questions.

Subsection 2012(d)(16) Definition of Subhauler.

Purpose

The purpose of this subsection is to define “Subhauler.”

Rationale

The definition for "Subhauler" is necessary to identify entities that are mutually exclusive from "subcontractors" in order to prevent confusion from the use of similar terminology in responding to questions. This definition was chosen to clearly delineate that a subhauler is providing for-hire transportation to another for-hire motor carrier.

Subsection 2012(d)(17) Definition of Transportation Network Company.

Purpose

The purpose of this subsection is to define “Transportation Network Company.”

Rationale

The definition for "Transportation Network Company" is necessary to establish the specific type of business or entity that is exempt from this regulation due to other regulatory efforts focused on these entities. This definition was chosen to match the California Public Utility Commission’s definition of a “transportation network company” for consistency.

Subsection 2012(d)(18) Definition of Vehicle Body Type.

Purpose

The purpose of this subsection is to define “Vehicle Body Type.”

Rationale

The definition for "Vehicle Body Type" is necessary to establish certain common body types for fleet owners to use in response to questions about vehicle operational characteristics. This will help narrow the scope of vehicle types staff expect fleet owners to respond about, and will allow staff to assign appropriate flexibilities if needed in future regulatory efforts.

Subsection 2012(d)(19) Definition of Vehicles Awaiting Sale.

Purpose

The purpose of this subsection is to define “Vehicles Awaiting Sale.”

Rationale

The definition for "Vehicles Awaiting Sale" is necessary to define vehicles which may be excluded from the reporting requirement. This definition is based on the “vehicle awaiting sale” exemption currently being used in CARB’s Truck and Bus Regulation for consistency.

Subsection 2012(d)(20)(A-D) Definition of Weight Class Bins.

Purpose

The purpose of this subsection is to define “Weight Class Bins.”

Rationale

The definitions for the various "Weight Class Bins" of light-duty, Class 2b-3, Class 4-6, and Class 7-8 are necessary to establish grouped categories by which fleet owners will report vehicle operational information. These bins were selected to be consistent with categories used in the manufacturer ZEV sales requirement and because vehicles in these groups have fairly similar operational characteristics. The data will enable staff to compare results to other data sources to understand how the reported data compares to statewide data, sales trends, and use profiles from other studies about similar vehicles. This type of information will help identify differences among truck types and industries which will help identify appropriate off-ramps or flexibilities for future ZEV requirements.

Section 2012(e)(1-3) General Requirements.

Purpose

The purpose of this section is to summarize what requirements apply to regulated parties and which sections describe requirements for reporting, the method for reporting, and record retention.

Rationale

Section 2012(e)(1) is necessary as it specifies that regulated entities must report by April 1, 2021 for their facility operation in 2020 and for any fleet as it was comprised as of January 1, 2021. Reporting is required by April, 2021, to provide sufficient time for regulated entities to collect information from the prior year. The responses would be used to evaluate new strategies that include fleet regulations, market based strategies, or potential geographic boundaries for a future rulemaking, as well as identify which sectors or individual entities to follow-up with for more detailed conversations. The information will also help identify patterns and guide staff in developing regulatory strategies on the deployment of ZEVs in a manner that encourages their use where they are most suitable, maintains equity among regulated parties that compete in the same markets, and considers the potential impact on funding and access to infrastructure. Requiring that entities disclose whether their reported information contains business confidential information will provide guidance to staff and regulated entities on how to respond to a California Public Records Act request.

Section 2012(e)(2) is necessary to identify how reported information must be submitted as it specifies that all three sections; 2012.1, 2012.2, and 2012.3 of the Large Entity Reporting Requirement should be reported to CARB through the webpage for Advanced Clean Trucks. Large entities are presumed to have internet capabilities and can submit reports in this way, as many already report online for other CARB regulations in this manner. A spreadsheet and instructions for how to submit information will be available on the Advanced Clean Trucks webpage, by December 31, 2020.

Section 2012(e)(3) is necessary to notify regulated entities about the information they must retain for audit purposes as well as the time period the information must be retained. The fleet owner or responsible person must maintain all individual fleet, vehicle, contract, and facility records used to compile responses to sections 2012.1, 2012.2, and 2012.3. The record keeping requirement for three years was deemed to be sufficient time to maintain records and is expected to be fairly consistent with existing practices for most entities.

Section 2012.1 General Entity Information Reporting.

Purpose

The purpose of this section is to specify the general information that regulated entities must report as part of the Large Entity Reporting Requirement.

Rationale

Overall, this section is necessary to identify the entity that is reporting and what information that are required to be submitted to CARB as detailed in the subsections.

Subsection 2012.1(a)(1-9) Entity name, Mailing address, Designated person contact information, Corporate parent name, TRUCRS ID, and Taxpayer identification number.

Purpose

The purpose of these subsections is to specify the information that must be reported so that staff can identity each regulated entity, have a method to contact them if needed, and to have a unique identifier if names are not clear.

Rationale

These subsections are necessary because they allow staff to classify the regulated entities within the scope of Section 2012(b). The mailing address provides a means to contact the entity by mail. The contact information is necessary for CARB to be able to identify to whom outreach, clarification, or other questions should be directed. It is important to identify a regulated entity's corporate parent name because staff needs to relate the regulated entities that are subsidiaries to their corporate parents. Identifying a Truck Regulation Upload, Compliance and Reporting System or TRUCRS ID is important because it will inform to staff that the regulated entity has previously reported information to CARB which includes company and vehicle information. The taxpayer identification number is a unique identifier that will help separate responses from entities with similar names, with grouping information from multiple divisions of the same company, can be used to identify tax records to audit and will help with recordkeeping purposes.

Subsection 2012.1(a)(10-14) Primary NAICS code, Annual U.S. revenue, Applicable operating authority numbers, Subhauler and subcontractor information.

Purpose

The purpose of these subsections is to specify the information that must be reported relevant to the regulated entities' business characteristics and practices.

Rationale

These subsections are necessary because they allow staff to classify the regulated entities within the scope of Section 2012(b) and to have information to put the responses in context. The NAICS code is necessary because it describes the specific sector a regulated entity's business falls under which helps identify entities that compete in the same markets. The total annual revenue in the United States helps determine the relative size of different companies in the same industry and would help compare fleet size or other characteristics among different size companies in the same business. Subsection 2012(b)(12) is necessary to identify the regulated entity's motor carrier identification numbers. Knowing this information allows staff to understand the types of operation an entity is authorized to perform. Subsections 2012(b)(13) and 2012(b)(14) are important to determine whether regulated entities identify use subcontractors or subhaulers in their typical business, the number of trucks subhaulers use, and whether subhaulers are operating under the regulated entity's authority. This information will help answer questions about whether an entity uses its own trucks or rely on other entities to conduct their business. This is critical to understand when developing strategies that have a level playing field if setting differing requirements by fleet size or other threshold.

Subsection 2012.1(a)(15-16) Regulated Entity's Sustainability Plan questions.

Purpose

The purpose of these subsections is to specify the information that must be reported so that staff can determine if a regulated entity has a sustainability plan and if that plan includes transportation-related emissions reduction goals.

Rationale

These subsections are necessary to find out if regulated entities have sustainability incorporated in their business model. This will inform staff whether the regulated entity is already making efforts to reduce their emissions and whether they are accounting for emissions associated with trucking and freight services. This information will provide an opportunity for staff to explore how industry is already incorporating transportation emissions into meeting sustainability goals that could potentially be applied more broadly as a method to increase the use of ZEVs.

Subsection 2012.1(a)(17-18) Number of Vehicles Your Entity Owns, Operates, and are Domiciled Inside and Outside California.

Purpose

The purpose of these subsections is to specify the information that must be reported so that staff can quantify the number of vehicles owned by the company that operate in California and are domiciled in California, as well as the vehicles owned by the entity that operate in California but are not domiciled in any California location.

Rationale

These subsections are necessary to determine the California vehicle populations of California domiciled vehicles and non-California domiciled vehicles for the regulated entities. This will inform staff on how many vehicles stay at the same location in California versus how many vehicles are not assigned to any particular terminal or are domiciled out of state. Currently, ZEVs are suitable for local haul operations that return to base where infrastructure can be installed. Information that identifies out-of-state operations and those that do not return to base will also be needed to identify potential off-ramps or other considerations until the ZEV market matures and access to public charging or hydrogen fueling infrastructure for trucks and buses expands.

Section 2012.2 Facility Category Reporting.

Purpose

The purpose of this section is to identify what general information regulated entities must report for each facility category they operated in California during the 2020 calendar year, and what detailed information for a representative facility of each facility category they operated in California during the 2020 calendar year as described in the subsections.

Rationale

This section is necessary because it provides instructions to complete the facility information reporting requirement and it will identify characteristics and patterns of facility categories in California. At stakeholder requests, staff modified the proposed regulation to allowing entities to group information by facility category rather than reporting information for every facility and to require additional details for one facility within each group. This approach simplifies reporting for affected stakeholders, but still provides sufficient information for staff to evaluate the information. The 2020 calendar year was selected because it is the most recent year before reporting would be required.

Subsection 2012.2(a)(1)(A) Number of Facilities Located in California.

Purpose

The purpose of this subsection is to collect information on the number of facility categories that a regulated entity operated in California.

Rationale

This subsection is necessary to identify the total number of facilities in each category. Collecting this information provides information on how many facilities of each type is operated by the entity and puts in context the responses to other questions about the entity and the fleet of vehicles.

Subsection 2012.2(a)(1)(B) Number of Facilities That Have Dock-Height Loading Bays.

Purpose

The purpose of this subsection is to identify the number of facility types a regulated entity owned or leased in California calendar year that have dock-height loading bays.

Rationale

This subsection is necessary because it will allow staff to identify the number of facility types that have dock-height loading bays. Dock-height loading bays are areas of a building where vehicles are typically loaded and unloaded and are possible indicator of sites that have some dwell time that may be suitable for installing ZEV infrastructure.

Subsection 2012.2(a)(1)(C) Number of facilities that have cold storage rooms.

Purpose

The purpose of these subsections is to identify the number of facility types a regulated entity owned or leased in California that have cold storage areas.

Rationale

These subsections are necessary because collecting this information will allow staff to identify the percentage of facility types that have cold storage and are likely to have transport refrigeration units (TRU) visiting the facility. This information will help identify locations where charging infrastructure may be needed to support zero-emission TRUs and where there may be overlapping requirements with a potential future ZEV truck regulation.

Subsection 2012.2(a)(1)(D-E) Number of facilities that have electric vehicle supply equipment or electric vehicle charging stations available for public or private use.

Purpose

The purpose of these subsections is to identify the number of facility types a regulated entity owned or leased in California that already have existing electric vehicle supply equipment for public or private use.

Rationale

Subsections 2012(a)(1)(D-E) are necessary to identify entities that already provide electric vehicle supply equipment or electric vehicle charging stations for employees or for public use to support light duty ZEV deployment. This information will help identify entities that have experience with the permitting and planning process to install infrastructure to support ZEVs, may be an indicator of entities that have experience with ZEV deployments and are taking action to meet sustainability goals. The information could be used to follow-up with these entities in exploring opportunities to support ZEV trucks and can be useful when evaluating light-duty ZEV policies to accelerate the purchase of ZEVs by large employers.

Subsection 2012.2(a)(1)(F-G) Facility Ownership Status.

Purpose

The purpose of this subsection is to identify the ownership status of facility types in California.

Rationale
This subsection is necessary to identify which facility types that are owned by the entity or subsidiaries with the same corporate parent. This is information will identify which entities have direct control of the facilities they operate and which entities rent, or lease,

their facilities and would need to work with a third party to make site improvements to support ZEVs and fueling infrastructure.

Subsection 2012.2(a)(1)(H) Shuttle Van or Bus Service to or From Facility.

Purpose

The purpose of these subsections is to identify entities that provide shuttle van or bus service.

Rationale

This subsection is necessary to identify the types of facilities that have entity-provided shuttle service. Public and some private fleets are already required to electrify their passenger transportation through the ICT and ZE ASB regulations. Other entities that provide or hire passenger transportation services may have opportunities to deploy ZEV shuttles and buses to further reduce emissions from passenger transportation. These entities could have opportunities to further expand the ZEV bus market and to take advantage of experience already gained by transit agencies.

Subsection 2012.2(a)(1)(I-J) Vehicles Assigned or Domiciled at Facility.

Purpose

The purpose of these subsections is to identify the types of facilities, and how many facilities have light-duty vehicles, trucks, vans, or buses, assigned or domiciled at the facility.

Rationale

These subsections are necessary to identify patterns between facility categories and the number of facilities that have vehicles assigned or domiciled at facilities. Entities that report they do not have trucks or vans will make it clear they do not need to complete the vehicle information in section 2012.3. This information will help identify how many facilities in each facility group have vehicles assigned or domiciled at facilities which will also be useful in interpreting whether vehicle use is a primary part of the operation or not. The information will also help staff interpret how the data provided about vehicles at each facility fits in with the operation of the entity.

Section 2012.2(a)(2)(A-H) Ground transportation needs.

Purpose

The purpose of this subsection is to identify different types of truck ground transportation is used to ship items as part of its operation and whether those needs are met with vehicles owned by the entity or is contracted out to a third party.

Rationale

This section in its entirety is necessary because it will allow staff to identify how shipping needs are met. This information will help staff determine how arrangement for shipments are made and will provide basic information on destination type. This information will help answer questions about potential opportunities and barriers to electrification. For example, ports and rail yards are likely to transition to ZEVs earlier that other fleets and could change the way businesses ship products, shipments that are directed out-of-state where ZEV infrastructure is currently not available are not likely to be suitable for ZEVs until a public fueling infrastructure is available, shipments to homes and neighborhoods for last mile deliveries tend to be short trips from a central location that are likely to be suitable for ZEVs, and shipments that are made between an entity's existing locations may have opportunities to include infrastructure to support charging on-route if there is sufficient dwell time for ZEVs to charge or fuel.

Section 2012.2(a)(3)(A-I) Contracting practices.

Purpose

The purpose of this section is to identify the information that each regulated entity must report for each facility type regarding how the entity typically enters into contracts for deliveries and services provided with trucks and how these contracts are managed.

Rationale

This section in its entirety is necessary because it will allow staff to identify what types of vehicle related services the entity contracts for and whether individual facilities manage the contracts for the services listed in Section 2012.2(a)(3)(A-I) or if they are managed centrally at a corporate level or by some other means. The criteria for contracts to be for one year or more minimizes the need to track information for infrequent services and reduces reporting burden. This set of questions helps identify entities to follow-up with for answering more detailed questions about contracting practices and whether entities could include requirements for their service providers to use ZEVs as part of their services they provide. The list of services represent common pickup and delivery services that tend to be last-mile services where ZEVs are already suitable and are likely to be an area of focus for future ZEV strategies.

Section 2012.2(a)(4) Grouped Facility Addresses

Purpose

The purpose of this section is to set forth the requirement for entities to report a physical address for each location operated and the corresponding facility category.

Rationale

This section is necessary to gather information about where each facility is located to allow staff to evaluate the potential effects of different ZEV adoption strategies including where the emissions benefits would occur, and where infrastructure is available or might be needed. The information would also be used to evaluate effects of potential overlap with other regulations, local requirements and to evaluate effects on disadvantaged communities. Additionally, the address will help identify whether the facility is in an urban area, and whether climate, topography, population density, and congestion may be a factor in accessing the feasibility of ZEVs serving the facility.

Section 2012.2(b) Representative Facility Questionnaire.

Purpose

The purpose of this subsection is to gather information about a representative facility for each facility category that is operated by an entity in California. Regulated entities would need to report general facility characteristics, estimated vehicle trips (excluding light-duty vehicles) in a typical week, and information about the number of suppliers that shipped their items to the representative facility.

Rationale

This subsection is necessary to identify the operational characteristics for a typical representative facility in each category and will provide detailed information about a handful of different facilities to reduce reporting burden. Staff will use information from multiple entities with similar facilities to group the results and identify trends for different businesses and facility types. The language in this section informs regulated entities that they should use their best judgement and select a representative facility for each of the facility categories they operate and indicates that compliance will be based on making good faith effort. This subsection is necessary to gather binned and categorized information about medium or heavy-duty vehicle trips and number of suppliers a typical facility deals with. This information will provide an adequate data sample and will help staff characterize industries to identify appropriate exemptions or flexibilities for future electrification strategies.

Sections 2012.2(b)(1)(A-H) General Representative Facility Questions.

Purpose

The purpose of this subsection is to identify a representative facility's location, approximate square footage of the facility and of cold storage rooms, number of dock-height loading bays, and a short description of the representative facility and its primary function or purpose.

Rationale

The location of the representative facility is necessary for staff to gather geographic information about the facility and will assist in identifying which records are used in supporting the responses. Geographic information will help identify whether the facility is in an urban area, and whether climate, topography, population, and congestion are a factor for the facility operation and where infrastructure would be needed to support ZEVs. The total building square footage is necessary to identify the typical facility size and general scale of operations relative to other similar facilities. The number of dock-height loading bays and cold storage square footage is necessary to identify the locations where goods are frequently loaded or unloaded from trucks with TRUs and to identify potential sites with opportunities for ZEV infrastructure. The short description of the representative facility is necessary to differentiate the types of facilities within the facility category in order to accurately analyze the data collected. For example the category "Store" could be an electronic parts vendor or an ice cream shop which would have significantly different characteristics.

Section 2012.2(b)(2)(A-J) Estimated Number of Vehicle Trips to the Representative Facility in a Typical Week.

Purpose

The purpose of this subsection is to identify the estimated number of vehicle trips to the representative facility in a typical week by using following bins for responses regarding the number of trips (Does not apply, 1-10, 11-20, 20-99, 100-500, >500).

Rationale

This subsection is necessary because it will provide the frequency of vehicle trips a representative facility experiences in a typical week, information on the types of pick-up and delivery services, and some information on the types of vehicles coming to and from the facility. The responses should be based on requirements specified in pick-up and delivery contracts, or by sampling the count of actual deliveries to or from the representative facility. The response bins were selected to simplify the responses and to indicate that a precise response is not required. For example a company that receives parcel delivery packages 3 to 5 days per week would still have the same response by using the bin listed as 1-10 without needing to count trucks nor visit contract terms. Some entities may contract for set deliveries from suppliers that may make it easier for them to rely on the contract terms to complete the responses.

Sections 2012.2(b)(3)(A-D) Identify How Many Suppliers Shipped Their Items to the Representative Facility.

Purpose

The purpose of this subsection is to identify the number of suppliers that shipped items to the representative facilities.

Rationale

This subsection is necessary because it will provide the number of suppliers that shipped food or beverage, linen or uniform cleaning service, goods (excluding food or beverage), or other supplies to a representative facility. This information will allow staff to identify the entities or facility categories that receive supplies that is shipped by others. This information will help staff follow-up with these entities to explore future strategies to encourage the use of ZEVs by suppliers, and to potentially answer questions if infrastructure at a receiver or property owner could enable ZEV deployment by the supplier.

Section 2012.3 Vehicle Usage by Facility Reporting.

Purpose

The purpose of this section is to collect information about existing vehicles and their operating characteristics, and the facility where on-road vehicles are domiciled or assigned.

Rationale

Overall, this section is necessary for staff to gather relevant usage characteristics at a sufficient sample size for various industries and use cases to help identify vehicle operational trends, characteristics, and duty cycles that are most suitable for electrification and to determine potential provisions or flexibilities for future electrification strategies.

Section 2012.3(a)(1-4) Facility Address, Facility Category, Contact Person Name, Contact Person Email Address.

Purpose

The purpose of these subsections are to identify the address, category, and contact person information for the facility location for which the entity is reporting vehicle usage information.

Rationale

These subsections are necessary to gather location and facility category data for each facility where vehicle information is being reported in order to characterize vehicle usage. The contact information is necessary for CARB to be able to identify to whom outreach and clarification or other questions should be directed.

Section 2012.3(a)(5-7) Whether Facility is Owned or Leased, Fueling Infrastructure Installed at the Facility, Whether Refueling Infrastructure is Over 10 Years Old.

Purpose

The purpose of these subsections are to gather information about whether the facility where the vehicles are domiciled or assigned is leased or owned, and to gather information about on-site fueling infrastructure.

Rationale

The facility ownership or lease status is necessary for staff to identify whether the entity has control over facility modifications to install fueling or charging infrastructure for ZEVs. The type of on-site refueling infrastructure, if present, is necessary to provide insight as to whether the facility has the ability to refuel ZEVs, and whether the fleets have already made recent investments to install on-site fueling infrastructure. The age of the primary refueling infrastructure is necessary to identify whether existing refueling assets may become stranded assets if a future regulation requires a transition to ZEVs.

Section 2012.3(a)(8) Trailer Information.

Purpose

The purpose of this section is to identify the types of trailers that tractors pull if there are tractors assigned or domiciled at the facility.

Rationale

This section is necessary because it will allow staff to identify the types of trailers being pulled which provide an indication of the type of cargo the fleet transports and the potential markets they serve.

Section 2012.3(a)(8)(A-H) What Types of Trailers are Pulled by Tractors Domiciled at this Facility.

Purpose

The purpose of these subsections are to gather information about what types of trailers are being pulled by tractors domiciled or assigned at this facility.

Rationale

The types of trailers pulled provides information on what types of items are being moved by the trucks and is easy for a fleet manager to identify. Examples of the clues that the trailer information provides includes, tractors that pull containers are more likely to serve the ports and railyards; whereas, tractors that pull dump trailers are likely to support construction activities and are more likely to be loaded to capacity. This kind of information is useful to narrow area of focus and to identify fleets that may have opportunities or challenges with deploying ZEVs. The information will also assist with comparing responses received with other data sources.

Section 2012.3(b) Grouped Vehicle Usage by Facility.

Purpose

The purpose of this subsection is to collect information about existing fleet vehicle fueling and operating characteristics.

Rationale

This information is key to determining what existing vehicle types are used and how they are operated and fueled to determine which are potentially suitable for electrification and how they compare to commercially available ZEVs and projected ZEV sales. The population information is necessary to identify how many vehicles are at a location and how much infrastructure may be needed to support ZEVs at that location. Grouping information by vehicle body type, weight class bin, and fuel type simplifies reporting for large fleets with multiple vehicles of the same type. Language in this section explains that responses for vehicle with seasonal uses should use a busy period in the year to ensure that the information reported could be used to provide insight as to whether a ZEV would be suitable to replace an equivalent combustion engine vehicle. Lastly, language is included to notify respondents that they are expected to use their judgement to use the same responses for the same vehicle group at multiple locations if their operating characteristics would have similar responses to the vehicle usage questions at multiple locations. Military tactical support vehicles would be excluded to minimize any potential national security concerns and because staff does not foresee including them in any future ZEV fleet regulations. Vehicles awaiting sale would be excluded because these vehicles are not being operated and would not contribute to answering questions about their use.

Section 2012.3(b)(1)

Purpose

The purpose of these subsection is to identify the number of vehicles in each group.

Rationale

The number of vehicles in each group is need to identify how many of each type there are and how many total vehicles are reported at each location.

Section 2012.3(b)(2)(A-Q)

Purpose

The purpose of these subsections is to collect information about how existing vehicles are currently used, operated, and fueled.

Rationale

This information is necessary to determine how the fleet's operational needs are currently being met and whether ZEVs may be suitable to meet those needs. This information can be used to identify opportunities and barriers to assess where exemptions or flexibilities may be appropriate in future electrification strategies. The responses can be rounded to the nearest 10 percent of the fleet to simplify reporting.

The information in section 2012.3(b)(2)(A-E) is needed to determine how many miles vehicles operate per day and is needed to help address questions about whether ZEV range is suitable. The range bins were selected to simplify reporting.

The information in section 2012.3(b)(2)(F) is needed to determine whether vehicles have a predictable usage pattern that is not highly variable and could be served by a vehicle with limited range without compromising the operation.

The information in section 2012.3(b)(2)(G) is needed to determine if the existing operation already relies on on-site fueling and could be an opportunity to deploy ZEVs without changing existing fueling practices.

The information in section 2012.3(b)(2)(H) is needed to determine how many vehicles returning to facility daily where they could be opportunities to install infrastructure to support ZEVs. Vehicles that do not return to the facility would not be able to rely on central fueling or charging at the facility.

The information in section 2012.3(b)(2)(I) is needed to identifying how many vehicles have electronic tracking. This information would be used to gather information about how different fleets track their vehicle operations and would identify entities that staff could contact to determine if electronic tracking information could be used to identify uses that are not suitable for electrification or could be used to support flexibility options or off-ramps.

The information in section 2012.3(b)(2)(J) is needed to identifying how many vehicles operate within a 50 mile radius of the facility. This information can be used to answer questions about emissions impacts in the local area, whether access to ZEV fueling infrastructure in the region would be beneficial and whether ordinances, traffic patterns in the area influence how vehicles are operated.

The information in section 2012.3(b)(2)(K) is needed to identify how many vehicles regularly tow trailers more than 100 miles per day to assess stakeholder concerns that towing with straight trucks could reduce range sufficiently to limit the viability of using ZEVs with limited range.

The information in section 2012.3(b)(2)(L) is needed to identify how many vehicles commonly operate at the vehicle weight limits to address potential concerns with ZEVs that may be heavier than an equivalent gasoline or diesel vehicle. This would also identify the number of vehicles that that could benefit from the increased weight limits of AB 2061.

The information in section 2012.3(b)(2)(M) is needed to identifying vehicles that are not registered in California. This information would help identify how many vehicles like yard trucks or campus vehicles are not registered and could help characterize purchasing and registration patterns of different businesses and whether these patterns vary across different entities.

The information in section 2012.3(b)(2)(N) is needed to identify how many vehicles are at the facility more than eight hours per day which is sufficient time to use overnight charging or on-site refueling for ZEVs.

The information in section 2012.3(b)(2)(O) is needed to identify how many vehicles were dispatched at the same time to support an emergency operation on the behalf of the government. This information would be used to follow-up with fleets that support emergencies and to determine appropriate flexibilities with future ZEV strategies.

The information in section 2012.3(b)(2)(P) is needed to identify how many vehicles have all wheel drive needs which could be used to compare to features available on ZEVs to determine if they are suitable for certain operations and to consider this information in considering appropriate flexibilities.

The information in section 2012.3(b)(2)(Q) is needed to identify how many vehicles are not operating or are kept as backup vehicles. Despite their low annual miles, backup vehicles may not be well suited for electrification as they may operate too few miles to achieve any cost or emissions benefits. Not asking questions about backups would potentially skew the data to over-emphasize the amount of vehicles which operate low miles.

Section 2012.3(b)(3) Average Annual Mileage for a Typical Vehicle in this Vehicle Group.

Purpose

The purpose of this subsection is to collect average annual mileage for a typical vehicle in the respective vehicle group.

Rationale

This subsection is necessary because it will provides relatively easy to identify usage data for a wide range of vehicles for staff to analyze in comparison to the other mileage questions to compare patterns in how vehicles are used.

Section 2012.3(b)(4) Average Number of Years a Vehicle is kept in the Fleet before Being Sold or Retired.

Purpose

The purpose of this subsection is to collect the average number of years vehicles are kept in the fleet before being sold or retired.

Rationale

This subsection is necessary to identify how long vehicles are typically kept which is needed to evaluate total cost of ownership consistent with existing purchase patterns and may shed light on how a used ZEV market may develop.

V. BENEFITS ANTICIPATED FROM THE REGULATORY ACTION, INCLUDING THE BENEFITS OR GOALS PROVIDED IN THE AUTHORIZING STATUTE

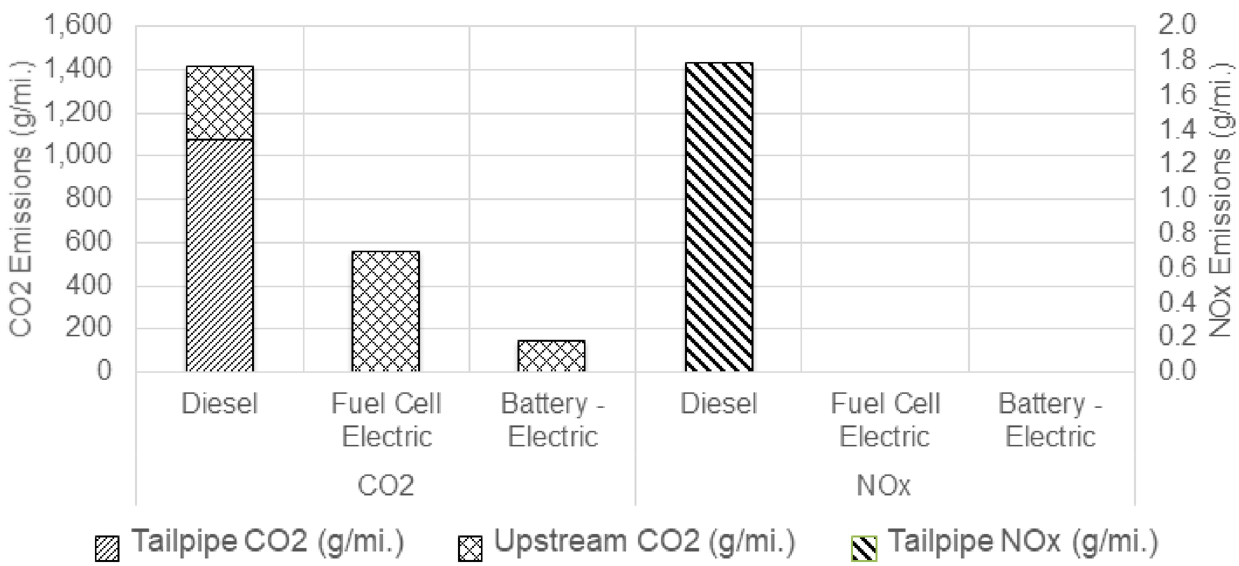
A. Air Quality and Climate Benefits

The purpose of the Proposed ACT Regulation is to accelerate the use of ZEVs in the medium-and heavy- duty truck sector and reduce the amount of harmful emissions generated from on-road mobile sources. The deployment of ZEVs meets goals identified in the SIP, the 2017 Climate Change Scoping Plan, and the 2016 ZEV Action Plan that supports the governor's Executive Orders B-16-12 and B-48-18, which calls for 1.5 million ZEVs in California by 2025 and 5 million ZEVs by 2030 and establishes several milestones on the pathway toward this target.

Also in 2018, Governor Brown issued executive order B-55-18, which sets a target to achieve carbon neutrality in California no later than 2045, and achieve and maintain net negative emissions thereafter. The Proposed ACT Regulation directly supports achieving these goals through the required sale of ZEVs in California from all large medium- and heavy-duty manufacturers.

ZEVs provide significant reductions in both criteria and GHG emissions. Figure V-1 displays the per-mile CO_2 and NOx emissions of a 2030 MY drayage tractor derived from EMFAC2017 (CARB, 2017f), (CARB, 2019d). This figure shows the lower emissions of ZEVs compared to diesel even when accounting for upstream emissions.

Figure V-1: Projected 2030 Emissions per Mile for a 2030 MY Drayage Truck[2]



[2] The NOx emissions displayed are of a vehicle meeting the 2010 MY NOx standard. The upcoming Heavy-duty Low-NOx Omnibus rulemaking will reduce NOx emissions of new on-road heavy-duty vehicles, but the standards have not been finalized.

The Proposed ACT Regulation is expected achieve a significant NOx, $PM_{2.5}$, and GHG emission reductions. These benefits are described in more detail in Chapter VI.

B. Benefits to Typical Businesses

1. Truck and Bus Owners

The Proposed ACT Regulation will increase the supply of ZEVs and will provide another vehicle option for fleets to consider in meeting their needs. Individual businesses that have operations that are well suited for using ZEVs will likely be able to lower their total cost of ownership by taking advantage of the operational cost savings of battery-electric vehicles. Zero-emission truck owners that own their charging or hydrogen fueling stations can lower fuel costs by taking advantage of the Low Carbon Fuel Standard (LCFS) program.

2. Utility Providers

The Proposed ACT Regulation will increase the number of ZEVs deployed, which will in turn increase the amount of electricity supplied by utility providers. Increased electricity usage from ZEVs provides an opportunity for a number of benefits to the utilities, their customers, and the overall grid itself. In a 2017 letter to CARB, the California Electric Transportation Coalition, a non-profit whose board of directors includes all the major California utilities, outlined the benefits of transportation electrification to California's power grid (CalETC, 2017). Electric vehicles are capable of shifting load to off-peak periods and increasing overall demand, both of which help create a more efficient, highly utilized grid. Studies have found that light-duty ZEVs provide a benefit to all utility customers as their electricity utilization drives down rates for all other ratepayers (MJB&A, 2017), (E3, 2019).

The Proposed ACT Regulation also helps the state's investor-owned utilities meet the goals of SB 350. SB350 requires the state's investor-owned utilities to develop programs "to accelerate widespread transportation electrification." Pacific Gas and Electric, Southern California Edison, and San Diego Gas and Electric have been approved to implement programs to install electric infrastructure on the customer's site (up until the charger) and may offer a voucher for the charger itself. All three utilities are either developing or have been approved to establish new electricity rates for commercial ZEV deployments. By ensuring that vehicles will be available to make use of these utility investments and rates, the Proposed ACT Regulation supports the utilities' programs and the goals of SB 350.

3. Other California Businesses

The Proposed ACT Regulation may result in benefits to zero-emission truck component suppliers, EVSE suppliers and installers, and hydrogen fuel station suppliers. Due to higher demand for ZEVs from the Proposed ACT Regulation, production of ZEVs in California would likely lead to increases in manufacturing and related jobs throughout the state. The increase in the production and usage of ZEVs could also benefit various businesses related to the ZEV component supply chain, including those involved in battery, fuel cell, and electric drivetrain businesses.

The Proposed ACT Regulation may also benefit EVSE suppliers who may see an increase in charging equipment installation as a result of increased ZEV purchases. Increased installation of charging infrastructure will benefit the EVSE suppliers, equipment installers, and electricians. All of the installations will be in California, and some of the EVSE equipment may be manufactured in California. Increased purchases of ZEVs under the Proposed ACT Regulation could also benefit various businesses related to installing hydrogen fueling stations and supplying hydrogen for fuel cell vehicles. All of these will likely be in California.

Benefits to Small Businesses

The Proposed ACT Regulation may result in benefits to small business due to higher demand for ZEVs, and would likely lead to increases in manufacturing, distribution, infrastructure installation and maintenance and other related jobs for small businesses throughout the state. Electricians, construction companies, including infrastructure installers, existing ZEV manufacturers, fuel cell and electric drivetrain parts and components businesses may fall into the small business category. Increased installation of charging infrastructure will benefit EVSE suppliers, equipment installers, and electricians that are small business. All of the installations will be in California, and some of the EVSE equipment may be manufactured in California. Increased purchase of ZEVs under the Proposed ACT Regulation could also benefit various California small businesses related to installing hydrogen fueling stations, supplying hydrogen and associated maintenance.

C. Health Benefits to Californians

The Proposed ACT Regulation reduces NOx and $PM_{2.5}$ emissions, resulting in health benefits for Californians, especially those operating trucks or working around them. These health benefits will result in fewer instances of premature mortality, fewer hospital and emergency room (ER) visits, and fewer missed days at school and work. In this staff report, CARB relies on the National Ambient Air Quality Standard for PM which was established by the U.S. EPA to quantify the health risk from exposure to PM. The method to estimate health benefits used in this analysis is the same as the one used for CARB’s proposed Low Carbon Fuel Standard 2018 Amendments, the Heavy-Duty Vehicle Inspection Program and Periodic Smoke Inspection Program, and ICT regulations.

CARB analyzed the value associated with five health outcomes in the business as usual (BAU), proposed amendments, and alternatives: Cardiopulmonary[3] mortality,

[3] Outcomes related to the heart or lungs

hospitalizations for cardiovascular[4] illness, hospitalizations for respiratory[5] illness, emergency room (ER) visits for respiratory illness, and ER visits for asthma.

These health outcomes were selected because US EPA has identified these as having a *causal* or *likely causal* relationship with exposure to $PM_{2.5}$ (U.S. EPA, 2010a). The US EPA examined other health endpoints such as cancer, reproductive and developmental effects, but determined there was only *suggestive* evidence for a relationship between these outcomes and PM exposure, and insufficient data to include these endpoints in the national health assessment analyses routinely performed by U.S. EPA.

The U.S. EPA has determined that both long-term and short-term exposure to $PM_{2.5}$ plays a *causal* role in premature mortality, meaning that a substantial body of scientific evidence shows a relationship between $PM_{2.5}$ exposure and increased risk of death. This relationship persists when other risk factors such as smoking rates, poverty and other factors are taken into account (U.S. EPA, 2009). While other mortality endpoints could be analyzed, the strongest evidence exists for cardiopulmonary mortality (U.S. EPA, 2009). The greater scientific certainty for this effect, along with the greater specificity of the endpoint, leads to an effect estimate for cardiopulmonary deaths that is both higher and more precise than that for all-cause mortality (CARB, 2010).

The US EPA has also determined a *causal* relationship between non-mortality cardiovascular effects and short and long-term exposure to $PM_{2.5}$, and a *likely causal* relationship between non-mortality respiratory effects (including worsening asthma) and short and long-term $PM_{2.5}$ exposure (U.S. EPA, 2009). These outcomes lead to hospitalizations and ER visits, and are included in this analysis.

In general, health studies have shown that populations with low socioeconomic standings are more susceptible to health problems from exposure to air pollution. (Krewski et al, 2009), (Gwynn and Thurston, 2001). However, the models currently used by U.S. EPA and CARB do not have the granularity to account for this impact. The location and magnitude of projected emission reductions resulting from many proposed regulations are not known with sufficient accuracy to account for socioeconomic impacts, and an attempt to do so would produce uncertainty ranges so large as to make conclusions difficult. CARB acknowledges this limitation.

Table V-1 shows the estimated avoided premature mortality, hospitalizations, and emergency room visits because of the Proposed ACT Regulation for 2020 through 2040 by California air basin, relative to the baseline. Values in parenthesis represent the 95 percent confidence intervals of the central estimate. As detailed in the previous section, the Proposed ACT Regulation is estimated to reduce overall emissions of $PM_{2.5}$ and NOx in most years, and lead to net reduction in adverse health outcomes statewide, relative to the baseline.

[4] Outcomes related to the heart or blood vessels

[5] Respiratory illness such as chronic obstructive pulmonary disease, and respiratory infections

The Proposed ACT Regulation may decrease the occupational exposure to air pollution of California truck operators and other employees who work around truck traffic. CARB staff cannot quantify the potential effect on occupational exposure due to lack of data on the typical occupational exposure for these types of workers.

Table V-1: Regional and Statewide Avoided Mortality and Morbidity Incidents from 2020 to 2040 under the Proposed ACT Regulation *

Air Basin	Avoided Premature Deaths	Avoided Hospitalizations for Cardiovascular Illness	Avoided Hospitalizations for Respiratory Illness	Avoided ER Visits
Great Basin Valleys	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Lake County	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Lake Tahoe	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Mojave Desert	4 (3 - 5)	1 (0 - 1)	1 (0 - 1)	1 (1 - 2)
Mountain Counties	4 (3 - 5)	0 (0 - 1)	0 (0 - 1)	1 (1 - 2)
North Central Coast	3 (2 - 3)	0 (0 - 1)	1 (0 - 1)	2 (1 - 2)
North Coast	1 (1 - 1)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Northeast Plateau	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Sacramento Valley	25 (19 - 30)	3 (0 - 6)	4 (1 - 6)	9 (6 - 13)
Salton Sea	3 (2 - 4)	0 (0 - 1)	1 (0 - 1)	1 (1 - 2)
San Diego County	27 (21 - 33)	4 (0 - 8)	5 (1 - 8)	11 (7 - 15)
San Francisco Bay	55 (43 - 67)	9 (0 - 17)	10 (2 - 18)	30 (19 - 41)
San Joaquin Valley	73 (57 - 89)	9 (0 - 17)	10 (2 - 18)	27 (17 - 36)
South Central Coast	10 (8 - 13)	2 (0 - 3)	2 (0 - 3)	4 (3 - 6)
South Coast	395 (309 - 483)	67 (0 - 131)	79 (19 - 140)	201 (127 - 275)
Statewide	601 (470 - 734)	94 (0 - 185)	113 (26 - 199)	289 (183 - 396)

*Values in parenthesis represent the 95% confidence interval. Totals may not add due to rounding.

In accordance with U.S. EPA practice, health outcomes are monetized by multiplying each incident by a standard value derived from the economic studies (U.S. EPA, 2010b). The value per incident is shown in Table V-2. The value for avoided premature mortality is based on willingness to pay,(U.S. EPA, 2000) which is a statistical construct based on the aggregated dollar amount that a large group of people would be willing to pay for a reduction in their individual risks of dying in a year. While the cost-savings associated with premature mortality is important to account for in the analysis, the evaluation of avoided premature mortality does not correspond to changes in expenditures, and is not included in the macroeconomic modeling (Section E). As avoided hospitalizations and ER visits correspond to reductions in household expenditures on health care, these values are included in the macroeconomic modeling.

Unlike mortality evaluation, the cost-savings for avoided hospitalizations and ER visits are based on a combination of typical costs associated with hospitalization and the willingness of surveyed individuals to pay to avoid adverse outcomes that occur when hospitalized. These include hospital charges, post-hospitalization medical care, out-of-pocket expenses, and lost earnings of both individuals and family members, lost recreation value, and lost household production (e.g., valuation of time-losses from inability to maintain the household or provide childcare)(Chestnut, 2006). These monetized benefits from avoided hospitalizations and ER visits are included in macroeconomic modeling (Section E).

Table V-2: Valuation per Incident for Avoided Health Outcomes

Outcome	Value per incident (2018$)
Avoided Premature Mortality	$9,419,320
Avoided Cardiovascular Hospitalizations	$56,588
Avoided Acute Respiratory Hospitalizations	$49,359
Avoided Emergency Room Visits	$810

Statewide valuation of health benefits were calculated by multiplying the value per incident by the statewide total number of incidents for 2020-2040 as shown in Table V-3. The estimated total statewide health benefits derived from criteria emission reductions are estimated to be $5.7 billion.

Table V-3: Statewide Estimated Annual Valuation from Avoided Health Outcomes

Calendar Year	Avoided Premature Deaths	Avoided Hospitalizations for Cardiovascular Illness	Avoided Hospitalizations for Respiratory Illness	Avoided ER Visits	Valuation (Million $2018)
2024	1	0	0	0	$7
2025	2	0	0	1	$16
2026	3	0	0	1	$28
2027	5	1	1	2	$47
2028	8	1	1	4	$76
2029	13	2	2	6	$118
2030	18	3	3	9	$173
2031	25	4	4	12	$232
2032	31	5	6	15	$294
2033	38	6	7	18	$357
2034	45	7	8	22	$423
2035	52	8	10	25	$489
2036	59	9	11	28	$555
2037	66	10	13	31	$620
2038	72	12	14	35	$683
2039	79	13	15	38	$746
2040	85	14	16	41	$807
Total Cost	$5,659	$5.3	$5.6	$0.2	**$5,670**

D. Greenhouse Gas Reduction Benefits - Social Cost of Carbon

The Proposed ACT Regulation accounts for GHG benefits in terms of carbon dioxide (CO_2). The benefit of these GHG reductions can be estimated using the Social Cost of Carbon (SC-CO_2), which provides a dollar valuation of the damages caused by one ton of carbon pollution and represents the monetary benefit today of reducing carbon emissions in the future.

In this analysis, CARB utilizes the current Interagency Working Group (IWG) supported SC-CO_2 values to consider the social costs of actions taken to reduce GHG emissions. This is consistent with the approach presented in the Revised 2017 Climate Change Scoping Plan (CARB, 2017c) and is in line with Executive Orders including 12866 and the OMB Circular A-4 of September 17, 2003, and reflects the best available science in the estimation of the socio-economic impacts of carbon (OMB, 2003).

The IWG describes the social costs of carbon as follows:

> *The social cost of carbon (SC-CO_2) for a given year is an estimate, in dollars, of the present discounted value of the future damage caused by a 1-metric ton increase in carbon dioxide (CO_2) emissions into the atmosphere in that year, or equivalently, the benefits of reducing CO_2 emissions by the same amount in that year. The SC-CO_2 is intended to provide a comprehensive measure of the net damages – that is, the monetized value of the net impacts- from global climate change that result from an additional ton of CO_2.*
>
> *These damages include, but are not limited to, changes in net agricultural productivity, energy use, human health, property damage from increased flood risk, as well as nonmarket damages, such as the services that natural ecosystems provide to society. Many of these damages from CO_2 emissions today will affect economic outcomes throughout the next several centuries* (NAP, 2017).

The SC-CO_2 is year specific, and is highly sensitive to the discount rate used to discount the value of the damages in the future due to CO_2. The SC-CO_2 increases over time as systems become more stressed from the aggregate impacts of climate change and future emissions cause incrementally larger damages. This discount rate accounts for the preference for current costs and benefits over future costs and benefits, and a higher discount rate decreases the value today of future environmental damages. While the Proposed ACT Regulation cost analysis does not account for any discount rate, this social cost analysis uses the IWG standardized range of discount rates from 2.5 to 5 percent to represent varying valuation of future damages. Table V-4 shows the range of IWG SC-CO_2 values used in California's regulatory assessments (U.S. Government, 2015).

Table V-4. SC-CO_2, 2012-2040 (in 2007$ per Metric Ton)

Year	5 Percent Discount Rate	3 Percent Discount Rate	2.5 Percent Discount Rate
2020	$12	$42	$62
2025	$14	$46	$68
2030	$16	$50	$73
2035	$18	$55	$78
2040	$21	$60	$84

If all GHG reductions under the Proposed ACT Regulation are assumed to be carbon reductions, the avoided SC-CO2 from 2020 to 2040 is the sum of the annual TTW GHG emissions reductions multiplied by the SC-CO2 in each year. The cumulative TTW GHG emission reductions along with the estimated benefits from the Proposed ACT Regulation are shown in Table V-5. These benefits range from about $256 million to nearly $1.1 billion through 2040, depending on the chosen discount rate.

Table V-5. Avoided Social Cost of CO_2

Year	GHG emission reductions (MMT)	Avoided SC-CO_2 5% discount rate (million 2018$)	Avoided SC-CO_2 3% discount rate (million 2018$)	Avoided SC-CO_2 2.5% discount rate (million 2018$)
2024	0.0	$0	$0	$0
2025	0.0	$0	$0	$0
2026	0.0	$0	$0	$0
2027	0.0	$0	$0	$0
2028	0.0	$0	$1	$2
2029	0.1	$2	$7	$10
2030	0.3	$5	$16	$24
2031	0.4	$8	$26	$38
2032	0.6	$12	$36	$52
2033	0.7	$15	$47	$67
2034	0.9	$19	$57	$82
2035	1.0	$22	$68	$97
2036	1.2	$27	$79	$111
2037	1.3	$30	$90	$128
2038	1.4	$35	$101	$142
2039	1.6	$38	$111	$157
2040	1.7	$43	$122	$171
Total	11.2	$256	$762	$1,081

It is important to note that the SC-CO_2, while intended to be a comprehensive estimate of the damage caused by carbon globally, does not represent the cumulative cost of climate change and air pollution to society. There are additional costs to society outside of the SC-CO_2, including costs associated with changes in co-pollutants, the social cost of other GHGs including methane and nitrous oxide, and costs that cannot be included due to modeling and data limitations. The Intergovernmental Panel on Climate Change (IPCC) has stated that the IWG SC-CO_2 estimates are likely underestimated due to the omission of significant impacts that cannot be accurately monetized, including important physical, ecological, and economic impacts.

E. Energy Saving and Reduction of Petroleum Fuel Dependence

In the long term, implementation of the Proposed ACT Regulation will lead the way in the heavy-duty vehicle sector to enable fuel switching from petroleum and other fossil-based fuels toward hydrogen or electricity. SB 350 and Senate Bill 1505 (SB 1505) together ensure the renewable attributes in both grid electricity and transportation use of hydrogen. To date, California is on track to achieve both targets (CPUC, 2017), (CARB, 2017d). The efficient use of energy will decrease overall per capita energy consumption, decreasing reliance on fossil fuels such as coal, natural gas, and oil. The fuel efficiency of ZEVs is higher than that of conventional internal combustion engine vehicles (diesel, gasoline, CNG, and propane powered vehicles). For example, the average fuel efficiency for BEVs is about three to five times as much of that for conventional internal combustion engine buses and the average fuel efficiency for FCEVs is about two times as much. The superior fuel efficiency of ZEVs and their alternative fuel sources together help pave a low carbon future for the heavy-duty vehicle sector.

F. Expanding Zero-Emission Technologies to Multiple Sectors

The Proposed ACT Regulation will require manufacturers to manufacture and sell ZEVs to meet the requirements. However, the rule does not prescribe which specific vehicles manufacturers must produce. The Proposed ACT Regulation credit and deficit method allows manufacturers to determine the vehicle types that are most cost effective for them to produce and to serve the markets they choose and to make adjustments as the market expands. This approach complements the Beachhead Strategy described in CARB’s Three-Year Heavy-Duty Strategy (CARB, 2017b).

The Beachhead Strategy focuses resources on applications with the potential to become sustainable quickly and to transfer to other applications where there may be opportunities to scale production. Expansion of a common supply chain that can provide similar components for powertrains and systems that can reduce cost over time. This in turn helps to build greater production volumes, leading to continued affordability.

By allowing the flexibility to choose which market segments to target, the Proposed ACT Regulation will help the market grow in the best suited sectors for electrification initially. Over time as costs drop, technology improves, and consumer acceptance increases, ZEVs will be able to expand to secondary and tertiary markets.

G. Benefits in Disadvantaged Communities and Job Creation

The Proposed ACT Regulation is expected to deliver environmental benefits that include GHG, and criteria pollutant emission reductions in disadvantaged community (DAC) areas. Production of ZEVs in California would likely increase, leading to an increase in jobs in manufacturing and related fields throughout the state. The heightened production and usage of ZEVs could also benefit various businesses related to the ZEV component supply chain, including those involved in battery, fuel cell, and electric drivetrain businesses.

The growing zero-emission truck industry will likely increase high quality employment opportunities in California. There are multiple zero-emission truck manufacturers with plants located in California. As production of zero-emission medium- and heavy-duty trucks increases, so would the number of zero-emission truck manufacturing and related industry jobs in DACs. Other potential benefits resulting from the Proposed ACT Regulation may relate to zero-emission truck component suppliers, EVSE suppliers and installers, and hydrogen fuel station suppliers and installers.

H. Other Societal Benefits

These efforts would also contribute to plans to reduce local emissions, and creating more sustainable communities and cities. ZEVs offer a number of other benefits to truck operators when compared to gasoline and diesel vehicles. ZEVs are quiet and have a smoother ride than ICE vehicles creating a better driving experience for operators. Reduced noise at the worksite creates a safer working environment, provides additional benefits the community the vehicle is operating, and do not conflict with noise ordinances which means they may be able to make more deliveries at night and could reduce congestion. Finally, ZEVs have the potential to use vehicle to grid technologies to support the electrical grid and lower the cost of electricity. Over time, advanced transportation systems and technologies have the potential to become a transformative element in the development of a cleaner, safer, and more efficient transportation system.

VI. AIR QUALITY

This chapter summarizes the potential air quality impacts in California in response to the Proposed ACT Regulation, and includes an overview of the emission inventory methods, a description of the baseline used to estimate emission benefits of the Proposed ACT Regulation, and the resulting changes in NOx, $PM_{2.5}$, and GHG emissions. The details of the emission inventory development are discussed in Appendix F.

A. Baseline Information

All actions as a result of the Proposed ACT Regulation are compared against a business as usual (BAU) baseline. The BAU Baseline reflects the current situation and includes the effects of existing state and federal regulations. More details on the BAU baseline are discussed in Chapter IX.

For the purposes of CEQA analysis, CARB staff compared the reasonably expected effects from the Proposed ACT Regulation to a fixed point in time, reflecting existing conditions in 2018. The term “existing conditions” is used as a point for comparison when evaluating reasonably foreseeable changes that are expected to result from the deployment of the required number of ZEVs, by the Proposed ACT Regulation.

B. Emission Inventory Methods

Staff used the latest available data on population, activity and in-use emissions from medium- and heavy-duty truck fleets operating in California to estimate the BAU baseline emissions and assess the impact of proposed and alternative scenarios on both criteria and GHG emissions.

All population and mileage numbers for vehicles affected by the Proposed ACT Regulation are derived from the EMFAC2017 model. Staff created scenarios for the BAU baseline conditions, conditions under the Proposed ACT Regulation, as well as alternative scenarios. Staff then produced emissions inventories for all scenarios by running the EMFAC2017 model to estimate tank-to-wheel emissions. WTW emissions were estimated using emission rates derived from the CA GREET 3.0.

NOx, $PM_{2.5}$, and GHG emissions reductions are based on the tailpipe emission difference between the ICE and ZEV vehicles. $PM_{2.5}$ emission reductions also include a 50 percent reduction in brake wear due to the regenerative braking of ZEVs reducing brake usage. GHG emission calculations include upstream emissions associated with fuel production. The GHG benefits for this rule do not include any ZEVs which may be used to comply with the California Phase 2 GHG regulation. Only ZEVs sold in excess of the California Phase 2 GHG regulation’s requirements are included in GHG calculations to avoid double-counting.

C. Emission Inventory Results

The Proposed ACT Regulation is expected to result in significant NOx, $PM_{2.5}$, and GHG emission reductions due to replacing internal combustion powered vehicles with zero-emission technology. ZEVs produce no tailpipe emissions, reduce brake wear PM emissions, and have lower upstream emissions. Table VI-1 summarizes the expected criteria emission benefits in 2031 and 2040. These emission reductions contribute to the State SIP Strategy and Climate Change Scoping Plan.

Table VI-1: Expected Emission Reductions of Proposed ACT Regulation

Calendar Year	NOx (tpd)	$PM_{2.5}$ (tpd)	WTW GHG (MMT/yr)
2031	5.0	0.16	0.4
2040	16.9	0.46	1.7

Figure VI-1 illustrates NOx emissions of the Proposed ACT Regulation relative to the BAU baseline. In the BAU baseline, projected NOx emissions decrease sharply until 2023. This is mainly due to the Truck and Bus regulation which requires most diesel vehicles with a GVWR above 14,000 lb. to upgrade to 2010 MY and newer engines. NOx reductions continue in the baseline as mainly due to natural attrition of Class 2b-3 vehicles and vehicles not subject to the Truck and Bus regulation including solid waste collection vehicles, public and utility fleets, and alternatively fueled vehicles. Under the Proposed ACT Regulation, emissions decline at a greater rate as ZEVs enter the fleet and displace the emissions of ICE vehicles.

Figure VI-1: Projected NOx Emissions

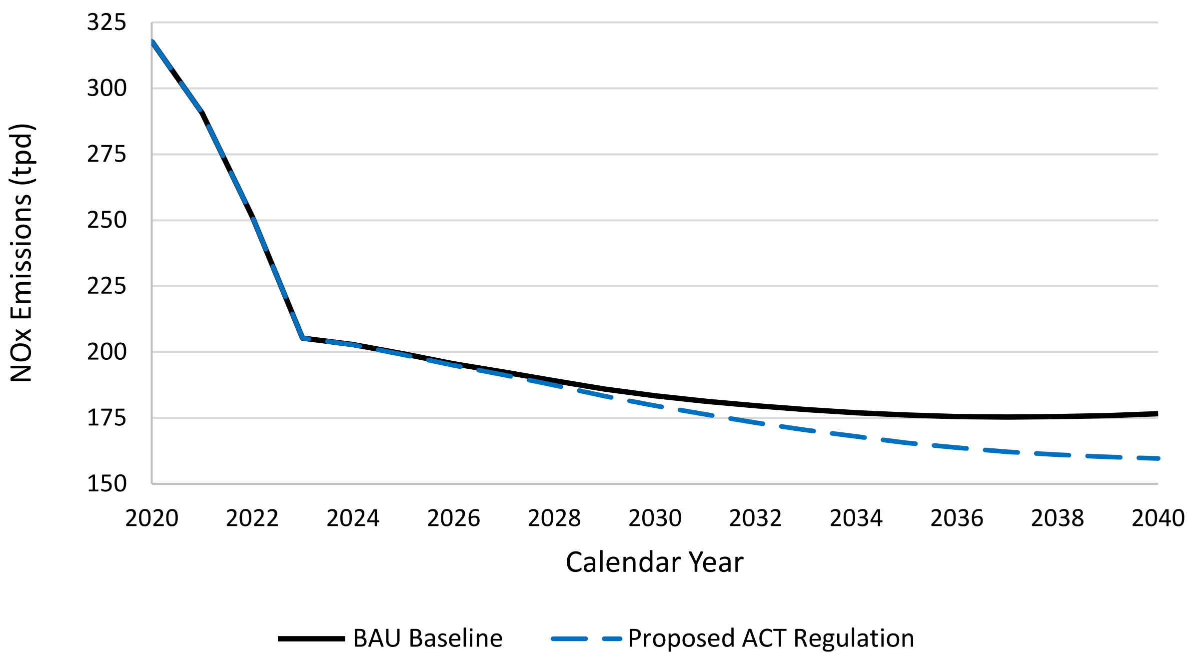


Figure VI-2 illustrates $PM_{2.5}$ emissions of the Proposed ACT Regulation relative to the BAU baseline. Similar to NOx, $PM_{2.5}$ emissions decrease sharply in the BAU baseline scenario until 2023 but slowly rise afterwards. By 2023, nearly all diesel trucks with a GVWR greater than 14,000 lbs. will have diesel particulate matter filters due to the Truck and Bus Regulation. Beginning 2024, $PM_{2.5}$ emissions begin to increase slightly as vehicle miles travelled in EMFAC continue to grow, but the increase is partially offset from some $PM_{2.5}$ emissions reductions from lighter vehicles that continue to be replaced through normal attrition. Under the Proposed ACT Regulation, emissions slightly decline as the emission reductions associated with ZEVs cancel out the expected $PM_{2.5}$ increases.

Figure VI-2: Projected PM2.5 Emissions

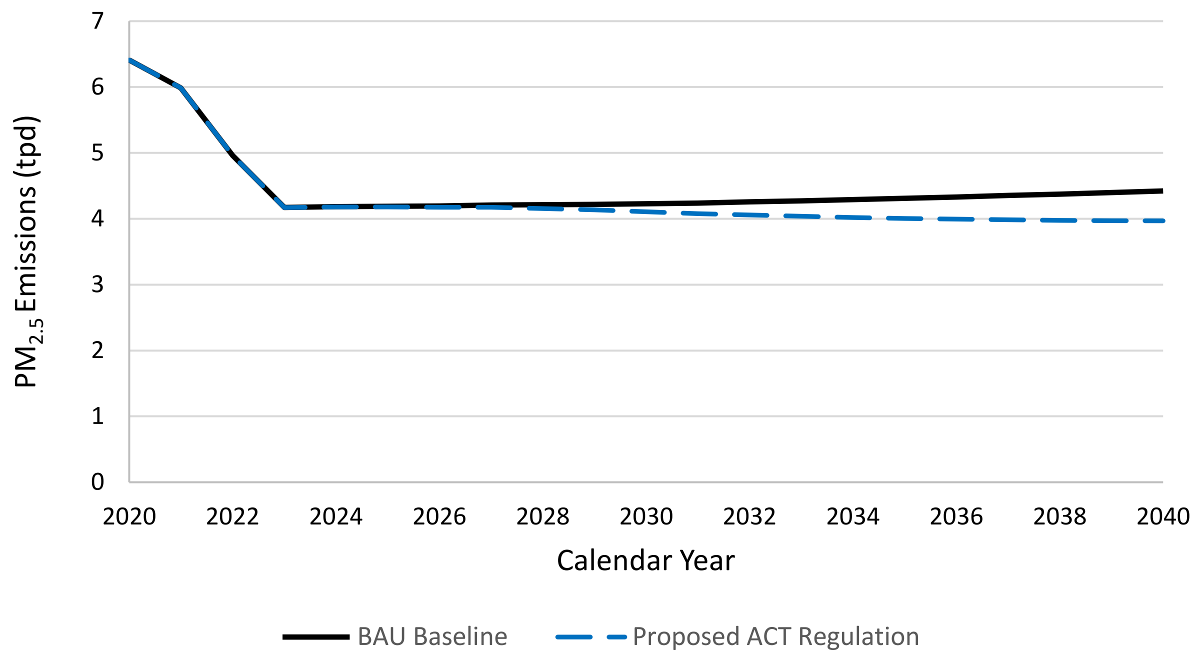
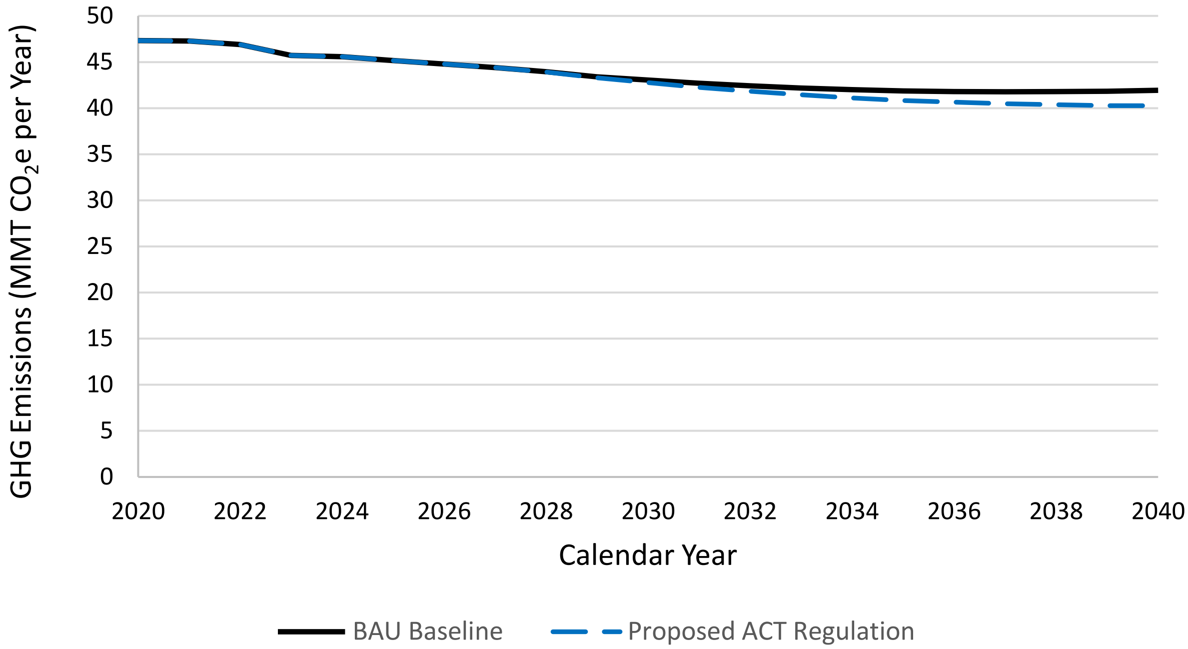


Figure VI-3 illustrates the WTW GHG emissions of the Proposed ACT Regulation relative to the BAU baseline. In the BAU baseline scenario, GHG emissions decline over time as the LCFS regulation decreases the carbon intensity of fuels and trucks are replaced and upgraded to more efficient models subject to the Phase 2 GHG regulations. Emissions start to level out near 2040 as vehicle miles travelled continues to increase. Under the Proposed ACT Regulation, GHG emissions decline throughout 2040 due to the lower tailpipe emissions of ZEVs compared to ICE vehicles. Note that the GHG emission benefits do not include ZEVs which may be used for Phase 2 GHG compliance. As a result, only a portion of the Class 4-8 group generate GHG benefits beyond the Phase 2 GHG regulation under the Proposed ACT Regulation.

From 2020 to 2040, the Proposed ACT Regulation is expected to reduce GHG emissions by a cumulative 11.2 MMT CO_2e. Of these reductions, 9.6 MMT CO_2e are due to tank-to-wheel emission reductions, 0.2 MMT CO_2e from well-to-tank emission reductions within the AB 32 boundary around California, and 1.4 MMT CO_2e from well-to-tank emission reductions outside the AB 32 boundary i.e. elsewhere in the world. The amount of emission reductions within the AB 32 boundary will vary depending on whether decreases in petroleum production and refining occur within or outside California.

Figure VI-3: Projected WTW GHG Emissions



VII. ENVIRONMENTAL ANALYSIS

CARB is the lead agency for the proposed regulation and has prepared an environmental analysis pursuant to its certified regulatory program (Cal. Code Regs., tit. 17, §§ 60000 through 60008) to comply with the requirements of the California Environmental Quality Act (CEQA). CARB's regulatory program, which involves the adoption, approval, amendment, or repeal of standards, rules, regulations, or plans for the protection and enhancement of the State's ambient air quality has been certified by the California Secretary for Natural Resources under Public Resources Code section 21080.5 of CEQA (Cal. Code Regs., tit. 14, § 15251(d)) Public Resources Code section 21080.5, allows public agencies with certified regulatory programs to prepare a "functionally equivalent" or substitute document in lieu of an environmental impact report or negative declaration, once the program has been certified by the Secretary for the Resources Agency as meeting the requirements of CEQA. CARB, as a lead agency, prepares a substitute environmental document (referred to as an "Environmental Analysis" or "EA") as part of the Staff Report to comply with CEQA (Cal. Code Regs., tit. 17, § 60005).

The Draft Environmental Analysis (Draft EA) for the proposed regulation is included in Appendix D to this Staff Report. The Draft EA provides a programmatic environmental analysis of an illustrative, reasonably foreseeable compliance scenario that could result from implementation of the Proposed ACT Regulation.

The Draft EA states that implementation of the Proposed ACT Regulation could result in beneficial impacts to GHG, PM, and NOx through substantial reductions in emissions from medium and heavy duty vehicles in California, long-term beneficial impacts to air quality through reductions in criteria pollutants, and beneficial impacts to energy demand.

For the purpose of determining whether the Proposed ACT Regulation will have a potential adverse effect on the environment, CARB evaluated the potential physical changes to the environment resulting from a reasonable, foreseeable compliance scenario.

Implementation of the Proposed Project could result in an increase in manufacturing and associated facilities to increase the supply of zero-emission trucks, along with construction of new hydrogen fueling stations and electric vehicle charging stations to support heavy-duty ZEV operations and associated increase in hydrogen fuel supply and transportation. Increased deployment of heavy-duty ZEVs could results in a relatively small increase production of electricity and hydrogen fuel, reduce rates of oil and gas extraction, and result in associated increases in lithium and platinum mining and exports from source countries or other states. This could result in increased rates of disposal of lithium batteries and hydrogen fuel cells; however, disposal would need to be in compliance with California law, including but not limited to California's Hazardous Waste Control Law and implementation regulations. For lithium-ion batteries, it is anticipated they still have a useful life at the end of truck life, and are likely to be repurposed for a second life. To meet an increased demand of refurbishing or reusing batteries and fuel cells, new facilities, or modifications to existing facilities, could be constructed to accommodate recycling activities. Fleet turnover would largely be unaffected since the regulation is based on changes at time of normal vehicle purchase.

While many impacts associated with the Proposed ACT Regulation could be reduced to a less-than-significant level through conditions of approval applied to project-specific development, the authority to apply that mitigation lies with land use agencies or other agencies approving the development projects, not with CARB. Consequently, the EA takes the conservative approach in its significance conclusions and discloses, for CEQA compliance purposes, that impacts from the development of new facilities or modification of existing facilities associated with reasonably foreseeable compliance responses to the Proposed ACT Regulation could be potentially significant and unavoidable. Table VII-1 below summarizes potential impacts of approving the proposed regulation.

Table VII-1: Summary of Potential Environmental Impacts

Resource Area Impact	Significance
Short-Term Construction-Related and Long-Term Operational Impacts on Aesthetics	Potentially Significant and Unavoidable
Conversion of Agricultural and Forest Resources Related to New Facilities	Potentially Significant and Unavoidable
Short-Term Construction-Related Air Quality Impacts	Potentially Significant and Unavoidable
Long-Term Operation Air Quality Emissions	Less than Significant
Short-Term Construction-Related and Long-Term Operational Impacts on Biological Resources	Potentially Significant and Unavoidable
Short-Term Construction-Related and Long-Term Operational Impacts on Cultural Resources	Potentially Significant and Unavoidable
Short Term Construction-Related Impacts on Energy Demand	Less Than Significant
Long-Term Operational Impacts on Energy Demand	Beneficial
Short-Term Construction-Related and Long-Term Operational Effects on Geology and Soil Related to New Facilities	Potentially Significant and Unavoidable
Short-Term Construction Related GHG Impacts	Less Than Significant
Long-Term Operational Related GHG Impacts	Beneficial

Resource Area Impact	Significance
Short-Term Construction-Related Hazard Impacts	Potentially Significant and Unavoidable
Long-Term Increased Transport, Use, and Disposal of Hazardous Materials	Potentially Significant and Unavoidable
Short-Term Construction-Related and Long-Term Operational Effects Hydrology and Water Quality Related to Changes in Land Use	Potentially Significant and Unavoidable
Short-Term Construction-Related Impacts on Mineral Resources	Less than significant
Long-Term Operational-Related Impacts on Mineral Resources	Potentially Significant and Unavoidable
Short-Term Construction and Long Term Operational-Related Noise Impacts	Potentially Significant and Unavoidable
Short-Term Construction-Related Impacts and Long-Term Operational Impacts on Population, Employment, and Housing	Less Than Significant
Short-Term Construction-Related Impacts and Long-Term Operational Impacts on Public Services	Less Than Significant
Short-Term Construction-Related Impacts and Long-Term Operational Impacts on Recreation	Less Than Significant
Short-Term Construction and Long Term Operational-Related Impacts on Traffic and Transportation	Potentially Significant and Unavoidable
Increased Demand for Water, Wastewater, Electricity, and Gas Services	Potentially Significant and Unavoidable

Information on the project description, location, and potential environmental effects, as currently known, are contained in the attached materials, including the notice for public workshops that was held on May 31, 2018. In addition to soliciting input on the proposed project, these workshops served as a CEQA scoping meeting to solicit input on the scope and content of the EA prepared for the proposed project.

The Notice of Preparation (NOP) was available for review and comment for 30 days, per the CEQA Guidelines (Cal. Code Regs., tit. 14 §15082(b)). The comment period for the NOP was held from May 15, 2018 to June 14, 2018.

Written comments on the Draft EA will be accepted starting October 25, 2019, through 5 p.m. on December 9, 2019. The Board will consider the final EA and responses to comments received on the Draft EA before taking action to adopt the Proposed ACT Regulation.

VIII. ENVIRONMENTAL JUSTICE

State law defines environmental justice as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies (Government Code, section 65040.12, subdivision (c)). CARB is committed to making environmental justice an integral part of its activities. The Board approved its Environmental Justice Policies and Actions (CARB, 2001) on December 13, 2001, to establish a framework for incorporating environmental justice into CARB's programs consistent with the directives of State law These policies apply to all communities in California, but recognize that environmental justice issues have been raised more in the context of low-income and minority communities.

Over the past thirty years, CARB, local air districts, and federal air pollution control programs have made substantial progress towards improving air quality in California and are on track to meet the statutory goals of reducing GHG emissions to 1990 levels by 2020. Despite this progress, some areas in California still exceed health-based air quality standards for ozone and PM. One of the most important factors for identifying disadvantaged communities are disproportionate effects of environmental pollution and other hazards that can lead to negative public health effects, exposure, or environmental degradation.

Legislation like SB 350 (De León, Chapter 547, Statutes of 2015) is at the cornerstone of California’s future ability to meet air quality, public health, and climate goals, along with ensuring economic prosperity, social equity, and energy security (CARB, 2018d). One key strategy to achieve these goals is by transitioning to zero-emission technologies in all sectors including industrial, residential, electricity, and commercial that meet the dynamic needs of low-income and disadvantaged communities. The Proposed ACT Regulation with a goal of developing a self-sustaining zero-emission truck market through increasing sales of zero-emission trucks in California by truck manufacturers is essential to this strategy.

Medium and heavy-duty are the predominant means of distributing good and services. Their prevalence can be seen along distribution centers, ports, warehouses, and major roadways which are commonly located around more densely populated urban areas, including in low-income and disadvantaged communities. The Proposed ACT Regulation requires percentage of heavy-duty truck sales to be ZE. These actions in the Proposed ACT Regulation would ensure that the public would be aware of and would benefit from the cleanest technology available on the market.

The Proposed ACT Regulation provides solutions that overcome barriers to deploy heavy-duty ZEVs in low-income residents and promote environmental justice. The deployment of heavy-duty ZEVs in low-income and disadvantaged communities eliminates tailpipe emissions, reduces particulate matter associated with brake wear, reduces petroleum use, reduces energy consumption and helps California achieve its air quality and climate protection goals. Zero-emission technologies have fuel efficiency two to five times as much as conventional internal combustion engines and are one of the most effective technologies to lead the transportation sector in reducing energy consumption and combustion related emissions. Heavy-duty ZEV adoptions in low-income and disadvantaged communities will be an important part of the solution in achieving GHG goals established in many statues or are complementary to existing measures including AB 32, SB 32, SB 350, and SB 375 and in maximizing NOx and PM reductions needed to meet SIP requirements.

In addition to reducing emissions, the Proposed ACT Regulation is expected to attract heavy-duty ZEVs industries to bring high quality job opportunities to California and to support employment in disadvantaged communities. As the demand and production of heavy-duty ZEV increases, so would the number of heavy-duty ZEVs manufacturing, operation and maintenance related jobs in California. For example, BYD, located in Lancaster, California, has a community benefits agreement (CBA) with Jobs to Move America (JMA), which will support the creation of a robust U.S. jobs program through deep investments in pre-apprenticeship and training programs. This CBA has a goal of recruiting and hiring 40 percent of its workers from populations facing significant barriers to employment, such as veterans and returning citizens (Charged Electric Vehicle Magazine, 2017). In addition, populations that have historically been excluded from the manufacturing industry, such as women and African Americans are also expected to be recruited and placed. The agreement also includes commitments from BYD to work with the JMA coalition to provide support systems for these workers to strengthen retention efforts, such as providing transportation for workers who may not have access to a car.

Besides BYD's heavy-duty ZEVs manufacturing and maintenance industry, the following companies', GreenPower, Motiv, Phoenix Motorcars, TransPower, and Efficient Drivetrains Inc. also produce heavy-duty ZEVs in California. Therefore, an increase demand for production of heavy-duty ZEVs would also create high quality jobs opportunities for other heavy-duty ZEVs manufacturers' in California.

Overall, the Proposed ACT Regulation is consistent with and helps advance CARB's environmental justice policies and goals. The ACT regulation echoes The Sustainable Freight Action Plan and supports the governor's Executive Order B-16-12 and Executive Order B-48-12, which calls for 5 million ZEVs (including heavy-duty vehicles) on the road by 2030, and setting a target of 250,000 chargers by 2025. In addition, establishes several milestones on the pathway toward this target to substantially reduce GHG emissions from medium and heavy-duty vehicles and have health benefits from reducing criteria pollutant emissions. Reducing GHG emissions will help stabilize the climate, which will benefit all communities, including low-income and disadvantaged communities.

IX. ECONOMIC IMPACTS ASSESSMENT OR STANDARDIZED REGULATORY IMPACT ANALYSIS

A. Business-As-Usual Baseline

For the ISOR, the economic and emissions impacts of the Proposed ACT Regulation are evaluated against the BAU baseline scenario each year for the analysis period from 2020 to 2040. The BAU case for the economic and emissions analysis for the Proposed ACT Regulation is referred to as the "BAU baseline" and uses the same vehicle inventory for both analyses. The baseline vehicle inventory includes the same vehicle sales and population growth assumptions reflected in CARB's EMFAC emissions inventory for weight Class 2b and greater vehicles for all fuel types (CARB, 2017f).

ZEVs required by the Proposed ACT Regulation can also be used to comply with the California Phase 2 GHG regulation and the U.S. EPA Phase 2 GHG regulation, and results in potential overlapping emissions and costs. In the Federal Phase 2 GHG rulemaking, EPA stated that they "do not project fully electric vocational vehicles to be widely commercially available in the time frame of the final Phase 2 rules. For this reason, [EPA and NHTSA] have not based the Phase 2 standards on adoption of full-electric vocational vehicles (U.S. EPA, 2016)." California adopted the U.S. EPA Phase 2 GHG regulation and similarly did not model ZEV deployments due to the CA Phase 2 GHG regulation.

Even though Phase 2 GHG has an Advanced Technology Multiplier until the end of the 2027 MY which may make ZEVs a temporarily more cost effective compliance option, staff does not believe the Phase 2 GHG regulation incentivizes ZEVs enough to ensure their production. Manufacturers bear risks in building and selling ZEVs due to the large upfront investments and uncertainty in future growth and may not be the lower cost option to comply with the Phase 2 GHG regulation post 2027.

For purposes of evaluating GHG emissions staff assumes no new GHG emissions benefits as a result of the Proposed ACT Regulation up to the total benefits anticipated from the California Phase 2 GHG requirements. Staff does count GHG emissions benefits after any California Phase 2 GHG anticipated benefits are exceeded. The interactions between California Phase 2 GHG and the Proposed ACT Regulation are also factored into the cost analysis later in this document.

The ZEVs that are already required to be purchased by the existing ICT and ASB regulations and AB 739 are also excluded from the from the costs and emissions analysis of the Proposed ACT Regulation and any alternatives analysis to avoid double counting.

This analysis of the Proposed ACT Regulation counts ZEVs sold starting with the 2021 model year, but will not include those sold in prior years because incentive funding programs are already offsetting most, if not all of the incremental costs. Staff does not assume ZEV sales will continue without incentive or other policies to promote them. For example, some industry market projections forecast ZEV adoption, but these include assumptions about availability of incentives and government policies to increase ZEV sales. ACT Research, a major freight movement analytics firm, released an August 2018 report titled “Commercial Vehicle Electrification: To Charge or Not To Charge (Truck News, 2018)”, which predicted that ZEVs will be adopted in increasing numbers due to incentives and government policies, among other factors. Another reason that ZEVs are not included in the baseline inventory is that medium and heavy-duty ZEV deployments were assumed in the SIP and only actions that are enforceable can be included in the SIP. The Proposed ACT Regulation would make ZEV sales enforceable.

B. Direct Costs

The Proposed ACT Regulation will require manufacturers to produce and sell vehicles that have a higher upfront cost than in the baseline. Manufacturers bear the risk associated with the incremental costs associated with producing and selling ZEVs, but producing and selling these ZEVs will simultaneously decrease the manufacturers’ cost of comply with the Phase 2 GHG regulation. Staff assumes the costs to California includes the higher upfront capital costs, infrastructure upgrades and lower operating expenses. This approach shows the full estimated cost to California for deploying the same number of ZEVs required by the regulation.

1. Changes Since the Release of SRIA

The Proposed ACT Regulation has been updated since the release of the Standardized Regulatory Impact Analysis (SRIA) on August 8, 2019. These changes and their estimated impacts are summarized below.

<u>ZEV percentage sales requirement</u>

The ZEV sales percentage requirements for Class 7-8 tractors was changed to begin 3 years earlier than when the SRIA was submitted to Department of Finance. In the SRIA, the ZEV sales percent requirement for Class 7-8 tractors did not start until 2027 MY. In the updated proposal, the requirements begin at 3 percent in 2024 MY, 5 percent in 2025 MY, and 7 percent in 2026 MY. These changes affect costs to manufacturers and California businesses and have been reflected in the updated analysis below.

<u>Phase 2 GHG Compliance Costs</u>

The formula for calculating Phase 2 GHG compliance costs avoided has been modified slightly to improve accuracy. This change slightly reduces the expected Phase 2 GHG costs avoided and increases the estimated total cost of the rule through 2040 by roughly 0.1 percent.

Large Entity Reporting Cost

The estimated large entity reporting cost has been updated since the release of the SRIA to better reflect the anticipated time needed for regulated entities to report. This change increases the cost of the rule through 2040 by less than 0.01 percent.

Class 4-5/Class 6-7 Split

The estimated ratio of Class 4-5 to Class 6-7 vehicles was changed from 49:51 to 46:54 to correct for an error in calculations. This change decreases the estimated cost of the rule through 2040 by roughly 0.05 percent.

Annualized Benefits

In response to DOF comments found in Appendix C-2, this analysis has been updated to display benefits annually rather than just showing totals as was done in the original SRIA. There are three types of benefits modeled in this analysis: avoided health costs, avoided social cost of carbon, and direct cost savings. Calculation and valuation of health benefits and social cost of carbon are displayed in Chapter VI and are displayed on pages V-6 and V-8, respectively. Direct costs and associated savings are displayed on page IX-30.

2. Vehicle Population and Annual Mileage

Staff divided the affected vehicle population into five vehicle groups to match the requirements of the Proposed ACT Regulation. Note that Class 6-7 and Class 8 excludes Class 7-8 tractors because there is a separate category for those vehicles.

- Class 2b-3 – Vehicles with a GVWR from 8,501 to 14,000 lb.
- Class 4-5 – Vehicles with a GVWR from 14,001 to 19,500 lb.
- Class 6-7 – Vehicles with a GVWR from 19,500 to 33,000 lb. (excluding Class 7 tractors)
- Class 8 – Vehicles with a GVWR above 33,001 lb. (excluding Class 8 tractors)
- Class 7-8 Tractors – Tractors with a GVWR above 26,001 lb.

In this analysis, all estimates for annual California sales come from CARB's Emission Factor (EMFAC) inventory model (CARB, 2017f). The EMFAC model is developed and used by CARB to assess emissions from on-road vehicles including cars, trucks, and buses in California, and to support CARB's regulatory and air quality planning efforts to meet the Federal Highway Administration's transportation planning requirements. U.S. EPA approves EMFAC for use in State Implementation Plan and transportation conformity analyses. It includes vehicle population growth, mileage accrual rates over time, vehicle fuel usage and associated emission factors, and vehicle attrition over time. The vehicle categories in EMFAC were matched to the Proposed ACT Regulation's vehicle groups as shown in Table IX-1:

Table IX-1: Vehicle Groups and EMFAC Categories

Vehicle Group	EMFAC Categories
Class 2b-3	Light Heavy-Duty 1 and Light Heavy-Duty 2
Class 4-5 & Class 6-7	T6 Small (Class 4-6 Vehicles), T6 Heavy (Class 7) excluding tractors, School Bus, All Other Buses
Class 8	T7 (Class 8) excluding tractors
Class 7-8 Tractor	T6 Heavy Tractors, T7 Tractors

EMFAC groups Class 4-5 and Class 6-7 into the same category called T6. However, because staff needed to match population categories with the proposed rule to more accurately model the resulting changes in vehicle populations for this analysis, the T6 category was split into Class 4-5 and Class 6-7. Staff assumes a 46 percent Class 4-5 to 54 percent Class 6-7 split based on Department of Motor Vehicles (DMV) data (DMV, 2018). (CARB, 2019e).

Because the Proposed ACT Regulation only affects vehicles sold into California, the total sales numbers were adjusted downward using California DMV data to remove out-of-state sales. The estimated number of California sales from 2024-2030 model years for each category are shown in Table IX-2. Truck sales are forecasted by EMFAC to grow at about 1 percent per year (CARB, 2018e).

Table IX-2: Estimated Number of Annual Sales per Vehicle Group

Model Year	Class 2b-3	Class 4-5	Class 6-7	Class 8	Class 7-8 Tractor	Total Sales
2024	53,761	6,436	7,556	1,119	4,686	73,559
2025	54,217	6,531	7,667	1,137	4,769	74,321
2026	54,753	6,649	7,806	1,177	4,918	75,302
2027	55,152	6,786	7,966	1,194	4,993	76,091
2028	55,765	6,904	8,105	1,216	5,075	77,064
2029	56,371	7,024	8,246	1,239	5,161	78,041
2030	56,968	7,147	8,390	1,264	5,263	79,032

Vehicle manufacturers sell trucks powered by a variety of fuels – most commonly gasoline or diesel, but also including compressed and liquid natural gas, propane, ethanol, and other fuels. In staff's assumed baseline conditions, for simplification, Class 2b-3 vehicles are split between gasoline- and diesel-powered assuming a 43 percent gasoline to 57 percent diesel ratio based on available EMFAC data (CARB, 2018e). Staff assumes Class 4-8 vehicles are solely diesel-powered to simplify the analysis. Based on EMFAC data, roughly 10 percent of Class 4-8 vehicles use a fuel other than diesel.

Under the Proposed ACT Regulation, manufacturers can comply with a combination of battery-electric, fuel-cell electric, and plug-in hybrid electric technologies. It is difficult to predict manufacturers' future plans for complying with the Proposed ACT Regulation, especially as battery and fuel-cell technologies improve and costs continue to decline.

Based on manufacturers' publicly announced plans, staff assumed manufacturers will comply with the Proposed ACT Regulation requirements for Class 2b-3 and Class 4-8 vocational trucks by building battery-electric vehicles. Staff assumed no FCEVs in these two categories because no manufacturers that would be regulated have announced plans to commercially produce FCEVs. Cummins is a powertrain manufacturer that has announced plans to offer a plug-in hybrid powertrain to vehicle manufacturers that allows for full-electric, series hybrid, and parallel hybrid functionality (Cummins, 2019). At this time it is unclear if PHEVs will result in lower costs for regulated manufacturers because the vehicles would have two propulsion systems, and would earn fewer NZEV credits than an equivalent ZEV meaning that more NZEVs would need to be sold to meet the same credit requirement. The reduced NZEV credit also ensures that total emission benefits remain about the same. Although NZEVs are expected to have lower cost per vehicle than full ZEVs, they still require charging infrastructure and will not have as significant operational cost savings as battery-electric vehicles. At workgroup meetings, multiple manufacturers have stated they would not produce both PHEVs and ZEV models if still required to produce ZEVs to comply. For all of these reasons, staff are not including PHEVs in the cost analysis.

For Class 7-8 tractors, staff assumes 90 percent of the required vehicles will be sold as battery-electric and 10 percent will be sold as fuel-cell electric. While there is interest from numerous manufacturers in fuel-cell tractor technology, most manufacturers are currently investing in battery-electric tractor technology. The proposed percentage requirements are not stringent enough to require electrification of the long haul sector meaning manufacturers can focus their deployments in short-haul tractor applications. Battery-electric technology is well suited for short-haul applications and offers potential fuel savings. Long-haul applications are where fuel cell electric trucks offer the greatest advantage over battery-electric tractors due to their rapid refueling and lower weight.

Table IX-3 outlines the assumptions for each vehicle group in the baseline and proposal scenarios.

Table IX-3: Vehicle Groups and Technologies

Vehicle Group	Baseline Scenario	Proposal Scenario
Class 2b-3	Gasoline (43%)	Battery-electric (All normal range)
Class 2b-3	Diesel (57%)	Battery-electric (All normal range)
Class 4-5	Diesel	Battery-electric (50% long range after 2030)
Class 6-7	Diesel	Battery-electric (50% long range after 2030)
Class 8	Diesel	Battery-electric (50% long range after 2030)
Class 7-8 Tractor	Diesel	Battery-electric (90%)
Class 7-8 Tractor	Diesel	Fuel Cell Electric (10%)

The percentage schedules shown below in Table IX-4 are applied to the annual sales numbers to calculate the annual number of zero-emission trucks required by the regulation.

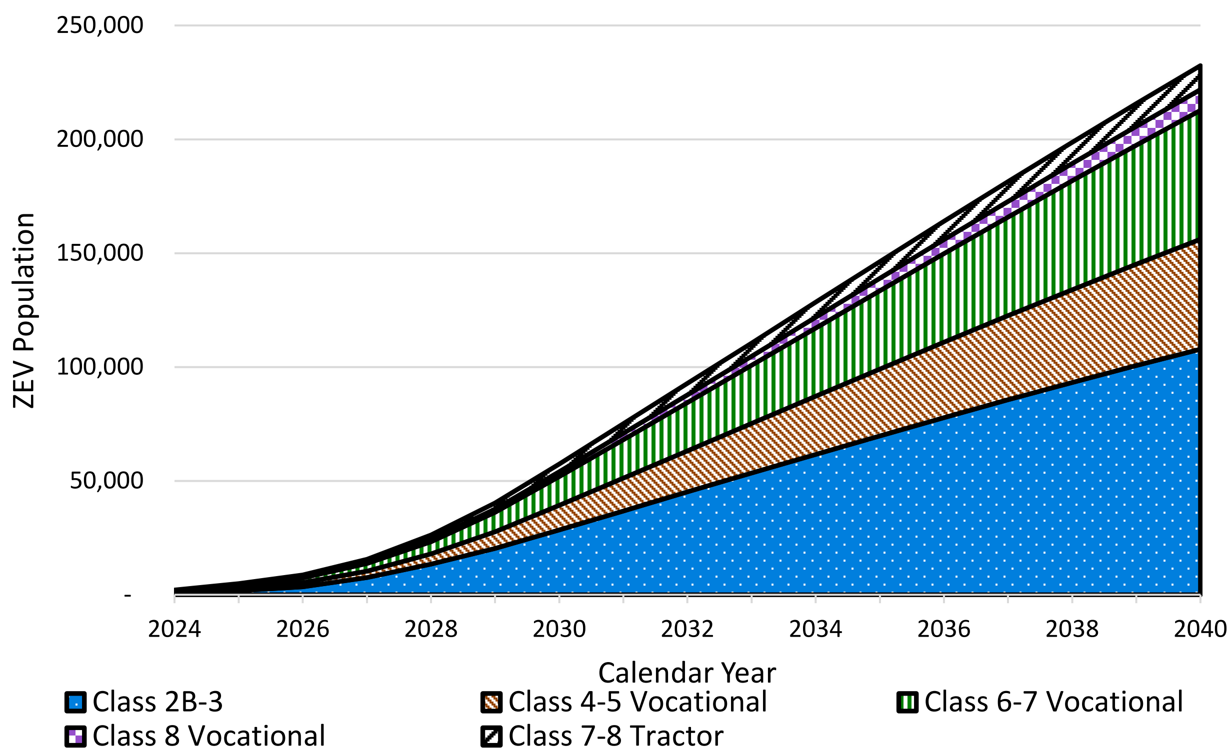
Table IX-4: Advanced Clean Trucks ZEV Sales Percentage Schedule

Model Year	Baseline	Class 2b-3*	Class 4-8**	Class 7-8 Tractor
2024	0%	3%	7%	3%
2025	0%	5%	9%	5%
2026	0%	7%	11%	7%
2027	0%	9%	13%	9%
2028	0%	11%	24%	11%
2029	0%	13%	37%	13%
2030 and beyond	0%	15%	50%	15%

*Pickup trucks are excluded from Class 2b-3 requirements until 2027
**Excluding Class 7-8 tractors

These percentages are applied to the annual California sales numbers to estimate the number of zero-emission trucks that will be sold in California as shown in Figure IX-1. The population growth rate increases to 2030 as the ZEV sales percentage requirement ramps up, and grows more slowly afterwards as the ZEV percentage remains flat and ZEV sales begin to replace ZEVs that retire out of the fleet.

Figure IX-1: ZEV Population Forecast over Time (>8,500 lb. GVWR)



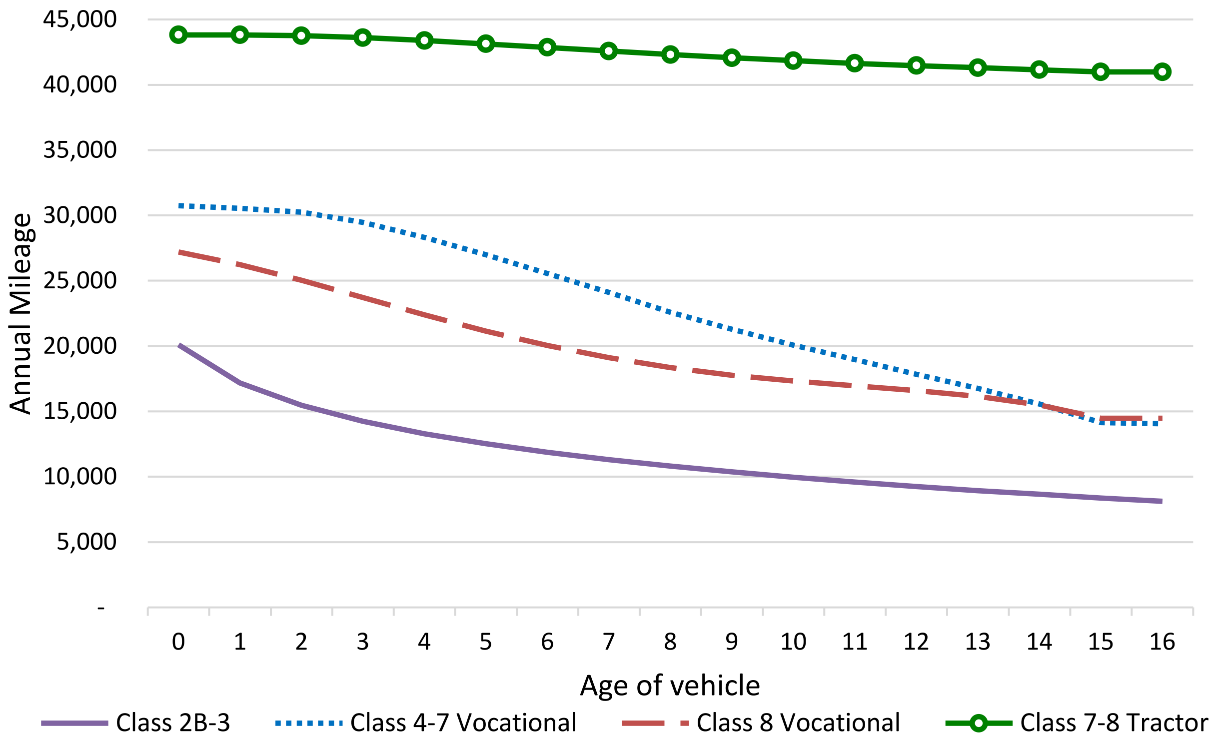
Staff are not anticipating any pre-buy situation where manufacturers increase sales of their vehicles before the Proposed ACT Regulation and decrease sales after implementation begins. Fleets, not manufacturers, decide when to purchase vehicles and this regulation is not likely to change their purchase patterns.

Annual mileage factors into a number of costs in this analysis including fuel costs, maintenance, and LCFS revenue. All annual mileage are based on EMFAC inventory estimates of mileage accrual rates over a vehicles life. For most vehicle categories, annual mileage is the highest early for low age vehicles and drops over time as the vehicle ages. EMFAC categories are matched to vehicle groupings as follows:

- Class 2b-3 annual mileage is the population weighted average of the following EMFAC categories: Light Heavy-Duty 1 and 2
- Class 4-5 and Class 6-7 vehicles are not separated in EMFAC and are lumped together into a Class 4-7 grouping. Based on data available from the 2002 US Vehicle Inventory and Use Survey and the 2018 California Vehicle Inventory and Use Survey, the annual miles for Class 4-5 and Class 6-7 trucks are fairly similar. (U.S. Census, 2004), (Caltrans, 2019). The Class 4-7 vocational truck annual mileage is the population weighted average of the following EMFAC categories: T6 Public, T6 Instate, T6 Instate – Construction, T6 Utility, T6 gasoline powered trucks, School Buses, and All Other Buses.
- Class 8 truck annual mileage is the population weighted average of the following EMFAC categories: T7 Public, T7 Single Unit, T7 Single Unit – Construction, T7 Solid Waste Collection Vehicle, and T7 Utility.
- Class 7-8 tractor annual mileage is the population weighted average on the three EMFAC drayage categories: Port of Los Angeles, Port of Oakland, and All Other Ports. We are currently assuming that all required sales of zero-emission tractors will be used in drayage service or similar shorter-haul operation.

Figure IX-2 illustrates the average mileage assumption for each vehicle group over the life of the vehicle from EMFAC. Staff are assuming ZEVs will travel the same miles as conventional ICE vehicles in their typical operation. Even today, commercially available ZEVs have the range to meet the majority of trucking needs and the lower operating cost of BEVs incentivizes higher mileage duty cycles. Over time as technology advances and more models become available, range should become less of an issue.

Figure IX-2: Annual Mileage Accrual Rates by Vehicle and Age



The California International Registration Plan and Out of State categories are not included in these calculations as these categories represent trucks that regularly travel in interstate operation. Due to their high annual miles and variable infrastructure needs, these categories are not assumed to be representative of a zero-emission duty cycle. In addition, many of these trucks are not sold into California despite operating within the state, so these sales would not be regulated under the Proposed ACT Regulation.

3. Cost Inputs

The estimated direct costs from the Proposed ACT Regulation and the BAU baseline scenario include: upfront capital costs of the vehicles, infrastructure, and ongoing operating costs which include fueling and maintenance. Compared to gasoline or diesel vehicles, ZEVs generally have higher upfront capital costs but lower operating costs, which result in an overall savings in staff's analysis over the useful life of the vehicles. Currently there are a number of rebate and voucher programs in California that offset some or all of the incremental costs for ZEVs and supporting infrastructure; however, none of these incentives are included in the cost analysis. LCFS credits are a form of incentive, but it is a market-based mechanism that increases the use of low carbon transportation fuels in California that has been established by California regulations. The assumptions underlying the direct costs are detailed in the following sections.

i. Costs to Manufacturers

Manufacturers are the regulated party in the Proposed ACT Regulation and would be responsible for selling ZEVs in California. The Proposed ACT Regulation requires that manufacturers must build and sell more expensive zero-emission trucks, certify their powertrain using the optional ZEP Certification procedure, and report information to CARB as part of their regulatory requirements. Manufacturers have the option to use the required zero-emission truck sales to help meet their Phase 2 GHG compliance obligation. Therefore, the incremental costs of producing ZEVs above the expected costs of compliance with the Phase 2 GHG without ZEVs are attributable to the Proposed ACT Regulation.

<u>Vehicle Price</u>

This section covers the cost to the manufacturer of building and selling a baseline ICE vehicle or a ZEV. Today and for the foreseeable future, battery-electric and fuel cell electric trucks will cost more than their diesel or gasoline counterparts. Declining battery and component costs in addition to economies of scale are expected to lower the incremental costs of ZEVs as the market expands. For this subsection, we are assuming the full incremental price of the vehicle when compared to the baseline is treated as a cost to the manufacturer. Vehicle prices are not amortized as the manufacturer would see the full cost in the year it is built and sold.

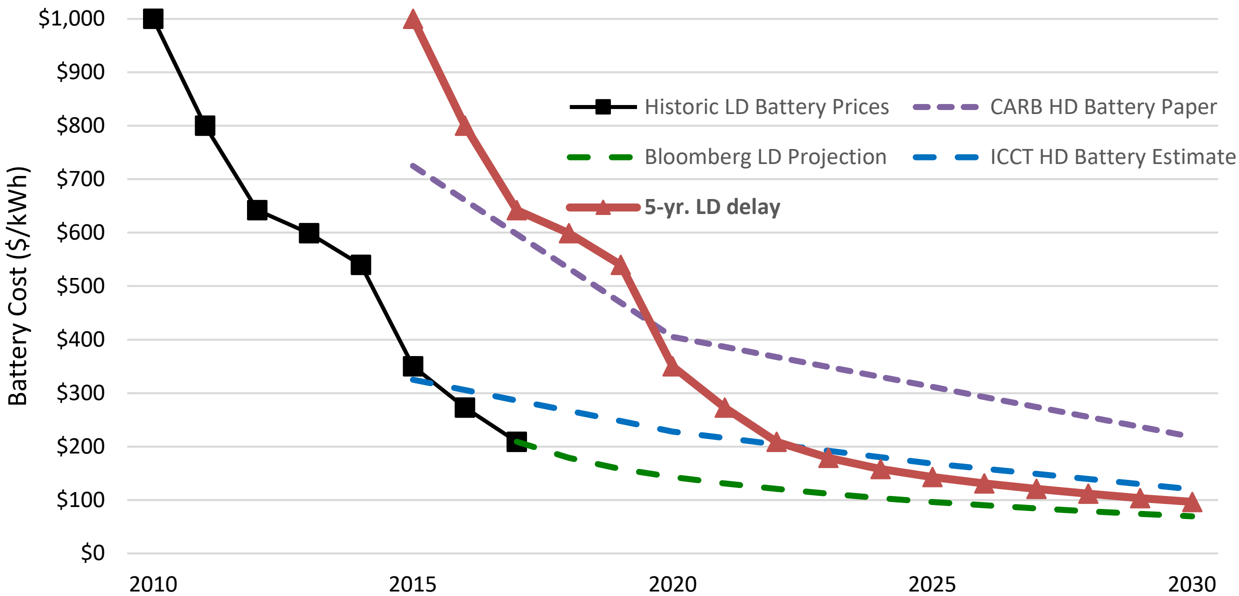
Gasoline and diesel vehicle prices are based on averages of prices taken from manufacturers' websites and other related websites (CARB, 2019f). For the Class 4-5, Class 6-7, and Class 8 vehicles, the cost is meant to represent a vehicle with a basic body such as a box or stake-bed and not a vehicle with an expensive specialty body such a boom truck or refuse truck.

Staff estimated the cost of ZEVs for battery-electric and fuel cell powered vehicles by adding electric components costs, fuel cell component costs, and energy storage costs to a conventional glider vehicle. The final retail price of the ZEVs is the sum of the total component costs adjusted by an additional 10 percent for other upfront costs such as research, development, retooling, and overhead. The calculated prices for battery-electric vehicles are comparable to battery-electric trucks and vans that are available through the HVIP program today

The cost of battery storage is the biggest factor in battery-electric truck incremental cost. Battery pack costs have dropped nearly 80 percent since 2010 and are projected to continue declining. The CARB discussion document "Battery Cost for Heavy-Duty Vehicles" was a literature review published in 2016 using data sources from 2013 and 2014 to assess battery costs for buses and heavy-duty vehicles (CARB, 2017g). Battery pack cost for heavy-duty applications are higher than for light-duty vehicles due to smaller volumes and differing packaging requirements even though many use the same cells. However, this report is somewhat dated and does not reflect the current state of the battery market. At the December 4th, 2018 Advanced Clean Trucks workgroup meeting, a number of manufacturers suggested we use light-duty battery prices with a five-year delay to reflect battery-price projections that are applicable to heavy-duty vehicles.

Figure IX-3 displays various battery price projections and the suggested 5-year light-duty delay. The 5-year delay of light duty battery pack prices is similar to projections made in the CARB discussion document for 2018 and becomes similar to the fairly recent projection made by ICCT after 2020.

Figure IX-3: Battery Price History and Projections



The battery-electric vehicle costs in this analysis are calculated using electric vehicle component costs from the International Council on Clean Transportation whitepaper (ICCT), "Transitioning to Zero-Emission Heavy-Duty Freight Vehicles" and battery costs will use the Bloomberg light-duty battery prices with a five-year delay.(International Council on Clean (ICCT, 2017), (Bloomberg, 2018). Hydrogen fuel cell component costs are from a variety of sources. Electrical component costs and hydrogen tank costs are calculated using the same ICCT source and battery costs are estimated using the same Bloomberg light-duty battery prices with a five year delay. Hydrogen system component costs are calculated using a presentation from Strategic Analysis titled "Fuel Cell Systems Analysis" which estimated fuel cell system costs for medium- and heavy-duty trucks (Strategic Analysis, 2018). This presentation analyzed fuel cell system costs on a component level basis for multiple weight classes of vehicle and provided temporal and volume-based cost projections.

Staff are not forecasting that this rule will affect commercial battery prices and ZEV technology significantly. The Proposed ACT Regulation affects a portion of California's heavy-duty trucking fleet, which is very small compared to the worldwide market for batteries in consumer electronics, light-duty vehicles, battery storage, and other applications. To the extent that this rule increases economies of scale for general ZEV components, infrastructure, and battery production, there may be lower component prices as a result of the rule, but these effects are less certain and are not modelled. The Proposed ACT Regulation may cause the cost for components specifically designed for medium- and heavy-duty ZEVs to decrease as economies of scale start to emerge in this new market.

The battery-electric vehicle is modelled using motors and electrical components in line with an existing diesel counterpart's power needs, and battery storage capacity based on the Age 0 daily mileage, the energy economy of the electric vehicle, and a 35 percent buffer to account for battery degradation and some operational variability. The hydrogen fuel cell tractor cost assumes the battery is 10 kWh, 40 kg of hydrogen storage, and the fuel cell stack's power output is half the vehicle's peak power needs.

In the proposal and some alternatives, a long-range battery-electric vehicle is modelled, which assumes a 50 percent larger battery. For tractors, longer range needs are assumed to be met with fuel cell electric tractors. Table IX-5: lists the specifications of the battery-electric vehicles.

Table IX-5: Battery Size Calculation

Vehicle Group	Age 0 Daily Mileage	Efficiency (kWh/mi)	Normal Range Battery Size (kWh)	Long Range Battery Size (kWh)
Class 2b-3	65	0.6	55	80
Class 4-5 Vocational	100	1.0	135	200
Class 6-7 Vocational	100	1.5	200	300
Class 8 Vocational	90	2.0	240	360
Class 7-8 Tractors	140	2.1	400	N/A

The assumed vehicle prices for gasoline and diesel vehicles are shown in Table IX-6 and the battery-electric and fuel cell electric price forecasts are shown Table IX-7.

Table IX-6: Baseline Vehicle Prices

Vehicle Group	Vehicle Price
Class 2b-3 - Gasoline	$45,000
Class 2b-3 - Diesel	$50,000
Class 4-5	$55,000
Class 6-7	$85,000
Class 8	$120,000
Class 7-8 Tractors	$130,000

Table IX-7: ZEV Price Forecast

Vehicle Group	2024 MY	2025 MY	2026 MY	2027 MY	2028 MY	2029 MY	2030+ MY
Class 2b-3 – Electric Normal Range	$64,896	$63,635	$62,599	$61,684	$60,829	$60,035	$59,241
Class 2b-3 – Electric Long Range	$69,241	$67,568	$66,201	$65,011	$63,909	$62,895	$61,881
Class 4-5– Electric Normal Range	$80,127	$77,616	$75,585	$73,852	$72,267	$70,830	$69,394
Class 4-5– Electric Long Range	$91,424	$87,841	$84,952	$82,503	$80,275	$78,266	$76,258
Class 6-7– Electric Normal Range	$116,174	$112,591	$109,702	$107,253	$105,025	$103,016	$101,008
Class 6-7– Electric Long Range	$133,554	$128,321	$124,112	$120,563	$117,345	$114,456	$111,568

Vehicle Group	2024 MY	2025 MY	2026 MY	2027 MY	2028 MY	2029 MY	2030+ MY
Class 8– Electric Normal Range	$154,799	$150,486	$147,007	$144,057	$141,371	$138,949	$136,527
Class 8– Electric Long Range	$175,655	$169,362	$164,299	$160,029	$156,155	$152,677	$149,199
Class 7-8 Tractor - Electric	$201,351	$194,134	$188,312	$183,371	$178,870	$174,809	$170,748
Class 7-8 Tractor - Fuel Cell	$216,931	$212,353	$207,885	$203,439	$199,004	$194,579	$190,155

Table IX-8 outlines the incremental cost difference between a ZEV and its diesel equivalent.

Table IX-8: Incremental ZEV versus Diesel Price Forecast

Vehicle Group	2024 MY	2025 MY	2026 MY	2027 MY	2028 MY	2029 MY	2030+ MY
Class 2b-3 – Electric Normal Range	$14,896	$13,635	$12,599	$11,684	$10,829	$10,035	$9,241
Class 2b-3 – Electric Long Range	$19,241	$17,568	$16,201	$15,011	$13,909	$12,895	$11,881
Class 4-5– Electric Normal Range	$25,127	$22,616	$20,585	$18,852	$17,267	$15,830	$14,394
Class 4-5– Electric Long Range	$36,424	$32,841	$29,952	$27,503	$25,275	$23,266	$21,258
Class 6-7– Electric Normal Range	$31,174	$27,591	$24,702	$22,253	$20,025	$18,016	$16,008
Class 6-7– Electric Long Range	$48,554	$43,321	$39,112	$35,563	$32,345	$29,456	$26,568
Class 8– Electric Normal Range	$34,799	$30,486	$27,007	$24,057	$21,371	$18,949	$16,527
Class 8– Electric Long Range	$55,655	$49,362	$44,299	$40,029	$36,155	$32,677	$29,199
Class 7-8 Tractor - Electric	$71,351	$64,134	$58,312	$53,371	$48,870	$44,809	$40,748
Class 7-8 Tractor - Fuel Cell	$86,931	$82,353	$77,885	$73,439	$69,004	$64,579	$60,155

Though the cost for manufacturers to comply is estimated in detail as described above, it is not straightforward to predict how these costs and cost-savings would be passed on to consumers. Vehicle pricing is complex, and different manufacturers could use different strategies to pass on these costs. It is possible that manufacturers may pass on incremental ZEV costs through the ZEVs themselves, through the rest of their ICE fleet, or some combination thereof.

Zero-Emission Powertrain Certification Costs

The Proposed ACT Regulation requires manufacturers starting 2024 MY to certify their vehicles using the Zero-emission Powertrain (ZEP) Certification procedure in order to earn ZEV credits. This requirement would only apply to vehicles affected by ZEP certification – complete vehicles above 14,000 lb. GVWR and incomplete vehicles above 10,000 lb. GVWR. Based on our current knowledge, there are roughly ten manufacturers who are regulated by the Proposed ACT Regulation and would sell ZEVs that be required to follow the ZEP certification procedure.

The Initial Statement of Reasons (ISOR) for the ZEP Certification rulemaking estimated the cost of certification would be $9,200 per powertrain (CARB, 2018f). For this rulemaking and analysis, we are estimating that each regulated manufacturer affected would certify two powertrains in 2024 model year and afterwards would certify an additional two new powertrains every 5 years afterwards.

The ISOR for ZEP certification included a $25 cost per vehicle for labelling costs and a $100 cost per vehicle family for ZEP vehicle family certification. We are not modelling this cost in for the Proposed ACT Regulation because this assumption does not take into account for avoided costs from not having to meet more rigorous ICE labelling requirements or ICE vehicle family certifications for the same number of vehicles, nor does it assume any potential reductions in ICE certification costs as the ZEV sales percentage requirement ramps up.

Manufacturers who are not regulated under the Proposed ACT Regulation would need to follow the ZEP certification to generate credits in this proposal. Manufacturers who are not required to meet ZEP certification may still do so if 1) they wish to earn credits in this rule to be sold to other manufacturers, or 2) a different program such as HVIP requires it. Because neither of these are costs attributable to the Proposed ACT Regulation, we are not modelling any ZEP certification costs to unregulated manufacturers. This assumes regulated manufactures would only buy credits if the credits reduce their overall compliance costs which already included ZEP certification costs.

Phase 2 GHG Compliance Costs

The federal and California Phase 2 GHG regulations require manufacturers to build trucks that are more fuel efficient and have lower GHG emissions. These requirements start in 2021 model year and ramp up through the 2027 model year. EPA estimated the cost per vehicle to comply with the regulation shown in Table IX-9 (U.S. EPA., 2016).

Table IX-9: U.S. EPA Phase 2 GHG Incremental Compliance Costs

Phase 2 GHG Category	2021-2023 MY	2024-2026 MY	2027+ MY
Class 2b-3 Pickup/Van	$524	$963	$1,364
Vocational Vehicles	$1,110	$2,022	$2,662
Tractors	$6,484	$10,101	$12,442

Manufacturers can meet the Phase 2 GHG standards through a variety of technologies including improved aerodynamics, low rolling resistance tires, engine and accessory optimization, weight reduction, idle reduction systems, hybridization, powertrain electrification, and more. The Proposed ACT Regulation requires the sale of ZEVs that can also be used to comply with Phase 2 GHG. The costs of producing ZEVs are assumed to be higher than other compliance options, but would also reduce the amount of upgrades the manufacturers would need to make for their remaining ICE sales. While it is possible for a manufacturer to meet their entire compliance obligation with electric trucks, the U.S. EPA assumed this compliance pathway is a higher cost option than building cleaner combustion vehicles. In the Federal Phase 2 GHG rulemaking, EPA stated that they "…do not project fully electric vocational vehicles to be widely commercially available in the time frame of the final Phase 2 rules. For this reason, [EPA and NHTSA] have not based the Phase 2 standards on adoption of full-electric vocational vehicles," (U.S. EPA, 2016).

The cost difference between Phase 2 GHG compliance costs in the BAU baseline scenario and the Proposed ACT Regulation represents the potential cost savings to the manufacturer. Manufacturers can build ZEVs and comply with the Proposed ACT

Regulation and the Phase 2 GHG regulations simultaneously which will reduce the number of ICE vehicles that need to be upgraded to meet Phase 2 standards. In the BAU baseline scenario, the cost to comply with the California Phase 2 GHG regulation is the number of vehicles sold multiplied by the cost per vehicle as outlined in Equation IX-1.

In the Proposed ACT Regulation scenario, as the ZEV sales percentage requirement ramps up, the number of ICE trucks that must be upgraded to the Phase 2 GHG standards decreases. This is because, per the Phase 2 GHG regulation, electric vehicles do not produce tailpipe GHG emissions and therefore can offset compliance requirements for the rest of the manufacturer's fleet. The lower costs of complying with the Phase 2 GHG regulation in the Proposal ACT Regulation scenario are estimated using the following formula:

Equation IX-1: GHG Phase 2 Annual Cost Savings to Manufacturer Due to Proposed ACT Regulation

$$GHG\ Phase\ 2\ Annual\ Cost\ Savings\ to\ Manufacturer\ Due\ to\ Proposed\ ACT\ Regulation$$
$$= \frac{Vehicles\ Sold}{Year}\ x\ \frac{Phase\ 2\ GHG\ Cost}{Vehicle\ Sold}\ x\ \frac{ZEV\ Sales\ \%\ x\ ATM\ x\ (1 - Phase\ 2\ Reduction\ \%)}{Phase\ 2\ Reduction\ \%}$$

Where:

- "ZEV Sales %" is the annual ZEV Sales percentage requirement each year
- "ATM" is the Phase 2 GHG Advanced Technology Multiplier which gives extra credit to NZEV, BEV, and FCEV vehicles until the end of the 2027 MY. This multiplier is 3.5, 4.5, and 5.5, respectively.
- "Phase 2 Reduction %" is the percentage of ZEVs a manufacturer would have to sell to meet the Phase 2 GHG standards while keeping the rest of their fleet at the Phase 2 GHG baseline. By 2027, manufacturers would need to build roughly 17-20 percent of their fleet as ZEVs to comply with Phase 2 GHG solely through ZEVs

This formula calculates the potential avoided costs to upgrade ICE vehicles to comply with the Phase 2 GHG regulation.

The Phase 2 GHG compliance costs offset by the Proposed ACT Regulation are derived primarily from the federal regulation. If these compliance cost savings are passed through to fleets it would likely be a nationwide effect. Therefore, staff make a conservative assumption that percent savings passed through to California fleets is proportional to California's share of the national truck population estimated at 10 percent as to not overestimate the cost-savings (EIA, 2018). Table IX-10: displays the nationwide and California portion of reduced Phase 2 GHG compliance costs relative to the compliance costs relative to the BAU baseline.

Table IX-10: Cumulative Nationwide and California Phase 2 GHG Cost Savings Relative to the BAU Baseline (million 2018$)

Calendar Year	Nationwide	California Portion
2031	-$1,424	-$142
2040	-$3,205	-$320

In February 2018, California adopted the California Phase 2 GHG regulations which incorporated the federal Phase 2 GHG regulation with additional requirements related to reporting and labelling. These additional requirements apply equally to ICE and ZEV vehicles, so there is no cost difference as a result of the Proposed ACT Regulation.

Manufacturer Reporting Costs

The Proposed ACT Regulation will require information from manufacturers regarding their total sales of combustion powered vehicles, ZEV sales, and NZEV sales starting in the 2021 model year. This information will be used to determine which manufacturers are regulated and their annual credit and deficit generation.

Manufacturers are already required to report information to CARB as a requirement of the California Phase 2 GHG regulation including sales per model year of every powertrain and vehicle family. Because manufacturers are already collecting and reporting this information to CARB, we are not modelling any significant additional reporting costs to manufacturers as a result of the Proposed ACT Regulation. Similarly, no reporting costs are attributed to unregulated ZEV manufacturers that may optionally report information for purposes of earning and trading credits to other manufacturers because credits are assumed to be purchased if regulated manufacturers can reduce their overall compliance costs.

ii. Costs to California Businesses

The Proposed ACT Regulation regulates vehicle manufacturers that primarily manufacture vehicles outside of California. Most of regulatory requirements associated with the Proposed ACT Regulation applies to these manufacturers. The only requirement on California businesses in the Proposed ACT Regulation is the large entity reporting requirement which is proposed as a one-time requirement. However, for purposes of demonstrating the potential economic impacts on the state’s overall economy, all of the costs from deploying the number of ZEVs required by the Proposed ACT Regulation are assumed to be borne in California. Therefore, in the statewide cost analysis, all costs including the incremental vehicle costs, infrastructure upgrades, fueling, maintenance, and other costs are assumed to be the direct costs of the regulation in California despite the lack of a specific fleet purchase requirement. For this analysis, vehicle and infrastructure costs are amortized over a five and twenty year period, respectively, to reflect typical purchasing patterns.

Large Entity Reporting

Under the Proposed ACT Regulation, large fleet owners and large companies that contract out for transportation related services will be required to report information to CARB regarding what vehicles they own and how they operate, as well as company-wide information about their California locations and how they and their contractors move freight and perform other services.

Staff are estimating that roughly 12,000 companies or entities will be affected by this reporting requirement consisting of 11,000 large companies or trucking fleets and 1,000 public entities. Companies that do not own trucks will need to report general information about their facilities and the types of contracts they have for meeting their transportation needs and for services they hire.

The amount of time necessary to report will vary from company to company based on the number of facility categories and vehicles they have. Companies are expected to have most of the information on hand, but it will take time to understand the regulation, compile information from various individuals, and submit the required information. Companies with a single facility category and little to no vehicles, such as an insurance firm or bank, or fleets maintaining electronic records on their vehicle operations are likely to complete their reporting in 4-10 hours. These averages assume that some large entities will not have any information to report other than to respond that they do not contract directly for any transportation services and do not operate medium- or heavy-duty trucks. Entities with a moderate amount of facilities and vehicles are estimated to need 20-30 hours to complete their reporting, and entities with a large number of vehicles and a wide range of facility types are estimated to need 40 hours to complete their reporting.

Based on a weighted average of the types of companies reporting, staff is estimating that an average entity will need 25 hours to complete the reporting. The hourly cost is assumed to be $50 per hour for staffing and lost revenue from the employee assigned to collect the information (CARB, 2008).

Sales Tax and Federal Excise Tax

Taxes are additional costs levied on the purchase of a vehicle. Because they are based on the purchase price of the vehicle, they are higher for ZEVs due to their higher upfront costs.

Vehicles purchased in California must pay a sales tax on top of the vehicle’s purchase price. California’s basic sales tax rate is 7.25 percent with 3.94 percent going to the State and the rest to local authorities. In addition to the basic sales tax, districts levy special taxes that differ amongst districts. A sales tax value of 8.5 percent was used for staff’s analysis based on a statewide population weighted average. This results in higher costs for fleets and higher revenue for state and local governments. Class 8 vehicles are subject to an additional Federal Excise Tax which adds 12 percent to their purchase price.

Gasoline, Diesel, Electricity, and Hydrogen Fuel Cost

Fuel costs are calculated using total fuel used per year and the cost of fuel per unit. The total fuel used per year is based on the vehicle population per calendar year, the annual mileage of these vehicles, and the fuel economy of the vehicles. Population and mileage assumptions are discussed on page IX-3. In general, ZEVs are 2 to 5 times as efficient as similar vehicles with internal combustion engines technologies and significantly reduce petroleum and other fossil fuel use and use less total energy (CARB, 2018b).

Fuel economy is measured in miles per gallon for gasoline and diesel, miles per kilowatt-hour for battery-electric, and miles per kilogram for fuel cell electric trucks. Gasoline and diesel fuel economy is derived from EMFAC inventory projections for each gasoline and diesel vehicle group. These projections incorporate the effects of Phase 2 GHG which will increase gasoline and diesel fuel economies over the next decade. Battery-electric vehicle fuel economy is derived from in-use data collected from a variety of vehicles. For fuel cell efficiency, we are applying the LCFS program’s Energy Efficiency Ratio (EER) of 1.9 to the diesel fuel economy to estimate the fuel cell fuel economy as we are not aware of any data available measuring the fuel efficiency of fuel cell electric tractors.

Staff modeled that for both battery-electric and fuel cell electric vehicles, the efficiency will improve at the same rate as for gasoline and diesel powered vehicles. This may be a conservative estimate as both of these technologies are less developed than ICE powertrains and reports have shown improvements in the technology recently.

Table IX-11 outlines the fuel economy assumptions for each vehicle group and technology type over the course of the regulation.

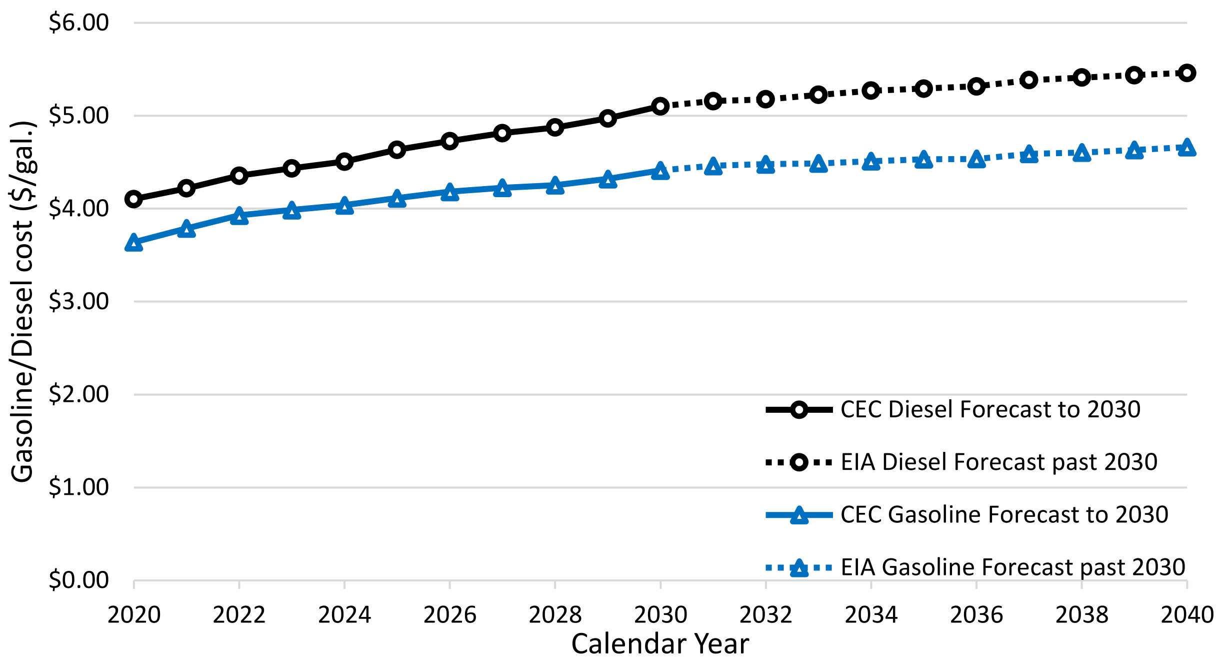
Table IX-11: Fuel Economy for Each Vehicle Group and Technology

Vehicle Group	Technology	Fuel Economy 2024-2026 MY	Fuel Economy 2027 MY and beyond	Units
Class 2b-3	Gasoline	10.9	11.7	mpg
Class 2b-3	Diesel	23.0	24.8	mpg
Class 2b-3	Battery-Electric	2.0	2.1	mi./kWh
Class 4-5	Diesel	13.8	14.3	mpg
Class 4-5	Battery-electric	1.3	1.3	mi./kWh
Class 6-7	Diesel	9.6	9.9	mpg
Class 6-7	Battery-electric	0.8	0.8	mi./kWh
Class 8	Diesel	7.7	8.1	mpg
Class 8	Battery-electric	0.6	0.7	mi./kWh
Class 7-8 Tractor	Diesel	8.8	9.2	mpg

Vehicle Group	Technology	Fuel Economy 2024-2026 MY	Fuel Economy 2027 MY and beyond	Units
Class 7-8 Tractor	Battery-electric	0.6	0.6	mi./kWh
Class 7-8 Tractor	Fuel Cell Electric	16.6	17.5	mi./kg

Gasoline and diesel fuel prices to 2030 are taken from the California Energy Commission's (CEC) "Revised Transportation Energy Demand Forecast, 2018-2030", adjusted to 2018 dollars using California consumer price index (CPI), (DOF, 2019). Fuel prices past 2030 are calculated using the Energy Information Administration's (EIA) 2018 Annual Energy Outlook for the Pacific region.(CEC, 2018), (EIA, 2018). The annual percentage change in EIA gasoline and diesel fuel prices past 2030 is applied to the 2030 CEC gasoline and diesel prices to estimate price changes past 2030. Figure IX-4 shows the projected prices of gasoline and diesel out to 2040.

Figure IX-4: Gasoline and Diesel Price Forecasts



Battery-electric fuel prices depend on how they are charged and include energy costs, fixed fees and demand fees. Vehicles charged at high power or during peak periods will have higher electricity costs than if charging overnight over an extended period. Electricity prices are calculated using CARB's Battery-Electric Truck and Bus Charging Calculator (Charging Calculator), slightly modified to include new utility rates, and assumes a fleet of 20 vehicles will be depot charged overnight on a separate utility meter using a managed charging strategy with the applicable rate schedule. Additionally, charger efficiency losses and local electricity taxes are incorporated into these numbers. The energy, demand, fixed costs, efficiency losses and local taxes and fees are all calculated using the Charging Calculator (CARB, 2019g). The cost per kWh is calculated separately for each utility and a weighted average is used to determine the cost per kWh per vehicle in 2018. Table IX-12 shows the electricity price per kWh for each vehicle group and major utility region as well as the weighted statewide average. In general, electricity costs are lower for larger vehicles because larger vehicles tend to use more electricity which decreases the fixed costs per kWh and allows the use of lower cost rate schedules for larger utility customers.

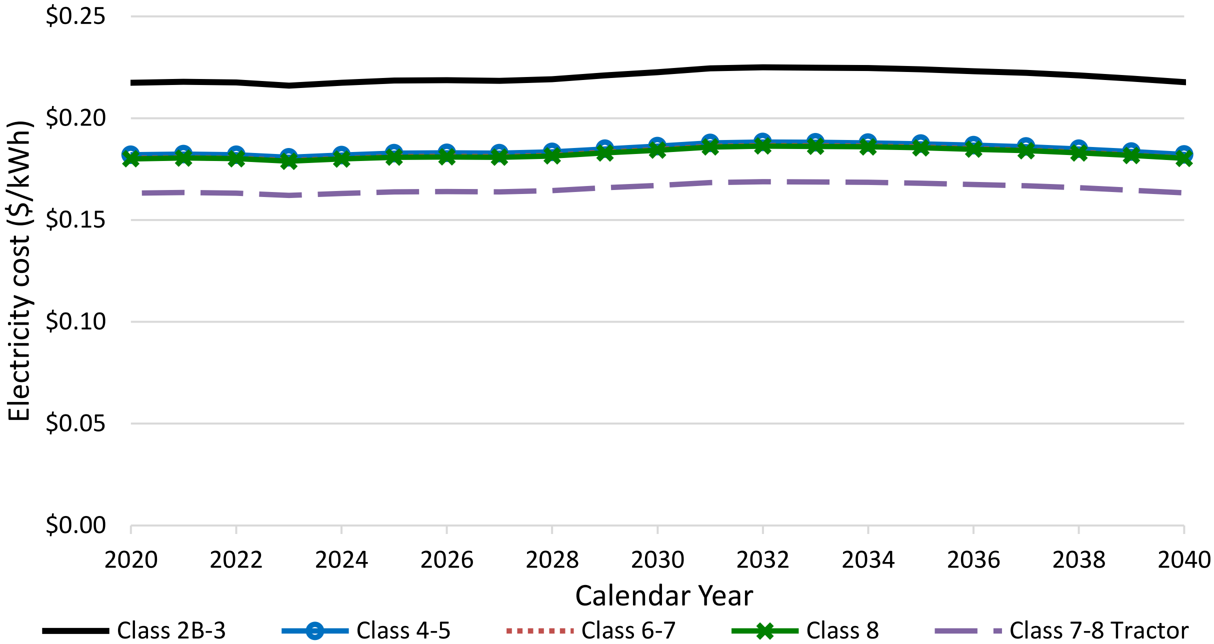
Table IX-12: Electricity Cost Calculation for 2018 (2018$/kWh)

Utility Area	Class 2b-3	Class 4-5	Class 6-7	Class 8	Class 7-8 Tractor
Los Angeles Department of Water and Power	$0.11	$0.10	$0.10	$0.11	$0.10
Pacific Gas and Electric (PG&E)*	$0.23	$0.20	$0.20	$0.20	$0.18
Sacramento Municipal Utility District	$0.15	$0.14	$0.11	$0.11	$0.10
San Diego Gas and Electric (SDG&E)**	$0.24	$0.19	$0.19	$0.22	$0.19
Southern California Edison (SCE)***	$0.19	$0.15	$0.15	$0.14	$0.13
Weighted Statewide Average	$0.21	$0.18	$0.18	$0.18	$0.16

*PG&E has proposed two new electricity rates for commercial ZEVs, CEV-S and CEV-L, which are currently under CPUC review with a decision expected in August/September 2019. If approved, these rates will decrease electricity rates to commercial fleets to roughly $0.13-$0.15/kWh in PG&E territory.
**SDG&E has proposed a new electricity rate for commercial ZEVs, EV-HP, which is currently under CPUC review. If approved, this rate will not significantly change the electricity costs modeled in this analysis but may provide benefits to fleets who intermittently charge during peak periods.
***SCE's newly introduced electric vehicle rates, EV-8 and EV-9, have no demand fees from 2019 to 2023 and phase them back over the following five years, with demand fees being fully reintroduced in 2029. This analysis is based on an SCE estimate for what the electricity rate will look like in 2029 once demand fees are fully reintroduced (SCE, 2019).

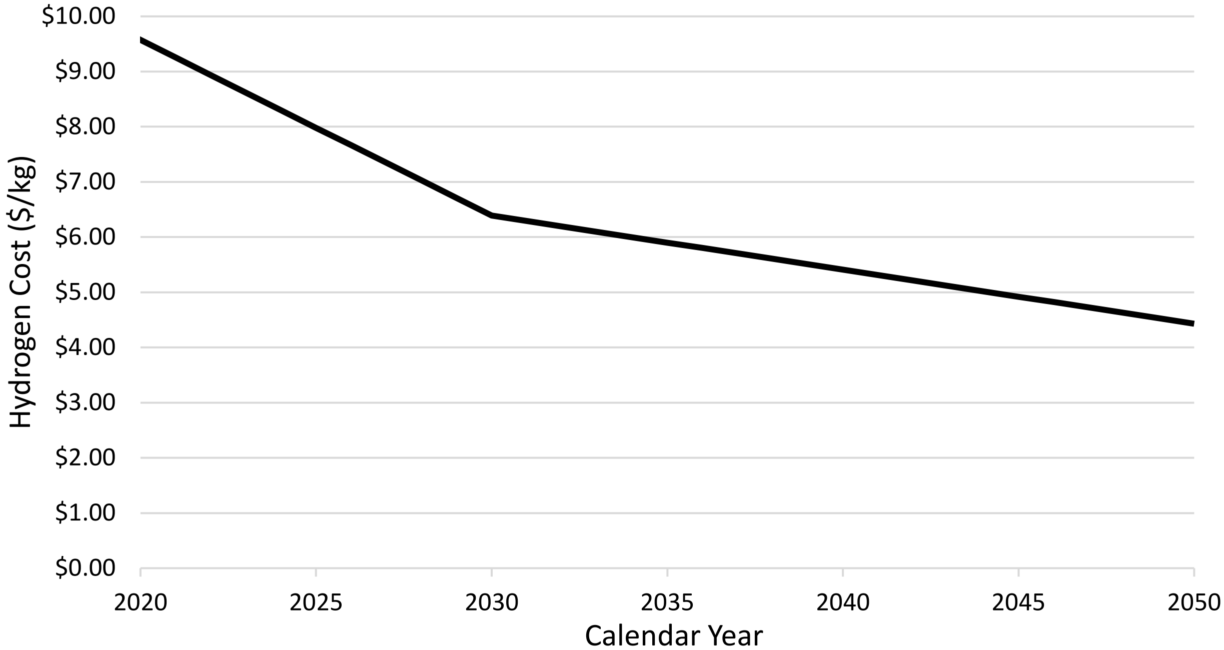
Electricity price changes over time are modelled using the CEC's "Revised Transportation Energy Demand Forecast, 2018-2030", adjusted to 2018 dollars using California CPI. Fuel prices past 2030 are calculated using the EIA 2018 Annual Energy Outlook for the Pacific region. The annual percentage change in EIA gasoline and diesel fuel prices past 2030 is applied to the 2030 CEC gasoline and diesel prices to estimate future price changes. Results per vehicle type are shown in Figure IX-5. The electricity costs for Class 4-5, Class 6-7, and Class 8 are fairly similar resulting in them overlapping on the graph.

Figure IX-5: Electricity Price Forecasts



For this analysis, hydrogen stations were assumed to be available at strategic locations around ports or major distribution hubs where the infrastructure costs are included in the hydrogen fuel price rather than reflecting costs for stations installed in a depot. This model is currently used for light-duty hydrogen stations and heavy-duty diesel sales and based on stakeholder feedback appears most appropriate near term estimate for heavy-duty hydrogen fueling. Hydrogen fuel costs are based on communication with Trillium CNG who estimated the cost of hydrogen at low, intermediate, and high volumes using different production methods (Trillium, 2018). This report uses the liquid hydrogen delivery numbers based on what Trillium presented as being most feasible for production at scale. The low volume cost will be used in 2018, the intermediate volume in 2030, and the high volume in 2050 with intermediate years being interpolated. These assumptions are based on expecting low volume production today, intermediate volume by 2030 when we would see some moderate sized deployments but no complete conversions yet, and continuing price reductions out to 2050. Hydrogen costs over time are shown in Figure IX-6.

Figure IX-6: Hydrogen Price Forecasts



The cost of fuel displayed above includes fuel taxes. State and local taxes on fuel are listed below in Table IX-13.

Table IX-13: Local and State Taxes on Fuel

Fuel Type	Local Tax	State Tax
Gasoline	2.25% sales tax	$0.493/gal excise tax
Diesel	4.5% sales tax	8.5% sales tax + $0.38/gal excise tax
Electricity	3.53% utility user tax*	$0.0003/kWh
Hydrogen	0	0

*Statewide population-weighted average

Low Carbon Fuel Standard Revenue

The Low Carbon Fuel Standard (LCFS) is a California regulation that creates a market mechanism that incentivizes low carbon fuels. The LCFS regulation was amended in 2018. These amendments 1) increased the Energy Efficiency Ratio for Class 4-8 trucks from 2.7 to 5.0, 2) reduced the carbon intensity target to 20 percent reduction by 2030, and 3) clarified how hydrogen station operators can receive credits. The regulation now requires the carbon intensity of California’s transportation fuels to decrease by 20 percent through the 2030 timeframe and maintains the standard afterwards. Electricity and hydrogen are eligible to earn LCFS credits which can be sold and used to offset the costs of these fuels. Fossil gasoline and diesel are generally not eligible for LCFS credits.

Fleets who own and operate their infrastructure generate credits based on the amount of fuel or energy they dispense. Credit values for different fuel types are calculated using the LCFS Credit Price Calculator (CARB, 2019h). The following credit values assume a credit price of $125 as estimated by LCFS program staff in the staff report for the 2018 rulemaking (CARB, 2018g). The average credit price for May 2019 was $185 has been above $180 since December 2018. Thus, the actual cost for fleets could be lower with higher LCFS credit value. An electric Class 2b-3 vehicle will earn $0.073/kWh in 2024 using grid electricity while an electric Class 4-8 vehicle will earn roughly $0.124/kWh in 2024. For hydrogen, we are assuming the hydrogen is produced from 33 percent renewable feedstock as required by SB 1505 (2006). This results in Class 4-8 vehicles earning $1.037/kg in 2024. LCFS credit revenue for a given fuel drops slightly over time as the program standards tighten and maintains upward pressure on the credit price.

Vehicle Maintenance Costs

Maintenance costs reflects the cost of labor and parts for routine maintenance, preventative maintenance, and repairing broken components. Maintenance costs for electric vehicles are generally assumed to be lower than for diesel in part due to their simpler design and fewer moving components. There is very little data available on hydrogen fuel cell vehicles currently, but available data appears to show maintenance costs that are comparable with diesel.

Maintenance costs for ICE Class 2b-3 vehicles are based on four sources from three reports (Access Services, 2016), (Utilimarc, 2015). Maintenance costs for ICE vocational vehicles are based on the American Truck Research Institute study, “An Analysis of the Operational Costs of Trucking: 2017 Update” cost for straight truck maintenance per mile (ATRI, 2017). Maintenance costs for ICE tractors are based on the American Truck Research Institute study, “An Analysis of the Operational Costs of Trucking: 2018 Update” cost for less-than-truckload maintenance cost per mile. (ATRI, 2018). The less-than-truckload cost was used because the slower speed, frequent stops of this type of service pattern matches most closely to the duty cycle of drayage or short-haul tractors that are more likely to become ZEVs prior to 2030. Table IX-14 shows the maintenance cost assumptions used in this analysis. Battery-electric vehicles are assumed to have 25 percent lower vehicle maintenance costs compared to gasoline and diesel based on an aggregation of sources and data (CARB, 2016d), (Electrification Coalition, 2013), (Propfe, 2012), (Taefi, 2015). Fuel cell electric vehicles are assumed to have similar maintenance costs to ICE vehicles. For example, Ballard recommends estimating a fuel cell bus’s maintenance costs as the same as a battery-electric bus plus $0.20/mi. for fuel cell maintenance. This adjustment will put a fuel cell bus’s maintenance costs in line with a diesel or CNG bus (Ballard, 2018).

Table IX-14: Maintenance Cost per Mile per Vehicle Group

Vehicle Group	Gasoline/Diesel ($/mi.)	Battery-Electric ($/mi.)	Fuel Cell Electric ($/mi.)
Class 2b-3	$0.17	$0.128	$0.17
Class 4-5 Vocational	$0.31	$0.233	$0.31
Class 6-7 Vocational	$0.31	$0.233	$0.31
Class 8 Vocational	$0.31	$0.233	$0.31

Vehicle Group	Gasoline/Diesel ($/mi.)	Battery-Electric ($/mi.)	Fuel Cell Electric ($/mi.)
Class 7-8 Tractor	$0.19	$0.142	$0.19

Maintenance Bay Upgrades

Maintenance bays are facilities used to service vehicles. Services performed can include inspections, routine maintenance, preventative maintenance, repairs, overhauls and more. Servicing electric vehicles requires separate safety equipment, diagnostic tools, and equipment which will incur costs to the facility.

Based on transit agency data, upgrading a fifteen bus maintenance bay to handle battery-electric buses would cost $25,000, and upgrading to handle fuel cell electric buses would cost $750,000. For this analysis, it is assumed that the cost per maintenance bay is the same and a fifteen bus maintenance bay could accommodate 25 trucks due to their smaller size. The number of maintenance bay upgrades each year is based on the increase in ZEV population per year to avoid double-counting in situations where a ZEV is replaced by a ZEV.

Midlife Costs

Midlife costs are the cost of rebuilding or replacing major propulsion components due to wear or deterioration. For diesel vehicles, this would be a midlife rebuild, for battery-electric vehicles this would be a battery replacement, and for a hydrogen fuel-cell vehicle this would be a fuel cell stack refurbishment. The frequency and cost of a midlife rebuild vary from technology to technology.

The frequency of a diesel engine rebuild varies based on the vehicle's weight class. Table IX-15 shows the anticipated diesel engine useful life based on years or miles. The cost of an engine rebuild is estimated to be one quarter of the total vehicle price.

Table IX-15: Useful Life of Diesel Engines

Vehicle/Engine Category	Useful Life (Years/Miles)
Class 4-5 (Light-Heavy Duty)	18/350,000
Class 6-7 (Medium-Heavy Duty)	18/450,000
Class 8 (Heavy-Heavy Duty)	18/850,000

Data is limited for battery-electric vehicles, but today ZEV manufacturers are offering vehicles with warranties of eight or more years and up to 300,000 miles on their products. Information on battery degradation trends from light-duty Tesla vehicles was used to estimate when batteries for trucks would need to be replaced. Staff estimate that the battery will be replaced every 300,000 miles. The cost of the battery replacement is assumed to be the size of the battery in kWh multiplied by the price per kWh at the time of the replacement.

For fuel cell electric vehicles, Ricardo has estimated that a fuel cell stack refurbishment is necessary every seven years and costs one third the cost of a new fuel cell stack at the time of refurbishment.

Based on the above assumptions, Table IX-16 shows when vehicles are assumed to incur midlife costs.

Table IX-16: Frequency of Midlife Rebuilds

Vehicle Group	Technology	Midlife Occurrence (yr)
Class 2b-3	Gasoline	Not necessary
Class 2b-3	Diesel	Not necessary
Class 2b-3	Battery-Electric	Not necessary
Class 4-5	Diesel	13
Class 4-5	Battery-electric	10
Class 6-7	Diesel	17
Class 6-7	Battery-electric	10
Class 8	Diesel	18
Class 8	Battery-electric	14
Class 7-8 Tractor	Diesel	18
Class 7-8 Tractor	Battery-electric	5, 13, 20
Class 7-8 Tractor	Fuel Cell Electric	7, 14, 21

Fueling Infrastructure Installation and Maintenance

Infrastructure is necessary to refuel or recharge vehicles. All vehicles need either dedicated refueling infrastructure onsite or publically available retail stations in order to operate. There are numerous ways infrastructure expenses can be accounted for which will affect the TCO in different ways. Infrastructure expenses are generally an upfront capital investment needed prior to vehicles being deployed, but infrastructure can last multiple vehicle lifetimes and generally is amortized over its life.

In the BAU baseline scenario, we are assuming that the fleet is either using existing gasoline or diesel infrastructure or publically accessible stations and the infrastructure cost is already incorporated into the fuel cost. As a result, diesel infrastructure costs are not separately modeled.

When a fleet purchases a battery-electric vehicle, they are responsible for setting up charging on their site. There are two main cost components of installing charging infrastructure: the cost of the charger itself and the cost of upgrading the site to deliver power to the charger. The latter can include trenching, cabling, laying conduit, potential transformer upgrades and more.

Charger and infrastructure cost estimates for Class 2b-3 and Class 4-5 vocational vehicles are derived from Pacific Gas and Electric cost estimates as part of their SB 350 applications (PG&E, 2017). Costs for Class 8 vocational and Class 7-8 tractors are taken from the ICT ISOR and come from electric transit bus deployment data. Class 6-

7 trucks are assumed to use the same infrastructure as a heavier truck but would be able to share the charger with another Class 6-7 truck; as a result, their infrastructure costs are half that of a Class 8 truck. Table IX-17 outlines the assumptions for charger power, charger cost, and infrastructure upgrade costs.

Table IX-17: Charger Power Ratings and Infrastructure Costs

Vehicle Group	Charger Power (kW)	Charger Cost	Infrastructure Upgrade Cost
Class 2b-3	19	$5,000	$20,000
Class 4-5	19	$5,000	$20,000
Class 6-7	40	$25,000	$27,500
Class 8	80	$50,000	$55,000
Class 7-8 Tractor	80	$50,000	$55,000

Fleets are assumed to amortize their infrastructure costs over a 20 year period with an interest rate of five percent. The amount of chargers installations and infrastructure upgrades each year is based on the increase in ZEV population per year to avoid double-counting infrastructure costs in situations where a ZEV is replaced by a ZEV.

Hydrogen infrastructure costs are incorporated into the hydrogen fuel costs identified by Trillium and are not included here.

Depot and on-route chargers for ZEVs require regular maintenance. The maintenance costs of depot chargers are estimated by considering costs for replacing charger heads, connectors, and other components, as well as labor costs for regular inspections (Tesla, 2016), (Clipper Creek, 2016). The information about on-route chargers is based on data from Foothill Transit who has experience with Proterra on-route chargers (Foothill Transit, 2017). Charger maintenance costs are estimated at $500/yr./charger. We assume that the maintenance cost for other fueling infrastructures are reflected in the fuel price.

<u>Transitional Costs and Workforce Development</u>

Transitioning to a new technology has inherent costs associated with its deployment, including shifts in operational and maintenance practices. These recurring costs include operator and technician trainings, purchasing and upgrading of software, securing additional spare parts, and others

Limited information is available for this type of transitional cost, but discussions occurred on this topic during the development of the Innovative Clean Transit rule. Based on discussions with transit agencies, Staff assumed that these “other costs” associated with ZEB deployments are equivalent to 2.5 percent of bus prices for all powertrains and discussed that the costs should go down over time for ZEBs as they become more common. This method is based on the assumption that the Cost Subgroup used to reflect estimated soft costs for conventional internal combustion engine bus (TAS, 2017).

In the cost analysis for the Proposed ACT Regulation, staff are making similar assumptions and that the workforce training and transitional costs are equal to 2.5 percent of the incremental cost difference between a baseline ICE vehicle and a ZEV. These costs continue until 2030 at which point the technology will have developed to a point where these transitional costs become business as usual for trucking fleets.

Registration Fees

Vehicles operating and registered in California must pay an annual registration fee. The registration fee varies based on the vehicle's cost, age, and weight. These calculations are different for ICE vehicles and ZEVs.

ICE and ZEV's are subject to the following fixed fees based on the DMV online calculator (DMV, 2019). These are constant annual fees for every vehicle and are shown in Table IX-18.

Table IX-18: Fixed Registration Fees for Diesel Vehicles and ZEVs

Diesel Fee Name	Amount	ZEV Fee Name	Amount
Current Registration	$58	Current Registration	$58
CVRA Registration Fee	$122	Current California Highway Patrol	$25
CVRA Service Authority for Freeway Emergencies Fee	$3	CVRA Service Authority for Freeway Emergencies Fee	$1
CVRA Fingerprint ID Fee	$3	CVRA Fingerprint ID Fee	$1
CVRA Abandoned Vehicle Fee	$3	CVRA Abandoned Vehicle Fee	$1
CVRA California Highway Patrol Fee	$41	Current Air Quality Management District	$6
Current Air Quality Management District	$6	Alt Fuel/Tech Registration Fee	$3
Current Cargo Theft Interdiction Program Fee	$3	CVRA Auto Theft Deterrence/DUI Fee	$2
CVRA Weight Decal Fee	$3	Reflectorized License Plate Fee	$1
Alt Fuel/Tech Registration Fee	$3	Road Improvement Fee	$100
CVRA Auto Theft Deterrence/DUI Fee	$4		
Reflectorized License Plate Fee	$1		
Total	$250	Total	$198

All vehicles registered in California must pay a Transportation Improvement Fee based on the price of the vehicle. For vehicles priced between $35,000 and $60,000, the fee is $150, and for vehicles priced above $60,000, the fee is $175.

All registered vehicles are assessed a Vehicle License Fee which is equal to the vehicle price multiplied by 0.65 percent and a separate percentage schedule. This separate schedule is shown in Table IX-19.

Table IX-19: Vehicle License Fee Decline over Time

Year	1	2	3	4	5	6	7	8	9	10	11+
Percentage	100%	90%	80%	70%	60%	50%	40%	30%	25%	20%	15%

For commercial ICE vehicles, vehicle owners are assessed an annual weight fee based on the vehicle's potential maximum loaded weight. For electric vehicles, the weight fee is based on its unladen weight. The estimated weight fees are shown in Table IX-20.

Table IX-20: Weight Fees for ICE Vehicles and ZEVS

Vehicle Category	Diesel Weight Fee	ZEV Weight Fee
Class 2b-3	$210	$266
Class 4-5	$447	$358
Class 6-7	$546	$358
Class 8	$1,270	$358
Class 7-8 Tractor	$2,064	$358

Overall, ZEV's pay lower registration fees over the vehicles life although it may be higher in the initial years of registration. This difference is greater for heavier vehicles due to the large difference in annual weight fees.

Battery Recycling, Repurposing, and Disposal

The energy capacity of the batteries used in ZEVs will naturally degrade over their useful life and require battery replacements. When battery capacity is not sufficient for meeting daily range needs for a truck or bus, it is expected that there will be a second life for the batteries. The used battery at the end of its vehicle useful can be repurposed into other applications such as stationary storage, then at the end of the battery life it can be recycled and non-recyclable materials can be disposed.

The cost for battery recycling at the end of battery life is not included here, because this cost could be offset by the residual value of the battery at the end of its useful life in a truck or bus. The end of life may be a revenue source depending on whether the battery can be recycled and repurposed, or could become a cost if it must be disposed of. Today, light-duty vehicle batteries are already being repurposed for second life applications including stationary storage (Nissan, 2018), (BMW, 2018). Even today, some lithium-ion battery manufacturers provide an attractive residual value to customers upon the retirement of a battery. Therefore, staff believes that the residual value will offset the recycling cost and become a revenue source, but does not include a residual battery value in the economic analysis.

4. Total Costs

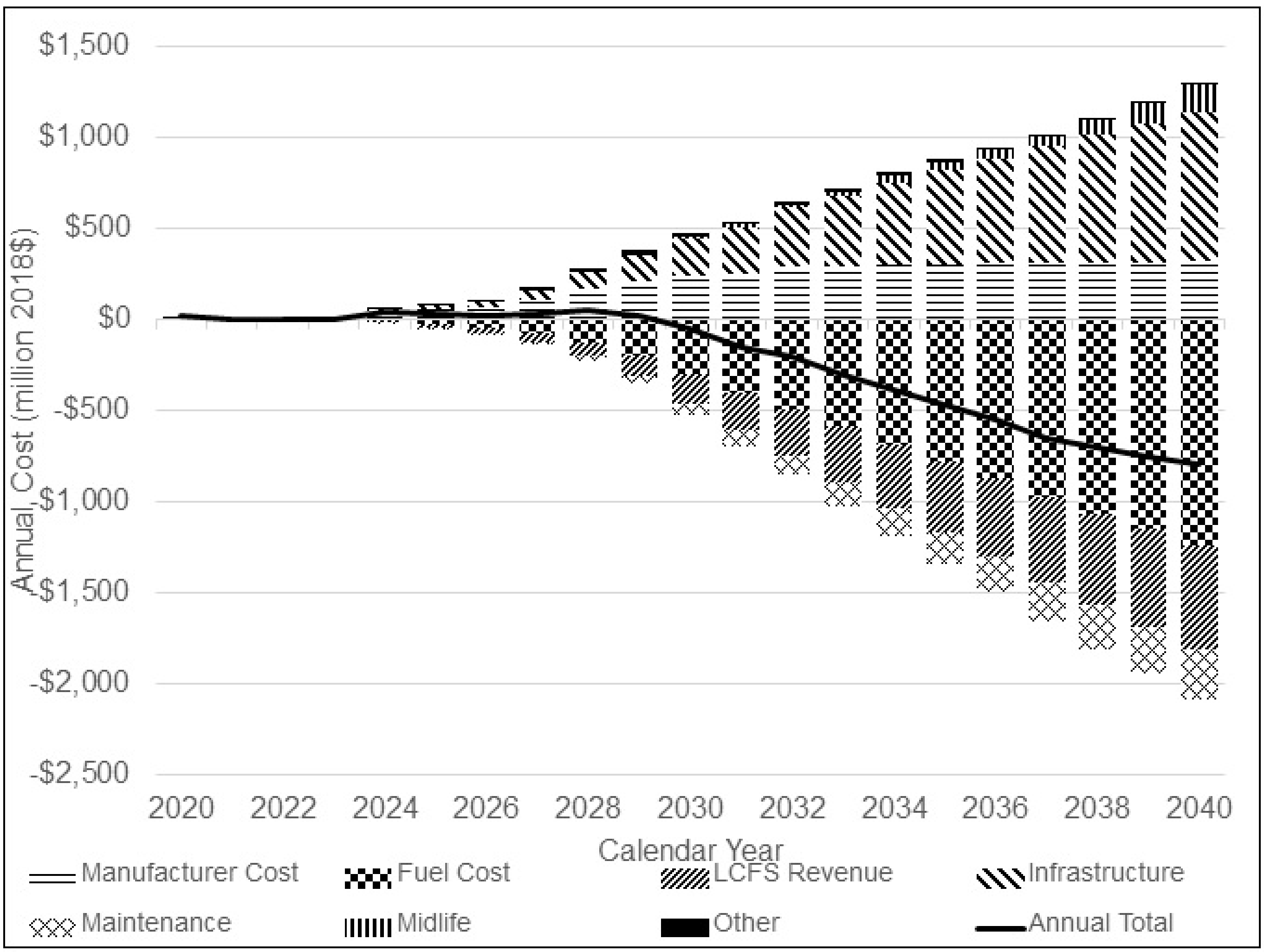
The Proposed ACT Regulation would increase the number of ZEVs sold in California relative to the BAU baseline. These ZEVs have higher upfront capital costs for the vehicle and infrastructure investments, but lower operating costs over time resulting in lower overall costs for truck transportation in California. The cost to truck transportation in California assuming all vehicle manufacturer costs and 10 percent of the Phase 2 GHG savings are passed on is -$4.9 billion between 2020 and 2040 compared to the BAU baseline scenario. Figure IX-7 illustrates the difference in cost between the

Proposed ACT Regulation and the BAU baseline scenario using the cost categories shown in Table IX-21. The total costs by cost input are shown in Table IX-22.

Table IX-21: Summarized Cost Items

Cost Category	Components
Manufacturer Cost	ZEV Price, ICE Phase 2 GHG (cost avoided), ZEP Certification
Fuel Cost	Gasoline, Diesel, Electricity, Hydrogen Fuel Cost
LCFS Revenue	LCFS Revenue
Infrastructure	Charger Costs, Infrastructure Upgrades, Charger Maintenance
Maintenance	Vehicle Maintenance Costs, Maintenance Bay Upgrades
Midlife	Midlife Costs
Other	Sales Tax, Federal Excise Tax, Registration Fees, Large Entity Reporting, Transitional Costs and Workforce Development

Figure IX-7: Total Estimated Direct Costs of Proposed ACT Regulation Relative to the BAU Baseline (million 2018$)



Based on the cost analysis, deploying ZEVs will decrease costs to the California economy primarily due to lower fuel costs. Manufacturers would see increased costs past 2024 MY in California as the cost to build ZEVs would be a higher cost pathway to comply with Phase 2 GHG than using other technologies. However, the Proposed ACT Regulation is estimated to reduce costs of compliance with the Phase 2 GHG regulation when factoring in nationwide savings due to the Advanced Technology Multiplier that expires at the end of 2027 MY.

Despite these potential short term cost savings, large manufacturers have hesitated to invest significant amounts of capital into zero-emission products because of uncertainty in the longer term market and estimated higher costs after 2027. Transitioning from conventional ICE powertrains to battery-electric and fuel cell electric technology represents a major paradigm shift for both manufacturers and fleets, and it is difficult to forecast how the technology may grow without established government policy. There are other non-monetary risks associated with ZEV development that need to be managed such as infrastructure availability, range anxiety, weight concerns. Studies from University of California, Davis and the North American Council on Fuel Efficiency show some hesitancy from the trucking industry despite the potential for cost savings.(Miller, 2017), (NACFE, 2018).

Additionally, manufacturers bear additional risks by building electric vehicles when compared to compliance strategies that depend on modest improvements in existing conventional truck technologies. Developing a zero-emission product line requires initial research and development expenses, new or heavily modified assembly lines, agreements with new suppliers, and more. While this analysis does show a cost saving while the Advanced Technology Multiplier is in effect, on a longer timeframe past 2027 MY, ZEVs are a more expensive vehicle to build. Demand for ZEVs is dependent on many factors outside the manufacturer’s control including fuel price swings, battery and other component prices, shifting fleet behavior, and others. So while this cost analysis shows that ZEVs overall have potential to decrease costs to manufacturers for complying with Phase 2 GHG regulation prior to 2028, staff believe the manufacturers may not commercially produce ZEVs in a BAU scenario without certainty from a regulation.

Table IX-22: Total Estimated Direct Incremental Costs Relative to the BAU Baseline (million 2018$)

Calendar Year	ZEV Price[1]	ICE Phase 2 GHG (Cost Avoided)[1]	ZEP Cert. [1]	Large Entity Reporting[2]	Sales & Excise Tax[2]	Fuel Cost[2]	LCFS Revenue[2]	Vehicle Maintenance Cost[2]	Maintenance Bay Upgrades[2]	Midlife Costs[2]	EVSE & Infrastructure Installation & Maintenance[2]	Transitional Costs & Workforce Development[2]	Registration Fees[2]	Total Cost*
2020	$0	$0	$0	$15	$0	$0	$0	$0	$0	$0	$0	$0	$0	$15
2021	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2022	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2023	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2024	$53	-$11	$0.18	$0	$6	-$10	-$8	-$3	$1	$0	$7	$1	$0	$36
2025	$70	-$15	$0.04	$0	$8	-$26	-$18	-$8	$1	$0	$18	$2	$0	$32
2026	$86	-$20	$0.04	$0	$10	-$47	-$31	-$13	$2	$0	$32	$2	-$1	$21
2027	$135	-$34	$0.04	$0	$14	-$79	-$48	-$22	$5	$0	$56	$3	-$2	$29
2028	$180	-$11	$0.04	$0	$19	-$129	-$74	-$36	$7	$0	$92	$4	-$3	$49
2029	$224	-$14	$0.04	$0	$23	-$203	-$111	-$56	$10	$5	$140	$6	-$5	$19
2030	$259	-$18	$0.04	$0	$27	-$304	-$158	-$81	$14	$8	$202	$6	-$7	-$54
2031	$262	-$18	$0.04	$0	$27	-$401	-$206	-$107	$18	$11	$263	$0	-$9	-$160
2032	$307	-$19	$0.04	$0	$31	-$494	-$254	-$131	$20	$15	$326	$0	-$11	-$211
2033	$312	-$19	$0.04	$0	$32	-$592	-$300	-$155	$22	$19	$388	$0	-$14	-$307
2034	$318	-$20	$0.04	$0	$33	-$690	-$345	-$178	$23	$37	$451	$0	-$16	-$386
2035	$323	-$20	$0.04	$0	$33	-$782	-$388	-$201	$23	$46	$514	$0	-$19	-$470
2036	$325	-$20	$0.04	$0	$33	-$872	-$430	-$222	$23	$51	$577	$0	-$21	-$556
2037	$328	-$20	$0.04	$0	$34	-$974	-$469	-$242	$23	$54	$639	$0	-$24	-$653
2038	$330	-$20	$0.04	$0	$34	-$1,064	-$507	-$261	$23	$84	$700	$0	-$27	-$708
2039	$333	-$20	$0.04	$0	$34	-$1,151	-$542	-$279	$22	$118	$761	$0	-$30	-$755
2040	$335	-$21	$0.04	$0	$34	-$1,237	-$576	-$296	$22	$153	$820	$0	-$33	-$798
Total*	$4,179	-$321	$1	$15	$432	-$9,057	-$4,465	-$2,292	$260	$600	$5,987	$25	-$222	-$4,857

*Note: Totals may differ due to rounding

1 – These cost items are costs to manufacturers

2 – These cost items are costs to California businesses

C. Direct Costs on Businesses and Individuals

1. Direct Costs on Typical Businesses

Medium- and Heavy-duty Manufacturers

Manufacturers are responsible for meeting the ZEV sales percentage requirement by both building and selling zero-emission trucks, or by using flexibility provisions. While none of the regulated manufacturers build vehicles in California, this analysis is included to provide further information to stakeholders. Manufacturing ZEVs requires large upfront costs that go into research and development, prototyping, assembly line upgrades and tooling, and other categories. All these costs plus the actual component cost of the vehicle need to be recouped during the sale of the vehicle.

Manufacturers would have a requirement to sell ZEVs but most fleets do not currently have a requirement to purchase ZEVs. As a result, manufacturers bear risk in that they may have to sell vehicles below cost to fleets to meet the requirements of the regulation. Any ZEV costs that manufacturers cannot pass on through sale of their ZEVs may be added to the cost of the rest of their ICE fleet, or the manufacturer may not pass on the cost and must absorb the cost themselves.

The two extremes are either the manufacturer is able to fully pass on the cost of an electric vehicle to the purchaser, or they are not able to pass any cost on to the purchaser. One way to estimate what the purchaser would be willing to pay for would be to look at the payback of the ZEV. Studies and surveys have found that commercial fleets are willing to pay more for cost-saving technologies within a certain payback period that varies from fleet to fleet.(Volvo, 2019), (U.S. EPA, 2014). Two years is considered to be the time period where any cost-saving expense becomes an easy decision for a fleet. Table IX-23 illustrates the percentage of incremental cost that the fleet will be willing to pay for based on a simple two-year payback analysis incorporating fuel costs, LCFS revenue, and amortized charger & infrastructure payments. These percentages should represent the floor for what portion of the incremental cost the fleet will pay for as most companies have longer horizons than two years with some looking at the full life of the vehicle.

Table IX-23: Percentage of Two-Year Simple Payback vs. Incremental Cost

Vehicle Group*	2024 MY	2025 MY	2026 MY	2027 MY	2028 MY	2029 MY	2030 MY
Class 2b-3	24%	26%	28%	29%	31%	34%	38%
Class 4-5	54%	61%	69%	73%	81%	89%	101%
Class 6-7	54%	63%	72%	77%	86%	98%	113%
Class 8	28%	34%	40%	41%	47%	55%	67%
Class 7-8 Tractor - Electric	33%	38%	42%	44%	48%	53%	60%
Class 7-8 Tractor - Fuel Cell	N/A	N/A	N/A	N/A	N/A	3%	8%

*Class 2b-3 is using average of payback versus diesel and gasoline, all comparisons versus the normal range version of vehicle.

It is possible that manufacturers may shift sales for California-bound trucks out of state to avoid the requirements of the Proposed ACT Regulation which would consequentially reduce overall emissions reductions. Current California conditions include higher sales tax, registration fees and other factors that cause a portion of California tractors and trucks to be sold initially out of state despite operating within California. Generally, trucking companies make purchasing decisions based on a variety of reasons including the location of their headquarters, fleet facilities, expected duty cycles, and level of local delegation. Staff does not believe the Proposed ACT Regulation is likely to exacerbate these issues as fleet behavior determines where vehicles are purchased and operated, not manufacturer decisions.

While the Proposed ACT Regulation cannot ensure that sales will not affect decisions to shift sales out of state, future planned ZEV rules can require companies to incorporate zero-emission trucks into their fleets regardless of whether they were purchased in state or not. This issue can be avoided in how future regulations are structured to ensure real emissions reductions occur in California.

Trucking Fleets

Manufacturers sell trucks to trucking fleets who operate the vehicles and incur costs after the point of sale including taxes, fueling, maintenance, midlife costs, and registration fees. Adding electric trucks to their fleet will also cause fleets to incur cost relating to EVSE, infrastructure, maintenance bay upgrades, workforce training, and other transitional costs.

The Proposed ACT Regulation will reduce costs to the overall state's trucking fleet as the operational cost savings of the ZEVs outweigh the potential infrastructure and vehicle prices. Amortizing the vehicle and infrastructure help with these company's cash-flow so they can have positive cash-flow shortly after purchase.

Table IX-24 illustrates an example where a reference fleet purchases 20 Class 4-5 trucks for usage in last mile delivery applications in 2024 for usage over twelve years. The costs for 20 diesel vehicles, 20 battery-electric vehicles and the difference between them is shown. All other mileage and cost assumptions are the same as described previously in this section. The costs over the twelve year period are lower for the battery-electric fleet as compared to the diesel fleet; however, the upfront capital expenses are significantly higher for the BEV fleet. Access to capital or financing will be critical for fleets to take advantage of the overall savings of BEVs. A more detailed discussion of fleet costs can be found in the "Draft Advanced Clean Trucks Total Cost of Ownership Discussion Document" released earlier this year (CARB, 2019i) and a copy of the document is in Appendix H.

Table IX-24: Fleet Cost Example

Cost line items	Diesel	Battery-Electric	Difference
Amortized Vehicle Price (including all mfr. expenses)	$1,270,361	$1,747,840	$477,479
Sales Tax	$93,280	$135,896	$42,616
Amortized EVSE Cost	$0	$104,315	$104,315

Cost line items	Diesel	Battery-Electric	Difference
Amortized Infrastructure Upgrades	$0	$417,261	$417,261
Charger Maintenance	$0	$120,000	$120,000
Fuel Costs	$2,220,329	$947,961	-$1,272,368
LCFS Revenue	$0	-$764,063	-$764,063
Maintenance Costs	$1,914,913	$1,436,185	-$478,728
Midlife Costs	$0	$259,200	$259,200
Maintenance Bay Upgrades	$0	$20,000	$20,000
Transitional Costs and Workforce Development	$0	$12,564	$12,564
Registration Fees	$245,823	$232,840	-$12,982
Total	$5,744,706	$4,669,999	-$1,074,706

2. Direct Costs on Small Businesses

There is no expected direct cost on small businesses under the Proposed ACT Regulation. No manufacturers or fleets who are regulated under this rule are small businesses.

Small businesses who operate trucks will not be required to purchase zero-emission trucks, but may independently decide to do so. This may enable cost savings for small businesses due to electric trucks' lower cost of operation.

3. Direct Costs on Individuals

There are no direct costs onto individuals as a result of this regulation. Individuals may see health benefits due to ZEVs displacing ICE vehicles and providing statewide, regional, and local emission benefits. Manufacturers and fleets will see increased and decreased costs as a result of this rule and will pass through to individuals in the state. Individuals may see macroeconomic benefits and costs; these costs are discussed further below.

D. Fiscal Impacts

1. Local Government

<u>Large Entity Reporting</u>

Cities and counties are required to complete the Large Entity Reporting requirement in 2021. There are 58 counties and 482 cities in California and each would be required to report information about their fleets and the transportation services they contract for.

<u>Utility User Taxes</u>

Many cities and counties in California levy a Utility User Tax on electricity usage. This tax varies from city to city and ranges from no tax to 11 percent. A value of 3.53 percent was used in this analysis representing a population-weighted average (SCO, 2016). By increasing the amount of electricity used, there will be an increase in the amount of the utility user tax revenue collected by cities and counties.

Gasoline and Diesel Fuel Taxes

Fuel taxes on gasoline and diesel to fund transportation improvements at the state, county, and local levels. Displacing gasoline and diesel with electricity and hydrogen will decrease the total amount of gasoline and diesel dispensed in the state, resulting in a reduction in fuel tax revenue collected by local governments. The local tax on fuel is listed in Table IX-13.

Local Sales Taxes

Sales taxes are levied in California to fund a variety of programs at the state and local level. The Proposed ACT Regulation will require the sale of more expensive zero-emission trucks in California which will result in direct increase in sales tax revenue collected by local governments. Overall, local sales tax revenue may increase less than the direct increase from vehicle sales if overall business spending doesn't increase.

Local Government Fleet Cost Pass-Through

The local government fleet is estimated to make up 2.9 percent of California's fleet based on information from manufacturers and the Department of General Services. A proportionate amount of the total costs outlined in Table IX-22 are assumed to pass-through to local governments.

Fiscal Impact on Local Government

Table IX-25 shows the estimated fiscal cost to local governments due to the Proposed ACT Regulation relative to baseline conditions. The fiscal impact to local government is estimated to be -$0.6 million over the first three years of the regulation and $4 million over the regulatory lifetime.

Table IX-25: Estimated Fiscal Impacts to Local Government (million 2018$)

Model Year	Large Entity Reporting	Utility User Tax Revenue	Local Gasoline and Diesel Fuel Taxes	Local Sales Tax	Local Government Fleet Cost Pass-Through	Fiscal Impact*
2020	-$0.6	$0	$0	$0	$0	-$0.6
2021	$0	$0	$0	$0	$0	$0
2022	$0	$0	$0	$0	$0	$0
2023	$0	$0	$0	$0	$0	$0
2024	$0	$0	-$1	$2	-$1	$1
2025	$0	$1	-$2	$3	-$1	$1
2026	$0	$1	-$3	$4	-$1	$2
2027	$0	$2	-$5	$6	-$1	$2
2028	$0	$3	-$8	$8	-$1	$2
2029	$0	$5	-$12	$10	-$1	$2
2030	$0	$8	-$18	$12	$2	$3
2031	$0	$10	-$24	$12	$5	$2
2032	$0	$12	-$30	$14	$6	$2
2033	$0	$14	-$36	$14	$9	$2
2034	$0	$17	-$41	$14	$11	$1
2035	$0	$19	-$47	$15	$14	$0
2036	$0	$20	-$52	$15	$16	-$1
2037	$0	$22	-$57	$15	$19	-$1
2038	$0	$24	-$62	$15	$21	-$3
2039	$0	$25	-$67	$15	$22	-$5
2040	$0	$27	-$71	$15	$23	-$6
Total*	-$0.6	$211	-$538	$190	$141	$4

*Note: Totals may differ due to rounding

2. State Government

CARB Staffing and Resources

The Proposed ACT Regulation would have a small impact on staffing resources and would require two additional Air Pollution Specialist (APS) positions responsible for administering contracts to set up the reporting systems, assisting stakeholders with inquiries, data analysis and auditing of information submitted by manufacturers and fleets, supporting ACT enforcement actions and other general implementation duties. Each position has a fully burdened cost to CARB of $180,000 in Fiscal Year (FY) 2020-2021 and $179,000 every year afterwards.

The manufacturer reporting requirement will require modifying an existing reporting system or developing a new system to handle the reporting. We are estimating a cost of $200,000 in FY2020-2021 in contracting costs to set up the manufacturer reporting system for the rule.

Similarly, the fleet and large entity reporting requirement will require modifying an existing reporting system or developing a new system to handle the reporting. We are estimating a cost of $200,000 in FY2020-2021 in contracting costs to set up the fleet reporting system for the rule.

Gasoline and Diesel Fuel Taxes

Fuel taxes on gasoline and diesel to fund transportation improvements at the state, county, and local levels. Displacing gasoline and diesel with electricity and hydrogen will decrease the total amount of gasoline and diesel dispensed in the state. This will result in a reduction in revenue collected by the state for use in multiple levels of government. The state tax on fuel is listed in Table IX-13.

Energy Resources Fee

The Energy Resource Fee is a $0.0003/kWh surcharge levied on consumers of electricity purchased from electrical utilities. The revenue collected is deposited into the Energy Resources Programs Account of the General Fund which is used for ongoing energy programs and projects deemed appropriate by the Legislature, including but not limited to, activities of the California Energy Commission.

Registration Fees

The state collects registration fees to fund transportation improvements at the state, county, and local levels. The fee structure for ZEVs is different from diesel vehicles with some fees such as the Vehicle License Fee being higher and others such as weight fees being lower. These differences result in lower registration fees for the ZEVs. These lower fees result in reduced revenue collected by the state for use in transportation services.

State Sales Tax

Sales taxes are levied in California to fund a variety of programs at the state and local level. This Proposed ACT Regulation will require the sale of more expensive zero-emission trucks in California which will result in higher sales tax collected by the state governments. Overall, state sales tax revenue may increase less than the direct increase from vehicle sales if overall business spending doesn't increase.

State Fleet Cost Pass-Through

The state government fleet is estimated to make up 2.1 percent of California's fleet based on information from manufacturers and the Department of General Services. A proportionate amount of the total costs outlined in Table IX-22 are assumed to pass-through to the state government.

Fiscal Impacts on State Government

Table IX-26 shows the estimated fiscal impacts to the state government due to the Proposed ACT Regulation relative to baseline conditions. The fiscal impact to state government is estimated to be -$1.4 million over the first three years of the regulation and -$2.1 billion over the regulatory lifetime.

Table IX-26: Estimated Fiscal Impacts on State Government (million 2018$)

Model Year	CARB Staffing and Resources	State Gasoline and Diesel Fuel Taxes	Energy Resources Fee	Registration Fee	State Sales Taxes	State Fleet Cost Pass-Through	Fiscal Impact*
2020	-$0.6	$0	$0	$0	$0	$0	-$0.6
2021	-$0.4	$0	$0	$0	$0	$0	-$0.4
2022	-$0.4	$0	$0	$0	$0	$0	-$0.4
2023	-$0.4	$0	$0	$0	$0	$0	-$0.4
2024	-$0.4	-$3	$0	$0	$2	-$1	-$2
2025	-$0.4	-$7	$0	$0	$3	-$1	-$6
2026	-$0.4	-$13	$0	-$1	$3	$0	-$11
2027	-$0.4	-$21	$0	-$2	$5	-$1	-$18
2028	-$0.4	-$33	$0	-$3	$7	-$1	-$30
2029	-$0.4	-$51	$0	-$5	$9	$0	-$47
2030	-$0.4	-$75	$0	-$7	$10	$1	-$70
2031	-$0.4	-$98	$0	-$9	$10	$3	-$93
2032	-$0.4	-$120	$1	-$11	$12	$4	-$115
2033	-$0.4	-$142	$1	-$14	$12	$6	-$137
2034	-$0.4	-$164	$1	-$16	$13	$8	-$159
2035	-$0.4	-$185	$1	-$19	$13	$10	-$180
2036	-$0.4	-$205	$1	-$21	$13	$12	-$201
2037	-$0.4	-$225	$1	-$24	$13	$14	-$222
2038	-$0.4	-$243	$1	-$27	$13	$15	-$241
2039	-$0.4	-$260	$1	-$30	$13	$16	-$260
2040	-$0.4	-$277	$1	-$33	$13	$17	-$279
Total*	-$8	-$2,120	$10	-$222	$165	$102	-$2,073

*Note: Totals may differ due to rounding

E. Macroeconomic Impacts

Regional Economic Models, Inc. (REMI) Policy Insight Plus Version 2.2.8 is used to estimate the macroeconomic impacts of the Proposed ACT Regulation on the California economy. REMI is a structural economic forecasting and policy analysis model that integrates input-output, computable general equilibrium, econometric and economic geography methodologies. More details on the methodology can be found in the original SRIA submitted to Department of Finance in Appendix C-1.

1. Summary and Agency Interpretation of Results

The results of the macroeconomic analysis of the Proposed ACT Regulation are summarized in Table IX-27. As analyzed here, CARB estimates the Proposed ACT Regulation is unlikely to have a significant impact on the California economy. Overall, the change in the growth of jobs, State GDP, and output is projected to not exceed 0.03 percent of the baseline. The Proposed ACT Regulation results in increased growth in the truck transportation industry in California as fuel savings and LCFS credit generation from the use of ZEVs grow over time. The fuel savings for the truck transportation industry represent decreased demand for gasoline and diesel from the industry, implying a decrease in growth for the industry. This analysis also shows the negative impact estimated for state and local government output and employment due to tax revenue decreases, without any offsetting revenues.

Table IX-27: Summary of Macroeconomic Impacts of Proposed ACT Regulation

Macroeconomic Output	2020	2025	2030	2035	2040
GSP - % Change	0.00%	0.00%	0.01%	0.01%	0.02%
GSP - Change (2018M$)	1	86	437	452	669
Personal Income - % Change	0.00%	0.00%	0.02%	0.03%	0.04%
Personal Income - Change (2018M$)	-10	65	474	869	1,404
Employment - % Change	0.00%	0.00%	0.02%	0.02%	0.03%
Employment - Change in Jobs	8	871	4,645	5,653	8,102
Output - % Change	0.00%	0.00%	0.01%	0.01%	0.01%
Output - Change (2018M$)	-2	136	632	492	777
Private Investment - % Change	0.00%	0.00%	0.00%	0.00%	0.00%
Private Investment - Change (2018M$)	-3	26	177	312	428

2. California Employment Impacts

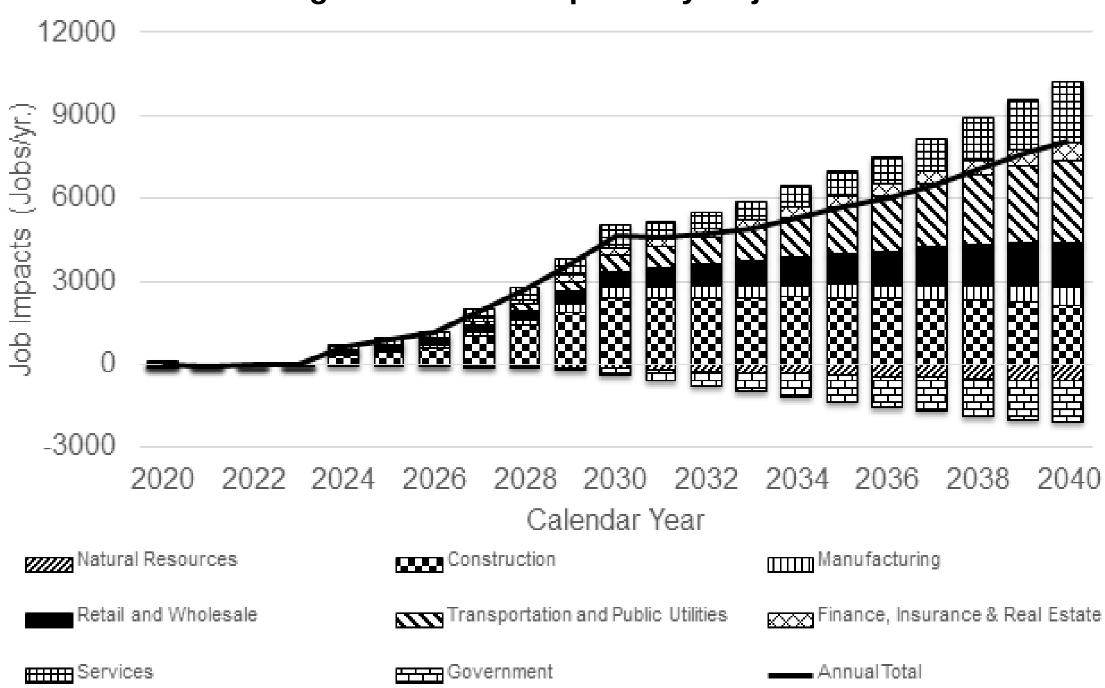
Table IX-28 presents the impact of the Proposed ACT Regulation total employment in California across all industries. The employment impacts represent the net change in employment, which consist of positive impacts for some industries and negative impacts for others. The employment impacts represent the net change in employment, which consist of positive impacts for some industries and negative impacts for others. The Proposed ACT Regulation is estimated to result in a slightly positive job impact from about 2025 to 2040. These changes in employment represent less than 0.04 percent of baseline California employment.

Table IX-28: Total California Employment Impacts

Calendar Year	2020	2025	2030	2035	2040
California Employment	24,368,647	25,267,147	26,206,546	27,105,799	27,920,649
% Change	0.00%	0.00%	0.02%	0.02%	0.03%
Change in Total Jobs	8	871	4,645	5,653	8,102

The total employment impacts shown above are net of changes at the industry level. The overall trend in employment changes by major sector are illustrated in Figure IX-8 and show the changes in employment by industries that are directly impacted by the Proposed ACT Regulation. As the requirements of the Proposed ACT Regulation go into effect, the industries generally realizing reductions in production cost or increases in final demand see an increase in employment growth. This includes the truck transportation, construction, and manufacturing sectors and upstream industries. The largest decrease in employment results from the public sector, which is estimated to realize a decrease in fuel and sales tax revenue and registration fees. The oil and gas extraction industry and automotive repair and maintenance industry see a decreased employment growth rate due to a reduction in final demand for their goods and services.

Figure IX-8: Job Impacts by Major Sector

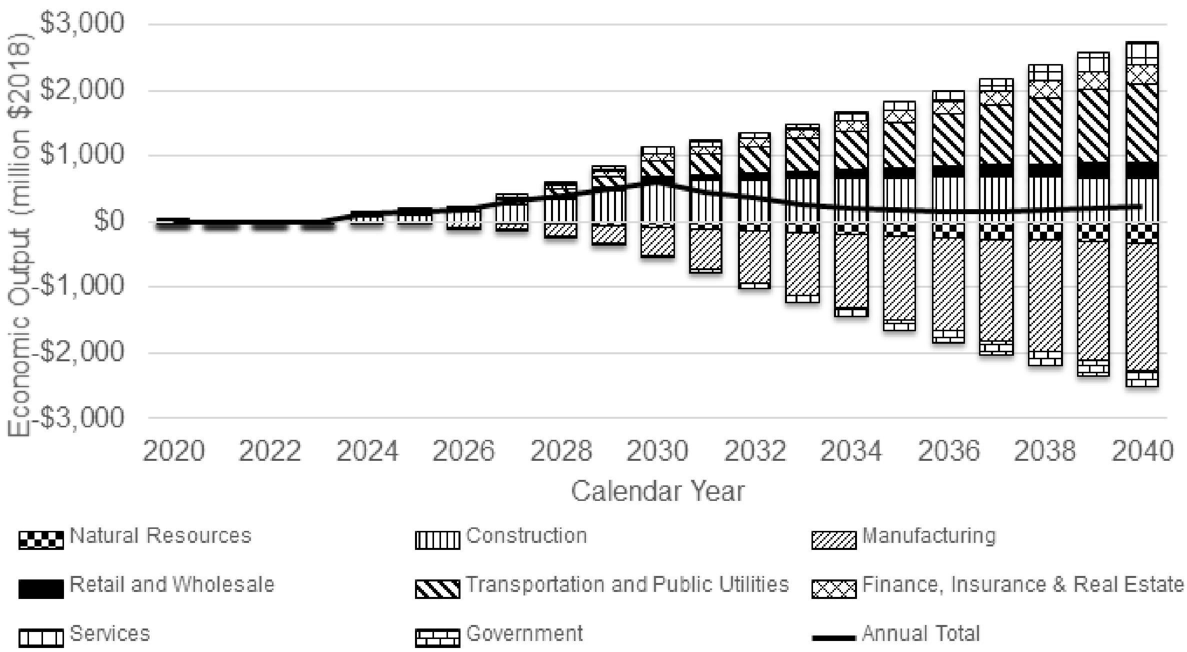


3. California Business Impacts

Gross output is used as a measure for business impacts because as it represents an industry's sales or receipts and tracks the quantity of goods or services produced in a given time period. Output growth is the sum of output in each private industry and State and local government as it contributes to the state's gross domestic product (GDP), and is affected by production cost and demand changes. As production cost increases or demand decreases, output is expected to contract, but as production costs decline or demand increases, industry will likely experience output growth.

The results of the Proposed ACT Regulation show an increase in output of $632 million in 2030 and an increase of $777 million in 2040 as illustrated by major sector in Figure IX-9. Similar to the employment impacts, there are positive impacts on output for transportation, public utilities, and construction and negative impacts on oil and gas extraction, automotive repair and maintenance, and the public sector. The negative output impact on manufacturing is primarily driven by the petroleum and coal products manufacturing industry, which is estimated to see a relatively large decrease in demand for gasoline and diesel.

Figure IX-9: Change in California Economic Output by Major Sector



4. Incentives for Innovation

Staff are proposing incentives for early ZEV sales by allowing credits to be generated from ZEV sales starting in 2021 MY, 3 years prior to the beginning requirements in 2024 MY. Staff anticipates growth in industries that manufacture ZEV technologies, including first and second tier suppliers for manufacturers of ZEVs, which will strengthen the supply chain, and promote technology improvements earlier than they would have otherwise occurred. This growth will help foster and support a self-sustaining medium- and heavy-duty ZEV market.

5. Significant Statewide Adverse Economic Impact Directly Affecting Business, Including Ability to Compete

The Proposed ACT Regulation imposes a ZEV sales mandate on ten large truck manufacturers selling vehicles in California and a one-time reporting requirement on about 12,000 large entities operating in California. Based on CARB staff analysis, the Executive Officer has made an initial determination that proposed regulatory action would not have a significant statewide adverse economic impact on directly affected businesses. In addition, the Executive Officer has made an initial determination that the proposed regulatory action would not have a significant statewide economic impact directly affecting representative private persons.

For the manufacturer ZEV sales mandate, the regulated entities are headquartered and produce vehicles entirely out-of-state for a national and international market. However, all of the costs from deploying the number of ZEVs required by the Proposed ACT Regulation are assumed to be borne in California. These costs including the incremental vehicle costs, infrastructure upgrades, fueling, maintenance, and other costs are assumed to be the direct costs of the regulation in California despite the lack of a specific fleet purchase requirement. This approach shows the full estimated cost to California for deploying the same number of ZEVs required by the regulation.

For the large entity reporting requirement, the regulated entities are large businesses and government agencies operating within California. This is a one-time reporting requirement that collects information about their owned vehicles and contracted vehicle services. It is expected that reporting entities will be using information already on-hand.

As shown in Table IX-22 and Table IX-27, these proposed regulations are not expected to have negative economic impacts and is projected to be a net benefit to the state. Trucking fleets and California businesses are expected to see a net reduction in costs which is projected to result in a net increase in California employment and economic output.

X. EVALUATION OF REGULATORY ALTERNATIVES

Government Code section 11346.2, subdivision (b)(4) requires CARB to consider and evaluate reasonable alternatives to the proposed regulatory action and provide reasons for rejecting those alternatives. This section discusses alternatives evaluated and provides reasons why these alternatives were not included in the proposal. As explained below, no alternative proposed was found to be less burdensome and equally effective in achieving the purposes of the regulation in a manner than ensures full compliance with the authorizing law. The Board has not identified any reasonable alternatives that would lessen any adverse impact on small business.

CARB solicited public input regarding alternatives to achieving the regulatory goals. Two public meetings were specifically devoted to the discussion of regulatory alternatives, including:

- April 25, 2017, at Sacramento: CARB staff held a workshop meeting (CARB, 2017h) to discuss how best to advance the market for advanced clean truck technologies primarily in local truck and last mile delivery application. At the meeting, CARB solicited feedback from stakeholders to develop methods as well as identify metrics and data to quantify the following alternatives concepts: fleet rule requirement and less stringent ZEV sales requirement.
- April 2, 2019, at Sacramento: CARB staff held a regulatory workgroup meeting (CARB, 2019j), to formally solicit regulatory concepts that would require heavy-duty vehicle and chassis manufacturers to sell a portion of Class 2b and greater vehicles sales as zero-emission and would require mandatory reporting for larger companies and fleets. At the meeting, the EMA sector requirement was discussed.

In addition to the workshop meetings, staff received two informal comment letters in regards to the April 2, 2019 regulatory workshop. The following alternatives were discussed: an NGO proposed more stringent Total Truck population requirement and natural gas Low NOx credit system.

A. Alternative Concepts

1. Alternative Concept: Less Stringent ZEV Sales Requirement

This alternative proposes a less stringent ZEV sales requirement than the Proposed ACT Regulation and would apply to the same manufacturers. Under this alternative, three percent of regulated manufacturer sales would need to be ZEVs in Class 2b-7 ramping up to 15 percent in 2030. Class 2b-3 pickup trucks and all Class 8 vehicles would be excluded from the ZEV sales requirement. This alternative would result in fewer ZEV sales compared to the Proposed ACT Regulation. In addition, it is expected that this alternative would result in lower costs to California due to the reduced ZEV percentage sales requirements on the manufacturers. However, all the required ZEV sales are assumed to be counted towards Phase 2 GHG compliance; this means that this alternative does not achieve any additional GHG emissions benefits. Therefore, this alternative is rejected because it fails to maximize the number of ZEVs deployed, does not maximize NOx, $PM_{2.5}$, and results in no new GHG reductions**.**

2. Alternative Concept: Stricter ZEV Sales Requirement

This alternative proposes a more stringent ZEV sales requirement than the Proposed ACT Regulation and would apply to the same manufacturers. Under this alternative, 15 percent of regulated manufacturer sales would need to be ZEVs in Class 2b-8 ramping up to 40 percent in 2030. Unlike the ACT proposed regulation and Alternative 1, no vehicle types are excluded from the ZEV sales requirement in this scenario. This alternative would result in greater ZEV sales compared with the Proposed ACT Regulation.

Furthermore, this alternative assumes that long range BEVs need to be sold in Class 2b-3 and more fuel cell vehicles would need to be sold in Class 7-8 tractors. With this alternative, the manufacturer would be required to sell more ZEVs which would require the manufacturer to make more expensive, longer range vehicles to meet this requirement. Even though this alternative results in more ZEVs deployed than the Proposed ACT Regulation and could provide more NOx and $PM_{2.5}$ emission reductions, it raises questions about the feasibility for manufacturers to comply with its requirements. Therefore this alternative was rejected due to the uncertainty as to whether the requirements could be met or sustained.

3. Alternative Concept: ZEV and Low NOx Credit Policy Approach

The “ZEV and Low NOx Credit Policy Approach” concept would give credit for combustion vehicles that meet a 0.02 g/bhp-hr NOx certification standard or better to count towards the ZEV requirement. Under this alternative, a credit mechanism would be created to allowing manufacturers to offset zero tailpipe vehicle manufacturing sales requirements until CARB implements a new heavy-duty emission standard for internal combustion engines that meets or exceeds the Low NOx standard. CARB is already in the regulatory process to reduce medium and heavy-duty emissions certification levels to maximize NOx reductions from combustion engines. These efforts are expected to establish the new low NOx certification standard by the 2024 model year which is when the Proposed ACT Regulation would begin requiring ZEVs. Low NOx engines do not achieve any GHG reductions and would not reduce PM from tire wear. The potential use of renewable fuels including RNG and RD procured by fleets are already covered under the LCFS program and the GHG reductions from these fuels is already attributed to the LCFS regulation.

Furthermore, this alternative concept will not advance the adoption of heavy-duty zero-emission technologies and develop a self-sustaining zero-emission truck market, which is a cornerstone of California’s long-term transportation strategy to reduce localized pollution and GHG emissions. Therefore, this proposed alternative is rejected because it would duplicative with CARB efforts already underway and would only add complexity to the Proposed ACT Regulation with no additional NOx emission reductions and would potentially result in less PM and GHG reduction.

4. Alternative Concept: 200,000 ZEV Sales Requirement

This alternative concept requires a more aggressive sales percentage requirement that would achieve at least 200,000 ZEVs, or 10 percent of the total truck population, to be on the road by 2030. In addition to increasing the sales percentages, the exemption that excludes pickups until 2027 MY from the class 2b-3 ZEV sales requirement would be removed. In general, this alternative raises questions about the feasibility of manufacturers to comply with this alternative especially for Class 2b-3 vehicles and tractors. Both Class 2b-3 and Class 7-8 tractors have more focused concerns about payload, range, towing, charging/refueling infrastructure and expected availability which presents more challenges for their deployment in this early market and suitability for meeting fleet needs. The sheer number of vehicle sales and likelihood that manufacturers would need to produce more costly long range vehicles, and the vehicles may need to be placed in applications where they may not be fully suitable. Even though this alternative results in more ZEVs deployed than the Proposed ACT Regulation and could provide more NOx and $PM_{2.5}$ emission reductions, it raises questions about the feasibility for manufacturers to comply with its requirements. Therefore this alternative was rejected due to the uncertainty as to whether the requirements could be met or sustained.

5. Alternative Concept: Fleet Rule Requirement

This concept would require fleets to include ZEVs as a certain percentage of their purchases. Under this alternative, fleet operators would be required to purchase ZEVs starting in 2020 beginning with a low fraction and ramping up to a higher percentage at a time when vehicles are normally being retired. This alternative would require the collection of more fleet related information needed to develop one or more fleet requirements. The Proposed ACT Regulation includes a reporting requirement for large entities and fleet owners to report information needed to develop a future regulation that would apply to fleets or those who hire them beginning in 2024 when the ZEV sales requirement would begin. The lead time to implement a manufacturer requirement is longer to provide sufficient time for manufacturers to change their manufacturing process to build ZEVs. Therefore, this alternative was rejected at this time because a manufacturer sales requirement is still necessary to ensure ZEVs are available and are fully supported before fleet rules can begin, and CARB is already planning to implement ZEV fleet rules in the near future.

6. Alternative Concept: EMA Sector Requirement

This concept would require manufacturers to produce and sell one specific model of ZEV for a specific application/use case (e.g., Last-mile delivery, public, utility, drayage, etc.). Under this alternative, beginning in 2024 model year, one specific vehicle application would be identified by CARB and all manufacturer's would need to offer a zero-emission truck that is capable of being used in that application. The concept is that only zero-emission trucks would be sold to fleets that operate their truck in that specific application. Other use cases would be unaffected. Manufacturers will be responsible to track the usage of trucks under this alternative. Due to ZEVs being the sole replacement for existing vehicles it is expected that vehicles under the affected use cases would eventually become entirely zero-emission under this alternative. However, this concept is not feasible until available ZEVs or ZEV technology meets all daily needs for every vehicle under the affected use cases. California already requires diverse types of ZEVs under AB739, ICT, and Zero-Emission ASB regulations while ports are planning an upcoming drayage regulation requiring zero-emission tractors. State and utility fleets also have a wide variety of truck and use cases, and to discretely define and enforce use cases would be difficult. This alternative was dismissed because it would be difficult to realistically implement and does not align with California's goal of maximizing transportation electrification.

B. Required Alternatives

1. Small Business Alternative

Government Code section 11346.2(b)(4)(B) requires a description of reasonable alternatives to the regulation that would lessen any adverse impact on small business and the agency's reasons for rejecting those alternatives.

CARB staff believe that the Proposed ACT Regulation would not result in any unexpected direct cost on small businesses. With high production rates of zero-emission trucks due to the Proposed ACT Regulation, there will be many benefits in various businesses, including ZEV manufacturing industries, ZEV components suppliers, EVSE suppliers and installers, and hydrogen fuel station suppliers. Some of these businesses may fall into the small business category, such as electricians, construction companies (including infrastructure installers), some ZEV manufacturers, fuel cell and battery producers, and electric drivetrain parts and components suppliers.

2. Performance Standards in Place of Prescriptive Standards

Government Code section 11346.2(b)(4)(A) requires that when CARB proposes a regulation that would mandate the use of specific technologies or equipment, or prescribe specific actions or procedures, it must consider performance standards as an alternative. The Proposed ACT Regulation, which requires that zero-emission trucks be produced when trucks are otherwise being purchased, is a performance standard, as it does not prescribe the kind of technology that must be deployed or explicitly require the purchase of any specific trucks by a specific date.

3. Health and Safety Code section 57005 Major Regulation Alternatives

CARB estimates the Proposed ACT Regulation will have an economic saving on the state's business enterprises of more than $8.3 billion between 2020 and 2040. CARB will evaluate alternatives submitted by stakeholders and consider whether there is a less costly alternative or combination of alternatives that would be equally as effective in achieving increments of environmental protection in full compliance with statutory mandates within the same amount of time as the proposed regulatory requirements, as required by Health and Safety Code section 57005. Staff reviewed and consolidated alternative proposals submitted to date in Chapter IX, none of which are as equally effective within the same amount of time.

XI. JUSTIFICATION FOR ADOPTION OF REGULATIONS DIFFERENT FROM FEDERAL REGULATIONS CONTAINED IN THE CODE OF FEDERAL REGULATIONS

Currently, there is no federal regulation requiring the sale of zero-emission technology in vehicles greater than 8,501 lb. GVWR. However, the federal Phase 2 GHG regulation does incentivize manufacturers to build zero-emission technology. This regulation requires medium- and heavy-duty manufacturers to produce more fuel efficient vehicles with lower CO_2 emissions starting in 2021 MY and increases in stringency through 2027 MY. Manufacturers can meet the Phase 2 GHG standards through a variety of technologies including improved aerodynamics, low rolling resistance tires, engine and accessory optimization, weight reduction, idle reduction systems, hybridization, powertrain electrification, and more. The federal Phase 2 GHG regulation also contains an Advanced Technology Multiplier of 3.5, 4.5, and 5.5 for NZEV, BEV, and FCEV technologies, respectively, which lasts until the end of the 2027 MY. The Proposed ACT Regulation compliments this provision because manufacturers can simultaneously earn credit in the Phase 2 GHG regulation and the Proposed ACT Regulation if producing ZEVs or NZEVs. However, despite including provisions to incentivize ZEV development, EPA and NHTSA did not base the Phase 2 standards on adoption of full-electric vehicles and did not assume ZEVs would be produced to comply.

As identified in the State's SIP and Climate Change Scoping Plan, medium- and heavy-duty ZEVs are a critical component of the state's goals and will become more crucial over time. Action is needed today to foster the zero-emission market and move beyond cleaner combustion technologies.

XII. PUBLIC PROCESS FOR DEVELOPMENT OF THE PROPOSED ACTION (PRE-REGULATORY INFORMATION)

Consistent with Government Code sections 11346, subdivision (b), and 11346.45, subdivision (a), and with the Board's long-standing practice, CARB staff held public workshops and had other meetings with interested persons during the development of the proposed regulation. These informal pre-rulemaking discussions provided staff with useful information that was considered during development of the regulation that is now being proposed for formal public comment.

CARB staff developed the Proposed ACT Regulation through an extensive public process. CARB has conducted a multi-level public process that includes technical workgroup meetings and workshops comprised of interested stakeholders including manufacturers, fleets, environmental groups, utilities, technology providers, fuel providers, and others.

The public process comprises many forms of communication dialogues with stakeholders and interested public. In addition to coordinating public workgroup meetings, CARB staff has conducted more than 100 individual meetings with more than 50 stakeholders. CARB staff has held two joint meetings with the California Governor's Office of Business and Economic Development (GO-Biz) in which fleets, manufacturers, and utilities discussed medium-and heavy-duty electrification. Additionally, staff has engaged in frequent discussions with ZEV technology providers, electric utilities, fuel providers, and non-governmental environmental organizations during various outreach events such as technology symposiums and expositions. To facilitate the exchange of information, CARB staff created an informal comment submittal form available for interested parties to submit comments about the Proposed ACT Regulation. The following provides a list of public meetings conducted.

A. Regulatory Workshops

Date	Summary of meeting
• November 1, 2016:	Initial public workshop discussed the strategies to accelerate the market for advanced clean technologies.
• April 25, 2017:	Second regulatory workshop discussed the potential regulatory concept, a draft fleet survey, and continued the discussion on costs.
• May 31, 2018:	Third public workshop staff presented updates on the regulatory concept.

Date	Summary of meeting
• August 30, 2018:	Fourth public workshop discussed the assessment of zero-emission fleet requirements.
• December 4, 2018:	Public workshop meeting discussed potential reporting requirements for car and truck fleets.
• April 2, 2019 :	Fifth public workshop discussed the Proposed ACT Regulation including mandatory reporting for large companies and fleets.
• June 20, 2019 :	Sixth workshop meeting discussed the proposed reporting requirement for large companies that contract to move freight or other products, and for large fleets that operate trucks locally or regionally.
• August 21, 2019 :	Seventh workshop provided updates to the proposed manufacturer sales requirement and large entity reporting requirement.

B. Workgroup Meetings

Date	Summary of Meeting
• November 14, 2016:	Public meeting discussed transportation electrification barriers and solutions for fleets.
• January 20, 2017:	First workgroup meeting included a discussion of strategies for deploying advanced clean local trucks.
• August 30, 2017:	Second workgroup meeting discussed the costs of advanced and conventional truck technologies in CA.
• December 4, 2018:	Third fleet/manufacturer meeting discussed the market potential for zero-emission trucks.
• February 25, 2019:	Fourth workgroup meeting reviewed the zero-emission truck and bus market segment analysis and assumptions.

C. Materials Shared with the Public

Prior to the release of staff proposal, it is essential to engage the public with more productive dialogue through sharing date points, data analysis methodologies, literature review, concept paper, and other technical tools. Workshop and workgroup discussion documents, analysis and tools, and materials are posted on CARB's Advanced Clean

Trucks Meetings and Workshop Public Meetings webpage (CARB, 2019k). Two discussion documents that included workshop documents, concepts and or discussions relating to the Proposed ACT Regulation, four analysis documents and tools, and a draft regulatory language for both parts of the Proposed ACT Regulation are identified here:

1. Discussion Documents

• Battery-Electric Truck and Bus Energy Efficiency Compared to Conventional Diesel Vehicles: May 2018:	This document provided a comparison of energy usage between diesel-powered vehicles and battery-electric vehicles. This document found that the EER for battery-electric heavy-duty vehicles is higher at lower speeds and the EER ranged from 3 in high speed operations to between 5 and 7 in low speed operations.
• February 2019: TCO Discussion Document.	This document analyzed the total cost of ownership for a diesel, battery-electric, and fuel cell electric vehicle in 2018, 2024, and 2030 for three different truck types and was made available for comment.

2. Draft Regulatory Language

• August 21, 2019: Proposed Draft Regulatory Language – Manufacturer Sales Requirement.	Developed proposed draft language for the manufacturer sales requirement for discussion and feedback.
• August 21, 2019: Proposed Draft Regulatory Language – Large Entity Reporting Requirement.	Developed proposed draft language for the large entity reporting requirement for discussion and feedback.

3. Analysis and Tools

Date and Name	Summary
• April 25, 2017: Draft Survey.	Survey tool to gather detailed information about everyday operations of local fleets and fleet characteristics.
• December 4, 2018: EMA Truck Segment Analysis	Matrix prepared by the Truck and Engine Manufacturers Association (EMA) as a first draft analysis of the suitability of ZEVs for Class 2b-8 commercial vehicle applications.
• December 4, 2018: Key Truck Specifications Sheet	Provided a list of questions to discuss and identify the mission critical questions to ask fleets.
• February 25, 2019: ACT Market Segment Analysis	Modified EMA Truck Segment Analysis to reflect the suggested changes to the battery-electric truck assessment.
• February 25, 2019: TCO Calculator	Calculator tool that helps public to compare the total cost of ownership for diesel battery-electric and hydrogen fuel-cell trucks.
• June 20, 2019: Comment Submittal Form	Tool to submit informal comments about the Advanced Clean Trucks proposal.

XIII. REFERENCES

The following documents are the technical, theoretical, or empirical studies, reports, or similar documents relied upon in proposing these regulatory amendments, identified as required by Government Code, section 11346.2, subdivision (b)(3). Additionally, each appendix references the documents upon which it relies, as required by Government Code, section 11346.2, subdivision (b)(3).

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The following documents are the technical, theoretical, or empirical studies, reports, or similar documents relied upon in proposing these regulatory amendments, identified as required by Government Code, section 11346.2, subdivision (b)(3). Additionally, each appendix References the documents upon which it relies, as required by Government Code, section 11346.2, subdivision (b)(3).

Note: Each "Explanatory Footnote" is a footnote containing explanatory discussion rather than referencing specific documents relied upon.

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XIV. APPENDICES

Appendix A: Proposed Regulation Order

Appendix B: US EPA 86.1803-01 Definitions

Appendix C: Standardized Regulatory Impact Analysis (SRIA)

Appendix C-1: Original SRIA Submitted to DOF

Appendix C-2: DOF Comments on SRIA

Appendix D: Draft Environmental Analysis

Appendix E: Zero-Emission Truck Market Assessment

Appendix F: Emissions Inventory Methods and Results for the Proposed Advanced Clean Trucks Regulation

Appendix G: Battery-Electric Truck and Bus Energy Efficiency Compared to Conventional Diesel Vehicles

Appendix H: Draft Advanced Clean Trucks Total Cost of Ownership Discussion Document

Appendix I: Advanced Clean Trucks - Fleet Operations Survey

Appendix J: Large Entity Reporting Sample Response

State of California

CALIFORNIA AIR RESOURCES BOARD

ADVANCED CLEAN TRUCKS REGULATION

FINAL STATEMENT OF REASONS

MARCH 2021

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Table A: Acronyms

Acronym	Definition
AB	Assembly Bill
ABT	Averaging, Banking, and Trading
ACT	Advanced Clean Trucks
AER	All-Electric Range
ASB	Airport Shuttle Bus
CAA	Clean Air Act
CARB or Board	California Air Resources Board
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CNG	Compressed Natural Gas
COVID	Coronavirus Disease
CPUC	California Public Utilities Commission
CTA	California Trucking Association
DMV	Department of Motor Vehicles
EA	Environmental Analysis
EER	Energy Economy Ratio
EMA	Engine Manufacturer’s Association
EMFAC	Emission Factors
EPA	Environmental Protection Agency
ePTO	Electric Power Take-Off
EVSE	Electric Vehicle Supply Equipment
FCEV	Fuel Cell Electric Vehicle
FSOR	Final Statement of Reasons
GHG	Greenhouse Gases
GVWR	Gross Vehicle Weight Rating
H&SC	Health and Safety Code
HD	Heavy-Duty
HEV	Hybrid Electric Vehicle
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
ICT	Innovative Clean Transit
IOU	Investor Owned Utilities
IRP	International Registration Plan
ISOR	Initial Statement of Reasons
LCFS	Low Carbon Fuel Standard
LD	Light Duty
LNG	Liquefied Natural Gas
MD	Medium-Duty
MDPV	Medium-Duty Passenger Vehicle
MHD	Medium-Heavy-Duty
MY	Model Year

Acronym	Definition
NAAQS	National Ambient Air Quality Standards
NG	Natural Gas
NGV	Natural Gas Vehicle
NOx	Oxides of Nitrogen
NZEV	Near-Zero-Emission Vehicle
OEM	Original Equipment Manufacturer
PHEV	Plug-In Hybrid Electric Vehicle
PM	Particulate Matter
POU	Public Owned Utilities
PZEV	Particle Zero-Emissions Vehicle
RD	Renewable Diesel
RNG	Renewable Natural Gas
SB	Senate Bill
SIP	State Implementation Plan
SRIA	Standardized Regulatory Impact Assessment
TCO	Total Cost of Ownership
TRUCRS	Truck Regulation, Upload, and Compliance Reporting System
VMT	Vehicle Miles Traveled
VOC	Volatile Organic Compounds
ZANZEFF	Zero- and Near-Zero-Emission Freight Facilities
ZE	Zero-Emission
ZEP	Zero-Emission Powertrain
ZEV	Zero-Emission Vehicle

State of California
AIR RESOURCES BOARD

Final Statement of Reasons for Rulemaking,

Including Summary of Comments and Agency Response

PUBLIC HEARING TO CONSIDER THE PROPOSED ADVANCED CLEAN TRUCKS REGULATION

Public Hearing Dates: December 12, 2019, and June 25-26, 2020

Agenda Item No.: 20-6-3

I. GENERAL

ACTION TAKEN IN THIS RULEMAKING

The Staff Report: Initial Statement of Reasons for Rulemaking (Staff Report) entitled "The Proposed Advanced Clean Trucks Regulation," and its supporting Appendices A through J, all of which were publicly released October 22, 2019 for a 45-day comment period, are incorporated by reference herein and contain a description of the rationale and supporting documentation for the proposed regulation. On October 22, 2019, all references relied upon and identified in the Staff Report were made available to the public.

Zero-emission (ZE) technologies are necessary to address the state's long-term air quality and climate protection goals. These technologies are part of a comprehensive strategy to reduce emissions from the transportation sector as reflected in the 2016 Mobile Source Strategy.

As explained in the Staff Report, the purpose of these regulations is to accelerate the market for zero-emission vehicles in the medium- and heavy-duty truck sector and to reduce emissions of oxides of nitrogen (NOx), fine particulate matter (PM), toxic air contaminants, greenhouse gases (GHG), and other criteria pollutants generated from on-road mobile sources. Requiring medium- and heavy-duty vehicles to transition to zero-emissions technology will reduce health risks to people living in and visiting California, and is needed to help California meet established near- and long-term air quality and climate mitigation targets. Requirements for fleets to report information about their operations will provide data needed to inform future strategies and policies.

On December 12, 2019, following a 45-day comment period, the California Air Resources Board (CARB or Board) conducted the first public hearing to consider the proposed Advanced Clean Trucks Regulation (ACT), as described in the Staff Report, and the associated Notice of Public Hearing (45-Day Notice). The regulation requirements are included in title 13, division 3, chapter 1, article 2, sections 1963-1963.5, and in title 13, division 3, chapter 1, new article 3.1, sections 2012-2012.3 of the California Code of Regulations. At this public hearing, staff presented the proposal as well as additional suggested modifications to the regulatory text to address comments received following the release of the Staff Report. At the conclusion of the hearing, the Board directed the Executive Officer and staff to consider the testimony and comments received and to continue working with stakeholders to address concerns about the proposed requirements.

A total of 121 written comment letters were received from individuals or organizations throughout the 45-day period. During the December 12, 2019, public hearing, 16 written comments were received along with 99 individuals who gave oral statements. Staff then proposed modifications to the original regulation addressing comments received during both the public hearing and 45-day comment period.

The text of the proposed modifications to the originally proposed regulation and supporting documents were made available for a supplemental 30-day comment period through a "Notice of Public Availability of Modified Text and Availability of Additional Documents" (30-Day Notice). The 30-Day Notice, modified regulatory language, and additional supporting documents were posted on April 28, 2020, on CARB's website (Link), accessible to stakeholders and interested parties. The comment period commenced on April 28, 2020 and ended on May 28, 2020 with a total of 342 comment letters received during this time. All modifications to the regulatory language are clearly indicated in the Notice of Public Availability of Modified Text.

The Final EA and written responses to the Draft Environmental Analysis (EA) were both posted on June 23, 2020 for public review.

The Final EA, Response to Comments, Final Regulation Order, and Proposed Resolution 20-19 were presented to the Board during the June 25, 2020 hearing, during which oral comments from 136 individuals and 114 written comments were received. The Board adopted Resolution 20-19 which approved written responses to the Draft EA, certified the Final EA, approved the findings, approved the statements of overriding considerations, and adopted the ACT Regulation. The June 2020 approval by itself did not and could not have resulted in any environmental impacts because the ACT Regulation will not go into effect until after the Office of Administrative Law approves it. In other words, although CARB complied with CEQA by completing environmental review prior to the Board’s June 2020 approval, CARB still had to comply with additional APA requirements before the ACT Regulation rulemaking process could be concluded. Note: a clerical error occurred in the Final EA. The emissions benefits tables on pages 35 and 55 in the Final EA do not match up with the updated emissions benefits in Attachment C to the Notice of Public Availability of Modified Text and Availability of Additional Documents and Information, posted on CARB’s website on April 28, 2020. This is the result of a minor clerical oversight in not transferring the new numbers from

Attachment C, which reflect the emissions benefits from the modified language identified in the April 28, 2020 notice, to the Final EA. The new emissions benefits result in greater benefits and, as a result, do not change any of the significance conclusions or determinations made in the Final EA for which the Board took action to certify. And the Board was provided with the updated numbers before the June 25th approval (Attachment C: "Updated Costs and Benefits Analysis for the Proposed Advanced Clean Trucks Regulation").

In Resolution 20-19, the Board directed the Executive Officer to "take CARB's final step for final approval of the Board-approved regulations" and submit the rulemaking package to the Office of Administrative Law if the Executive Officer determines no additional modifications to the regulations are appropriate. The Executive Officer determined that no additional modifications to the regulatory language are necessary, but CARB did add some documents to the rulemaking record. A list of supporting documents added to the record was made available for a supplemental 15-day comment period through a "Second Notice of Public Availability of Additional Documents and Information" (15-Day Notice). The 15-Day Notice and additional supporting documents were posted on October 5, 2020, on CARB's Website (Link), accessible to stakeholders and interested parties, and ended on October 20, 2020, with 8 comments received during this period.

This Final Statement of Reasons (FSOR) updates the Staff Report by identifying and providing the rationale for the modifications made to the originally proposed regulation, including changes directed by the Board at the December 12, 2019, hearing and text circulated for public comment during the 30-day comment period. The FSOR also contains a summary of the comments received during the formal rulemaking process by CARB on the proposed ACT Regulation or on the process by which they were adopted as well as CARB's responses to those comments.

MANDATES AND FISCAL IMPACTS TO LOCAL GOVERNMENTS AND SCHOOL DISTRICTS

The Board has determined that this regulatory action will not result in a mandate to local school districts but will to local agencies. However, the Board finds that the costs to local agencies are not reimbursable pursuant to Part 7 (commencing with section 17500), Division 4, Title 2 of the Government Code. Pursuant to Government Code sections 11346.9(a)(2) the proposed regulatory action is a mandate that would create costs and cost-savings to local agencies, but not to school districts. The mandate is not reimbursable because costs associated with the proposed regulation apply generally to all entities that purchase affected vehicles and respond to the reporting requirement, including local agencies. Therefore, the regulation does not constitute a "Program" imposing any unique requirements on local agencies as set forth in section 17514 of the California Government Code.

The ACT Regulation directly impacts local government entities, who are local agencies. In 2021, each of the 58 counties and 482 cities in California would be required to complete the Large Entity Reporting requirement to report information about their fleets and the type of transportation services for which they contract.

Many cities and counties in California levy a Utility User Tax on electricity usage. This tax varies from city to city and ranges from no tax to 11 percent. A value of 3.53 percent was used in this analysis representing a population-weighted average (SCO, 2016).[1] By increasing the amount of electricity used, there will be an increase in the amount of the utility user tax revenue collected by cities and counties.

Fuel taxes on gasoline and diesel fund transportation improvements at the state, county, and local levels. Displacing gasoline and diesel with electricity and hydrogen will decrease the total amount of gasoline and diesel dispensed in the state, resulting in a reduction in fuel tax revenue collected by local governments.

Sales taxes are levied in California to fund a variety of programs at the state and local level. The ACT Regulation will require the sale of more expensive zero-emission trucks in California which will result in a direct increase in sales tax revenue collected by local governments. However, local sales tax revenue may increase less than the direct increase from vehicle sales if overall business spending doesn't increase.

The local government fleet is estimated to make up 2.9 percent of California's total fleet based on information from manufacturers and the Department of General Services. A proportionate amount of the total costs are assumed to pass-through to local governments.

The estimated fiscal impacts to local government compared to a business as usual baseline are estimated at -$0.6 million over the first three years of the regulation and $4 million over the regulatory lifetime.

CONSIDERATION OF ALTERNATIVES

Government Code section 11346.9(a)(4) requires that CARB consider reasonable alternatives which “include, but are not limited to, alternatives that are proposed as less burdensome and *equally effective in achieving the purposes of the regulation* in a manner that ensures full compliance with the authorizing statute or other law being implemented or made specific by the proposed regulation.” (emphasis added) For the reasons set forth in the Staff Report, in staff's comments, responses at the hearing, and in this FSOR, the Board determined that no alternative considered by the agency would be equally effective in achieving the purpose for which the regulatory action was proposed, or would be as effective and less burdensome to affected private persons, or

[1] (SCO, 2016) California State Controller's Office, User Utility Tax Revenue and Rates (web page: https://sco.ca.gov/Files-ARD-Local/LoSCzcRep/2016-17 Cities UUT.pdf, last accessed June 2019).

would be more cost-effective to affected private persons and equally effective in implementing the statutory policy or other provisions of law than the action taken by the Board. The ACT regulation ISOR included the following primary purposes for adoption of the regulation:

- Accelerate first wave of zero-emission (ZE) truck deployments in best suited applications;
- Achieve 100 percent zero-emission pickup-and-delivery in local applications by 2040;
- Support the Ports of Los Angeles and Long Beach Clean Air Action Plan for 100 percent zero-emission drayage trucks by 2035;
- Support AB 739 requiring California state government fleets to purchase ZEVs;
- Enable a large-scale transition to zero-emission technology;
- Maximize the total number of ZEVs deployed;
- Complement existing and future programs;
- Provide environmental benefits, especially in disadvantaged communities thereby supporting the implementation of AB 617;
- Ensure requirements are technologically feasible and cost effective; and
- Foster a self-sustaining zero-emission truck market.

1. Less Stringent ZEV Sales Requirement

This alternative proposes a less stringent zero-emission vehicle (ZEV) sales requirement than the ACT regulation and would apply to the same manufacturers. Under this alternative, three percent of regulated manufacturer sales would need to be ZEVs in Class 2b-7 ramping up to 15 percent in 2030. Class 2b-3 pickup trucks and all Class 8 vehicles would be excluded from the ZEV sales requirement. This alternative would result in fewer ZEV sales compared to the ACT regulation and would be expected to result in lower upfront costs to California due to the reduced ZEV percentage sales requirements on the manufacturers. However, all the required ZEV sales are assumed to be counted towards Phase 2 GHG compliance meaning no additional GHG emissions benefits would be achieved. Therefore, this alternative is rejected because it fails to maximize the number of ZEVs deployed, does not maximize reductions of NOx, $PM_{2.5}$, and results in no new GHG reductions.

2. Stricter in Early Years ZEV Sales Requirement

This alternative proposes a more stringent ZEV sales requirement in the early years of the regulatory timeframe than the ACT Regulation and would apply to the same manufacturers. Under this alternative, 15 percent of regulated manufacturer sales would need to be ZEVs in Class 2b-8 ramping up to 40 percent in 2030. This alternative would result in greater ZEV sales compared with the ACT regulation. Furthermore, this alternative assumes that more long-range battery electric vehicles (BEVs) need to be sold in Class 2b-3 and more fuel cell vehicles would need to be sold in the Class 7-8 tractor category. With this alternative, the manufacturer would be required to make more expensive, longer range vehicles and sell more ZEVs in total to meet this higher sales requirement. Even though this alternative results in more ZEVs deployed than the ACT Regulation in the early years of the requirement and could provide more NOx and $PM_{2.5}$ emission reductions, it raises questions about the feasibility for manufacturers to comply with its requirements since they would need to expand sales for vehicles that are less suitable for early electrification. Therefore, this alternative was rejected due to the uncertainty as to whether the requirements could be met or sustained.

3. ZEV and Low NOx Credit Policy Approach

The “ZEV and Low NOx Credit Policy Approach” concept would give credit for combustion vehicles that meet a 0.02 g/bhp-hr NOx certification standard and use low carbon fuels to count towards the ZEV requirement. This concept is not, functionally, a true alternative to the proposed regulation because it does not propose an alternative to the core element of the ACT regulation which is a ZEV sales requirement. Rather, under this concept, a complementary credit mechanism would be created to allow manufacturers to offset zero tailpipe vehicle manufacturing sales requirements with engines that meet the optional Low NOx standard until CARB implements a new heavy-duty emission standard for internal combustion engines that achieves similar NOx reductions. As a matter of policy, this concept simply does not attempt to address the core goal of the ACT regulation which is to accelerate the widespread adoption of ZEVs but is instead an ancillary concept to this core goal of enabling and incentivizing manufacturers to continue to manufacture internal combustion engines.

CARB has separate regulations and rulemakings to address different issues. The purpose of the ACT regulation is to foster and accelerate the large-scale adoption of ZEVs. Separately, CARB is currently developing the Low NOx Omnibus rulemaking, which, in pertinent part, will ensure that heavy-duty diesel and Otto-cycle engines used in on-road heavy-duty vehicles comply with stringent NOx emission standards as those engines and vehicles are operated. The Low NOx Omnibus regulation will establish a new NOx standard by the 2024 model year, the same year that ACT begins implementation. The Omnibus rulemaking also establishes an opportunity for manufacturers that elect to voluntarily certify engines to more stringent standards than required to generate emissions credits.

CARB also has the Low Carbon Fuel Standard (LCFS) regulation which achieves GHG reductions by requiring fuel producers to reduce the carbon intensity of their fuels or purchase credits from low carbon fuel suppliers. The LCFS program is successfully reducing carbon intensity of California transportation fuels by providing a strong market-based incentive to produce low carbon fuels including electricity, hydrogen, natural gas, and biofuels which can generate credits under that program. LCFS credits can be sold and used to offset the costs of these fuels. Fossil gasoline and diesel are generally not eligible for LCFS credits. Electricity and hydrogen are both low carbon fuels with high Energy Efficiency Ratios (EER) meaning they can generate LCFS credits. Electricity is a relatively inexpensive and efficient way to fuel a vehicle and significant savings can be achieved especially when the LCFS credits are considered. For fleets that charge for extended periods overnight, the LCFS credits can offset all or nearly all of the electricity costs. The LCFS program specifies that emission reductions associated with low carbon fuels are attributed to any regulation that requires the usage of an alternative technology, so the emission benefits of medium- and heavy-duty vehicle electrification are already attributed to the ACT regulation's ZEV requirement, as required under the LCFS program.

Awarding credit to Low NOx engines in this rulemaking under this credit concept would also not achieve all of the primary purposes identified for the ACT regulation as required by Government Code section 11346.2, subsection (b)(4)(A), quoted above.

Notwithstanding the fact that this concept does not meet the bare minimum threshold of being a "reasonable alternative" due to its failure to address the core element of the ACT regulation, the ZEV sales requirement, CARB nonetheless chose to address its shortcomings and reasons for rejecting the credit concept. First, awarding credit to combustion-powered vehicles would incentivize the production of internal combustion engines which is directly inconsistent with the stated goals noted above, especially because it would not achieve maximum emission reductions possible by spurring ZEV production in the heavy and medium duty vehicle categories. Second, and relatedly, this credit concept would have a direct effect in decreasing the number of ZEVs and NZEVs produced in California because manufacturers would likely pursue manufacturing strategies that achieve compliance by simply buying credits to meet the ZEV sales requirement from manufacturers producing combustion vehicles that qualify for the Low NOx credits; this would clearly undermine the goal of accelerating the medium- and heavy-duty vehicle zero-emission market. Third, the proposed credit concept would be duplicative with the Low NOx Omnibus rulemaking and fail to generate additional emissions reductions because the Low NOx Omnibus rulemaking has addressed incentives related to manufacturers' voluntary production of engines that meet this concept's low NOx standard. Fourth, because the actions identified are duplicative with the Low NOx Omnibus rulemaking and the LCFS regulation, this credit concept would generate no criteria or GHG emission benefits which would fail to meet the objective that emission reductions from the ACT regulation are real, permanent, quantifiable, verifiable, and enforceable. Therefore, this concept fails to meet the purposes of the ACT regulation, including the goal to decrease emissions in conjunction with the state's air quality and climate change targets and is therefore rejected as it would be duplicative with CARB efforts already underway.

4. 200,000 ZEV Sales Requirement by 2030

This alternative concept requires a more aggressive sales percentage requirement that would achieve at least 200,000 ZEVs, or 10 percent of the total truck population, to be on the road by 2030. In general, this alternative raises questions about the feasibility of manufacturers to comply with this alternative especially for Class 2b-3 vehicles and tractors. Both Class 2b-3 and Class 7-8 tractors have more focused concerns about payload, range, towing, charging/refueling infrastructure, and model availability than other vehicles. These issues will present more challenges for their deployment in this early market and suitability. The sheer number of vehicle sales and likelihood that manufacturers would need to produce more costly long-range vehicles means they may need to be placed in applications where they may not be fully suitable. Even though this alternative results in more ZEVs deployed than the ACT Regulation and could provide more NOx and $PM_{2.5}$ emission reductions, it raises questions about the feasibility for manufacturers to comply with its requirements due to the rapid increase in sales prior to 2030. Therefore, this alternative was rejected due to the uncertainty as to whether the requirements could be met or sustained.

5. Fleet Rule Requirement

This concept would change the point of regulation to fleet owners. As described in the 2016 Mobile Source Strategy, this would require fleets to gradually increase ZEV purchases when replacing vehicles starting in 2020. As explained in the Staff Report, manufacturers have been reluctant to produce medium- and heavy-duty ZEVs. This alternative cannot succeed unless ZEVs are available to purchase and have a robust maintenance support network. CARB initially considered using a fleet regulation to accelerate the market, but later determined that ZEV availability and support was insufficient to meet state commitments. A necessary first step would be to ensure that ZEVs were supported by manufacturers and made widely available before placing requirements on fleets. In fact, the ACT Regulation includes a reporting requirement for large entities and fleet owners to provide information needed to develop future zero-emission fleet rules. The manufacturer ZEV sales requirement needs to be in place first because of the lead time needed to develop and manufacture vehicles. CARB has already begun the process to develop future fleet regulations that can take effect the same year as the first ZEV sale is required. Therefore, this alternative was rejected at this time because a manufacturer sales requirement is necessary to ensure ZEVs are available and fully supported before fleet rules can begin. CARB is already planning to implement complementary ZEV fleet rules in the near future.

6. Truck and Engine Manufacturer's Association Sector Requirement

This concept would require manufacturers to produce and sell one specific model of ZEV for a specific application/use case (e.g., Last-mile delivery, public, utility, drayage, etc.). Under this alternative, beginning in the 2024 model year, one specific vehicle application would be identified by CARB and all manufacturers would need to offer a zero-emission truck that is capable of being used in that application. The concept is that only zero-emission trucks would be sold to fleets that operate a truck in that specific application while other use cases would be unaffected. Manufacturers will be responsible in tracking the usage of trucks under this alternative. Due to ZEVs being the sole replacement for existing vehicles, it is expected that vehicles under the affected use cases would eventually become entirely zero-emission. However, this alternative concept is not feasible in the near-term until available ZEVs or ZEV technology meets all daily needs for every vehicle under the affected use cases. It is also impractical for the manufacturer and CARB to know if the buyer was planning on using the truck in the specified application when the initial purchase was being made. For example, it is impractical to identify whether a new tractor will be used for drayage or another use at the time of purchase and moreover, the owner can change the intended use at any time. In addition, California already requires diverse types of ZEVs under AB739, Innovative Clean Transit (ICT), and Zero-Emission Airport Shuttle Bus (ASB) regulations. State and utility fleets also have a wide variety of truck and use cases, and to discretely define and enforce requirements based on use cases would be impractical. This alternative was dismissed because it would be difficult to realistically implement and does not align with California's goal of maximizing transportation electrification everywhere feasible.

7. Small Business Alternative

Government Code section 11346.9(a)(5) requires a description of reasonable alternatives to the regulation that would lessen any adverse impact on small business as well as the agency's reasons for rejecting those alternatives. CARB staff believe that the ACT Regulation would not result in any unexpected direct cost on small businesses. With high production rates of zero-emission trucks due to the ACT Regulation, there will be many benefits in various businesses, including ZEV manufacturing industries, ZEV components suppliers, electric vehicle supply equipment (EVSE) suppliers and installers, and hydrogen fuel station suppliers. Some of these businesses may fall into the small business category, such as electricians, construction companies (including infrastructure installers), some ZEV manufacturers, fuel cell and battery producers, and electric drivetrain parts and components suppliers.

Based on the thresholds, staff does not foresee that any manufacturers subject to the ZEV sales requirement would be small businesses. Likewise, staff does not foresee that the large entity reporting requirements for any businesses meeting the revenue threshold, fleets meeting the size threshold, or government agencies subject to the reporting requirement would be small businesses. However, there is the potential that some brokers may qualify as small businesses and may be subject to the large entity reporting requirement. Brokers make up a small percentage of the entities regulated under the ACT Regulation, but their participation in the large entity reporting requirement is fairly unlikely based on the data at hand. Staff estimate that less than one percent of regulated entities are small businesses.

8. Health and Safety Code Section 57005 Major Regulation Alternatives

CARB estimates the ACT regulation will have an economic saving on the state's business enterprises of more than $5.9 billion between 2020 and 2040. CARB evaluated alternatives submitted by stakeholders to consider whether there are less costly alternatives or combinations of alternatives equally as effective in achieving increments of environmental protection, in full compliance with statutory mandates and within the same amount of time as the proposed regulatory requirements, as required by Health and Safety Code section 57005. Staff reviewed and consolidated alternative proposals submitted to date in Chapter IX, none of which are as equally effective within the same amount of time.

II. MODIFICATIONS MADE TO THE ORIGINAL PROPOSAL

MODIFICATIONS APPROVED AT THE BOARD HEARING AND PROVIDED FOR IN THE FIRST 30-DAY COMMENT PERIOD

Subsequent to the December 12, 2019, Board hearing, modifications to the original proposal were made at the Board's direction and to address comments received during the 45-day public comment period. CARB staff released a Notice of Public Availability of Modified Text and Availability of Additional Documents and Information (30-Day Notice)[2] on April 28, 2020, which notified the public of additional documents added into the regulatory record and presented additional modifications to the regulatory text.

The following is a summary of the changes made to the initial proposal as part of the 30-Day Notice. Staff's proposed modifications to previously proposed adoptions of new sections 1963, 1963.1, 1963.2, 1963.3, 1963.4, and 1963.5, that are to be codified into article 2, chapter 1, division 3, title 13 of the California Code of Regulations, and 2012, 2012.1, 2012.2, and 2012.3, that are to be codified into new article 3.1, chapter 1, division 3, title 13 of the California Code of Regulations, are summarized below. For further detail see Notice of Public Availability of Modified Text and Availability of Additional Documents and Information. Posted on April 28, 2020. Available online at: https://ww3.arb.ca.gov/regact/2019/act2019/30daynotice.pdf.

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[2] California Air Resources Board. Notice of Public Availability of Modified Text and Availability of Additional Documents and Information. Posted on April 28, 2020. Available online at: https://ww3.arb.ca.gov/regact/2019/act2019/30daynotice.pdf.

Staff proposed changes to increase the number of ZEVs sold by manufacturers in California and to streamline reporting requirements for large fleets as directed by the Board.

For the manufacturer ZEV sales requirement, staff proposed changes to sections 1963 through 1963.5 to strengthen ZEV sales requirements and to provide a clearer market signal on the pathway to reach carbon neutrality by 2045 in California, which is consistent with Board direction and many public comments received for the ACT rulemaking. These changes are critical to California achieving its future ZEV adoption goals and to meet both climate and health-based air quality targets.

Staff proposed increasing the percentage of ZEV sales in California across all vehicle groups from 2024 to 2030 as well as from 2030 to 2035 rather than keeping them constant during that period. Staff also proposed including pickups in the ZEV sales requirement for the Class 2b-3 vehicle group beginning with the 2024 model year, rather than excluding them until 2027. This change will increase the number of ZEVs required to be sold in the Class 2b-3 vehicle group from 2024 through 2026 and is supported by new information in recent market announcements showing that a number of zero-emission pickup and van models will be commercially available from several manufacturers well before the 2024 model year. These changes in the Class 2b-3 vehicle group are necessary to ensure strong market signals for ZEVs produced in this category. Proposed increases in the Class 7 and 8 tractor group sales percentages are necessary to ensure there are sufficient tractor sales to meet the goal of achieving an all zero-emission drayage fleet by 2035 which would directly benefit disadvantaged communities and accelerate the market for tractors. In combination, these changes would increase ZEV sales in all vehicle size categories and would provide a clear path towards achieving carbon neutrality by 2045.

Staff proposed additional flexibilities for manufacturers that produce a small number of tractors each year as well as changes to ZEV and near-zero-emission vehicle (NZEV) credit lifetimes to align credit life for manufacturers with California's Greenhouse Gas Phase 2 regulations. Staff also extended NZEV credit for an additional five years from 2030 to 2035 for NZEVs that achieve more than 75 miles of all-electric range. A number of additional changes, both substantive and non-substantive, were made to clarify definitions, better explain credit accounting and retirement order, and prevent double counting of NZEV credits with the Advanced Clean Cars regulation.

For the large entity reporting requirement, staff proposed changes to sections 2012 through 2012.3 to streamline reporting while ensuring key data are still collected to support future ZEV fleet regulations. The changes would limit the required reporting to vehicle owners and brokers. Staff proposed removing the entirety of originally proposed section 2012.2, which eliminated the requirement to report information about contracting practices, facilities, and truck trip counts. CARB will still seek to gather this information through other means, including a voluntary survey by a third-party contractor.

Staff also proposed lowering the vehicle count threshold for the reporting requirement to fleets with 50 or more trucks and buses rather than the originally proposed 100 vehicle fleet size; this will ensure representative sampling of truck usage across more fleets, which is necessary given the higher ZEV sales proposed. Staff proposed including language that specifies a period of time for entities to respond to staff requests for clarification of apparent anomalies in reported information, to the extent they occur. A number of other changes included adding clarifying definitions, removing references to the sections that were removed, clarifying that personal residence information is not part of the reporting requirement, and adding examples of methods to use with existing data when responding to questions.

These changes are necessary to meet Board direction by strengthening ZEV sales requirements consistent with vehicle availability and technological feasibility. These changes would ensure long-term market signals are in place to help achieve carbon neutrality in California by 2045. Additionally, streamlining and clarifying large entity reporting is necessary to meet Board direction and stakeholder concerns, while ensuring critical information is gathered to support future rulemakings and policy decisions.

UPDATE TO THE INITIAL STATEMENT OF REASONS

In the Initial Statement of Reasons, page 84 (IV-35), the rationale for section 2012.1 errantly referenced sections 2012(b)(12), 2012(b)(13), and 2012(b)(14), The correct sections that should be referenced are sections 2012.1(a)(12), 2012.1(a)(13), and 2012.1(a)(14).

UPDATE TO THE ECONOMIC IMPACT ASSESSMENT IN THE INITIAL STATEMENT OF REASONS

As part of the 30-Day Changes to the regulation, staff released Attachment C: Updated Cost and Benefit Analysis. This attachment reevaluated the emission benefits, climate benefits, health benefits, and economic costs and benefits for the ACT regulation due to the proposed modifications. This document also outlines changes made to the economic analysis for the 30-Day Changes.

ADDITIONAL DOCUMENTS INCORPORATED INTO THE RECORD IN THE SECOND 15-DAY COMMENT PERIOD

Subsequent to the June 25, 2019, Board hearing, additional documents were incorporated into the rulemaking record to further support the rulemaking. CARB Staff released a Second Notice of Public Availability of Documents and Information (15-Day

Notice) [3] on October 5, 2020, which notified the public of additional documents added into the regulatory record. No modifications were made to the regulatory text.

NON-SUBSTANTIAL MODIFICATIONS

Subsequent to the 30-day public comment period mentioned above, staff identified the following additional non-substantive changes to the regulation:

1. Section 1963(c)(9). "Pounds" was added after GVWR 26,001 for the definition of Class 7-8 tractor group.

2. Section 1963(d). "The" was corrected to "their" to fix a grammatical error.

3. Section 1963.2(i). Replaced "or" with "and" for consistency with the phrase "produced and delivered for sale" used throughout the regulation. The original regulation text used "produce and deliver" and the notice for the 30 day changes described the modification as using "and" but "and" was inadvertently omitted.

4. Section 1963.5(a)(1). The *Audit of Record* provision was edited to read as "A manufacturer must make records of vehicle sales into California available to the Executive Officer within 30 days of a request for audit to verify the accuracy of the reported information. Submitting false information is a violation of this regulation and violators will be subject to penalty."

5. Section 2012(b)(5). Deleted "operated in California" to remove duplicative language used earlier in the sentence.

6. Section 2012(c)(2). Deleted the second use of "that" for proper grammar.

7. Section 2012(c)(4). Deleted "or" at the end for proper grammar since subsection (c)(4) is not the second to last in the list.

8. Section 2012(c)(5). Added "; or" at the end of this subsection (and deleted the period) for proper grammar as it is the second to last subsection in the list.

9. Section 2012(d)(2). Changed "Federal Motor Carrier Safety Association" to "Federal Motor Carrier Safety Administration" to use the correct name for the federal agency. The correct title is also found in 2012.1(a)(13).

10. Section 2012(e)(1). Changed "title 17, sections 91000-91022" to "17 CCR 91000-91022" to remain consistent with other sections referencing the California Code of Regulations in the regulation text.

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[3] California Air Resources Board. Second Notice of Public Availability of Additional Documents and Information. Posted on April 28, 2020. Available online at: https://ww3.arb.ca.gov/regact/2019/act2019/15daynotice.pdf.

11. Section 2012.1(a)(15). Replaced “delivery” with “deliver” for proper grammar.

12. Section 2012.2(a)(7). Replaced “refueling infrastructure” with “fueling infrastructure” to be consistent with section 2012.2(a)(6).

13. Section 2012.2(b). “This” was added to amend a grammatical error to now read as “Additional guidance for analysis periods used to respond to questions in this section is located in 2012.2(b)(7).”

14. Section 2012.2(b)(2)(H). This provision was edited to fix grammatical errors to read as “… a vehicle that returns to the vehicle home base nightly for 9 out of 10 work days, or always stays at home base, ~~it~~ would be counted.”

III. DOCUMENTS INCORPORATED BY REFERENCE

The regulation adopted by the Executive Officer incorporates by reference the following document:

- Title 40 of the Code of Federal Regulations, entitled Protection of the Environment: 40 CFR section 86.1803-01, amended on July 1, 2011, incorporated by reference in section 1963(c)(15)(A).

This document was incorporated by reference because it would be cumbersome, unduly expensive, and otherwise impractical to publish it in the California Code of Regulations. Distribution to all recipients of the California Code of Regulations is not needed because the interested audience for this document is limited to the technical staff at a portion of reporting facilities, most of whom are already familiar with this document. Also, the incorporated document was made available by CARB upon request during the rulemaking action and will continue to be available in the future.

IV. SUMMARY OF COMMENTS AND AGENCY RESPONSE:

Written comments were received during the 45-day comment period in response to the December 12, 2019, public hearing notice, and written and oral comments were presented at the First Board Hearing. Written comments were received during the 30-day period in response to the release of the 30-Day Notice package which included the modified staff proposal, and written and oral comments were presented at the Second Board Hearing. Written comments were received during the 15-day comment period in response to the release of the 15-Day Notice. Listed below are the organizations and individuals that provided comments:

Table B: Comment Period Codes

Comment Code	Comment Period	Description
OP	45-Day	Written comments received during the 45-day comment period for the Original Proposal
B1	1st Hearing Written Testimony	Written comments submitted at 1st Board Hearing
T1	1st Hearing Oral Testimony	1st Board Hearing oral testimony comments
RP1	30-Day	Written comments received during the comment period for the 30-Day Notice
B2	2nd Hearing Written Testimony	Written comments submitted at 2nd Board Hearing
T2	2nd Hearing Oral Testimony	2nd Board Hearing oral testimony comments
RP2	15-Day	Written comments received during the comment period for the 15-Day Notice

Table C: Written Comments Received on the 45-Day Original Proposal

Comment Code	Submitter	Affiliation	Date Received
OP-01	Jimmy O'Dea	Union of Concerned Scientists	November 12, 2019
OP-02	Katherine Garcia	Sierra Club	November 12, 2019
OP-03	Jeanne Orcutt	Coastal Energy Alliance	November 12, 2019
OP-04	Katie Beskeen	Elk Grove Chamber of Commerce	November 14, 2019
OP-05	Scott Ashton	Oceanside Chamber of Commerce	November 14, 2019
OP-06	Joani Woelfel	FAR WEST EQUIPMENT DEALERS ASSOCIATION	November 18, 2019
OP-07	Ryan Kenny	Clean Energy	November 18, 2019
OP-08	Kathy Dervin, MPH	350 Bay Area Action/ 350 Bay Area Transp.	November 19, 2019
OP-09	Gene Wunderlich	Southwest California Legislative Council	November 19, 2019
OP-10	Erin Guerrero	California Attractions and Parks Association	November 19, 2019
OP-11	Ashley Remillard	Individual	November 20, 2019
OP-12	Samuel Bayless	CA Fuels and Convenience Alliance	November 21, 2019

Comment Code	Submitter	Affiliation	Date Received
OP-13	Clayton Heard	Individual	November 21, 2019
OP-14	Alicia Berhow	Orange County Business Council	November 22, 2019
OP-15	William Barrett	American Lung Association	November 22, 2019
OP-16	Stephen Soltz	Individual	November 24, 2019
OP-17	Riley Newman	Individual	November 24, 2019
OP-18	Melinda Heinemann	Individual	November 24, 2019
OP-19	Kenneth Hetge	Individual	November 25, 2019
OP-20	Constance Laningham	Individual	November 25, 2019
OP-21	Terry Spellman	Individual	November 25, 2019
OP-22	Mary Clumeck	Individual	November 25, 2019
OP-23	Keven Lenahan	Individual	November 25, 2019
OP-24	Brent Junkins	Individual	November 25, 2019
OP-25	Charles Krogh	Individual	November 25, 2019
OP-26	F. P. Skocilich	Individual	November 25, 2019
OP-27	Don Tucker	Individual	November 25, 2019

Comment Code	Submitter	Affiliation	Date Received
OP-28	Genevieve Gale	Central Valley Air Quality Coalition	November 25, 2019
OP-29	Carol Moran	Individual	November 25, 2019
OP-30	Lois Thompson Hicks	Individual	November 25, 2019
OP-31	Carolyn Westover	Individual	November 26, 2019
OP-32	Priscilla Quiroz	Solid Waste Association of North America - CA Chapter	November 26, 2019
OP-33	Paul Miller	Northeast States for Coordinated Air Use Management	November 26, 2019
OP-34	Connie Yee	Individual	November 26, 2019
OP-35	Adrian Byram	Individual	November 26, 2019
OP-36	Joshua Blumenkopf	Individual	November 27, 2019
OP-37	Patrick Swarthout	Greater Coachella Valley Chamber of Commerce	November 27, 2019
OP-38	Marcos Cruz	Individual	November 29, 2019
OP-39	Leah Silverthorn	California Chamber of Commerce	November 29, 2019
OP-40	Amanda Millstein	California Climate Health Now	November 29, 2019

Comment Code	Submitter	Affiliation	Date Received
OP-41	Thomas Hauck	IBEW 569	November 30, 2019
OP-42	Patrick Murphy	Individual	November 30, 2019
OP-43	Jim Stewart	Individual	December 1, 2019
OP-44	Veronica Pardo	California Refuse Recycling Council	December 2, 2019
OP-45	Erin Rodriguez	California Legislature	December 2, 2019
OP-46	Ray Pingle	Sierra Club	December 2, 2019
OP-47	David Page	Individual	December 2, 2019
OP-48	Micah Mitrosky	IBEW-NECA	December 3, 2019
OP-49	Michael Bullock	Individual	December 3, 2019
OP-50	Robert Graham	Strong PHEV Coalition	December 4, 2019
OP-51	Donna Boggs	California Grain & Feed Association	December 5, 2019
OP-52	Donna Boggs	California Seed Association	December 5, 2019
OP-53	Robert Harriman	High Desert Concrete Inc.	December 5, 2019
OP-54	Seren Taylor	Personal Insurance Federation of CA	December 5, 2019

Comment Code	Submitter	Affiliation	Date Received
OP-55	Janette Daniel-Whitney	Individual	December 6, 2019
OP-56	Katy Gurin	350 Humboldt	December 6, 2019
OP-57	Patricia Michaud	Individual	December 6, 2019
OP-58	Bob Shepherd	Caterpillar Dealers	December 6, 2019
OP-59	Leslie Aguayo	Greenlining Institute	December 6, 2019
OP-60	Wayne Nastri	South Coast AQMD	December 6, 2019
OP-61	Martha Helak	SMUD	December 6, 2019
OP-62	Elena Engel	350 Bay Area Action	December 6, 2019
OP-63	Kevin Maggay	SoCalGas	December 6, 2019
OP-64	Andrew Langley	County of Marin	December 6, 2019
OP-65	Bob Keller	Individual	December 6, 2019
OP-66	Marc Carrel	BREATHE California of Los Angeles County	December 6, 2019
OP-67	Rebecca Franke	Individual	December 8, 2019
OP-68	Susan Dembowski	350 Climate Action, Sunrise Inland Empire, Indivisible group/Rooted in Resistance, Indivisible Suffragists, Ban Single Use Plastics	December 8, 2019

Comment Code	Submitter	Affiliation	Date Received
OP-69	Sean Edgar	CleanFleets	December 8, 2019
OP-70	Jan Dietrick	350 Ventura County Climate Hub	December 8, 2019
OP-71	Marty Rhine	Individual	December 8, 2019
OP-72	Patricio Portillo	Natural Resource Defense Council	December 8, 2019
OP-73	Veronica Southerland	Individual	December 9, 2019
OP-74	Dawn Fenton	Volvo Group North America	December 9, 2019
OP-75	Laura Robinson	350 Riverside	December 9, 2019
OP-76	Samuel Appel	BlueGreen Alliance	December 9, 2019
OP-77	Michelle Kinman	Los Angeles Cleantech Incubator	December 9, 2019
OP-78	Christopher Lish	Individual	December 9, 2019
OP-79	Ben Granholm	Western Propane Gas Association	December 9, 2019
OP-80	Ben Granholm (Duplicate Submission)	Western Propane Gas Association	December 9, 2019
OP-81	Kathryn Lynch	CRRC Southern District	December 9, 2019

Comment Code	Submitter	Affiliation	Date Received
OP-82	Heidi Sickler	Silicon Valley Leadership Group	December 9, 2019
OP-83	Sasan Saadat	Earthjustice	December 9, 2019
OP-84	Barbara Chance	Allison Transmission Inc.	December 9, 2019
OP-85	Andrea Vidaurre, submitted for 10 individuals	Center for Community Action and Environmental Justice	December 9, 2019
OP-86	Andrea Vidaurre, submitted for 10 individuals	Center for Community Action and Environmental Justice	December 9, 2019
OP-87	Timothy Blubaugh	Truck & Engine Manufacturers Association	December 9, 2019
OP-88	Andrea Vidaurre, submitted for 10 individuals	Center for Community Action and Environmental Justice	December 9, 2019
OP-89	Andrea Vidaurre, submitted for 10 individuals	Center for Community Action and Environmental Justice	December 9, 2019
OP-90	Andrea Vidaurre, submitted for 10 individuals	Center for Community Action and Environmental Justice	December 9, 2019
OP-91	Andrea Vidaurre, submitted for 10 individuals	Center for Community Action and Environmental Justice	December 9, 2019

Comment Code	Submitter	Affiliation	Date Received
OP-92	Andrea Vidaurre, submitted for 10 individuals	Center for Community Action and Environmental Justice	December 9, 2019
OP-93	Jack Lucero Fleck	Individual	December 9, 2019
OP-94	Lauren Navarro	Environmental Defense Fund	December 9, 2019
OP-95	Irvin Dawid	Individual	December 9, 2019
OP-96	Joy Williams	Environmental Health Coalition	December 9, 2019
OP-97	Margaret McCall	Lawrence Berkeley National Laboratory	December 9, 2019
OP-98	Michael Tunnell	American Trucking Association	December 9, 2019
OP-99	Eileen Wenger Tutt	California Electric Transportation Coalition	December 9, 2019
OP-100	Nancy Skinner	California State Senator, SD-09	December 9, 2019
OP-101	Evan Edgar	California Compost Coalition	December 9, 2019
OP-102	Fariya Ali	Pacific Gas & Electric	December 9, 2019
OP-103	James Talavera	Los Angeles Department of Water & Power	December 9, 2019

Comment Code	Submitter	Affiliation	Date Received
OP-104	Jered Lindsay	Southern California Edison	December 9, 2019
OP-105	Chelsea Jenkins	ROUSH CleanTech	December 9, 2019
OP-106	Janet Whittick	California Council for Environmental and Economic Balance	December 9, 2019
OP-107	John Shears	Center for Energy Efficiency and Renewable Technologies	December 9, 2019
OP-108	Leah Silverthorn	California Chamber of Commerce	December 9, 2019
OP-109	Sarah Van Cleve	Tesla, Inc.	December 9, 2019
OP-110	Frank Harris	California Municipal Utilities Association	December 9, 2019
OP-111	Elaine Maltz	Individual	December 9, 2019
OP-112	Katie Davis	Individual	December 9, 2019
OP-113	Sandra Emerson	Fossil Free California	December 9, 2019
OP-114	Belen Gutierrez	Center for Community Action and Environmental Justice	December 9, 2019
OP-115	Leslie Aguayo	Greenlining Institute	December 9, 2019

Comment Code	Submitter	Affiliation	Date Received
OP-116	Chris Shimoda	California Trucking Association	December 9, 2019
OP-117	Andrea Vidaurre	Center for Community Action and Environmental Justice	December 9, 2019
OP-118	Howard Maltz	Individual	December 9, 2019
OP-119	Joyce Xi	Individual	December 9, 2019
OP-120	Joyce Xi	Individual	December 9, 2019
OP-121-Form	Patricia Lewis	Earthjustice	December 10, 2019
OP-121-Form-26	Richard Renouf	Earthjustice	December 10, 2019
OP-121-Form-170	Michael D'Adamo	EarthJustice	December 10, 2019
OP-121-Form-277	Bess Townsend	Earthjustice	December 10, 2019
OP-122	Laurel Beckett	Individual	December 11, 2019
OP-123-Form	Marjorie Streeter	Sierra Club	December 11, 2019
OP-123-Form-42	Stephen Parks	Sierra Club	December 11, 2019
OP-123-Form-905	Gerald Glaser	Sierra Club	December 11, 2019
OP-123-Form-1161	Bill Reinke	Sierra Club	December 11, 2019

Comment Code	Submitter	Affiliation	Date Received
OP-123-Form-1241	Tynan Wyatt	Sierra Club	December 11, 2019
OP-124-Form	Rebecca Dwan	Union of Concerned Scientists	December 11, 2019
OP-125-Form	Joel Hirsch	Electric Trucks Now	December 11, 2019
OP-126-Form	Melissa Hutchinson	Natural Resource Defense Council	December 11, 2019
OP-126-Form-4	S. Stoveken	Natural Resource Defense Council	December 11, 2019
OP-126-Form-3353	Ellen Macneale	Natural Resource Defense Council	December 11, 2019
OP-126-Form-3484	Sari Fordham	Natural Resource Defense Council	December 11, 2019

Table D: Written Comments Received at the First Board Hearing – December 12, 2019

Comment Code	Submitter	Affiliation	Date Received
B1-01	Alyssa Silhi	California Special Districts Association	December 12, 2019
B1-02	Kate Kanabay	Autocar, LLC	December 12, 2019
B1-03	Andrew Frank	Individual	December 12, 2019
B1-04	Michael Geller	Manufacturers of Emission Controls Association	December 12, 2019
B1-05	Jed Mandel	Truck & Engine Manufacturers Association	December 12, 2019
B1-06	Patricio Portillo	Natural Resources Defense Council	December 12, 2019
B1-07	Charles White	Western Independent Refiners Association	December 12, 2019
B1-08	Ken Dunham	West Coast Lumber and Building Material Association	December 12, 2019
B1-09	Jennifer Helfrich	Healthcare Systems	December 12, 2019
B1-10	Lauren Navarro	Environmental Defense Fund	December 12, 2019
B1-11	Ross Good	Fiat Chrysler Automobiles	December 12, 2019
B1-12	Thomas Lawson	CRRC, Agility, CNGVC, Clean Energy, WPGA, SoCalGas, BAC, Trillium	December 12, 2019
B1-13	Veronica Roman	Center for Community Action and Environmental Justice	December 12, 2019

Comment Code	Submitter	Affiliation	Date Received
B1-14	Ruben Aronin	California Mayors	December 12, 2019
B1-15	Joyce Xi	Climate Scientists	December 12, 2019
B1-16	Jaime Hall	General Motors	December 12, 2019

Table E: Oral Comments Received at the First Board Hearing - December 12, 2019

Comment Code	Submitter	Affiliation	Date Received
T1-01	Matt Miyasato	South Coast AQMD	December 12, 2019
T1-02	Mark Tang	Bay Area Air Quality Management District	December 12, 2019
T1-03	Mike Lewis	Construction Industry Air Quality Coalition	December 12, 2019
T1-04	David Asti	Southern California Edison	December 12, 2019
T1-05	Nico Bouwkamp	California Fuel Cell Partnership	December 12, 2019
T1-06	Frank Harris	California Municipal Utilities Association	December 12, 2019
T1-07	Kate Kanabay	Autocar, LLC	December 12, 2019
T1-08	Michael Geller	Manufacturers of Emission Controls Association	December 12, 2019
T1-09	Harris Frank	Individual	December 12, 2019
T1-10	Ray Pingle	Sierra Club	December 12, 2019
T1-11	Dawn Fenton	Volvo Group North America	December 12, 2019
T1-12	Priscilla Quiroz	Solid Waste Association of North America - CA Chapter	December 12, 2019

Comment Code	Submitter	Affiliation	Date Received
T1-13	Micah Mitrosky	IBEW 569	December 12, 2019
T1-14	Jennifer Kropke	IBEW LA	December 12, 2019
T1-15	David Yow	Port of San Diego	December 12, 2019
T1-16	Ben Granholm	Western Propane Gas Association	December 12, 2019
T1-17	Joy Williams	Environmental Health Coalition	December 12, 2019
T1-18	Patricio Portillo	Natural Resource Defense Council	December 12, 2019
T1-19	Jed Mandel	Truck & Engine Manufacturers Association	December 12, 2019
T1-20	Robert Graham	Strong PHEV Coalition	December 12, 2019
T1-21	Todd Campbell	Clean Energy	December 12, 2019
T1-22	Leah Silverthorn	California Chamber of Commerce	December 12, 2019
T1-23	Gary Conover	California Automotive Wholesalers Association	December 12, 2019
T1-24	Ken Dunham	West Coast Lumber and Building Material Association	December 12, 2019
T1-25	Chuck White	Western Independent Refiners Association	December 12, 2019

Comment Code	Submitter	Affiliation	Date Received
T1-26	Erin Guerrero	California Attractions and Parks Association	December 12, 2019
T1-27	Steve McCarthy	California Retailers Association	December 12, 2019
T1-28	Jennifer Helfrich	Ceres Business for Innovative Climate and Energy Policy	December 12, 2019
T1-29	Bernie Kotlier	IBEW-NECA	December 12, 2019
T1-30	Janet Whittick	California Council for Environmental and Economic Balance	December 12, 2019
T1-31	Consuelo Hernandez	City of Sacramento	December 12, 2019
T1-32	Sasan Saadat	Earthjustice	December 12, 2019
T1-33	Sara Greenwald	350 Bay Area Action	December 12, 2019
T1-34	Clair Brown	350 Bay Area Action	December 12, 2019
T1-35	Richard Katz	No Coal in Richmond	December 12, 2019
T1-36	Candace Kim	Moving Forward Network	December 12, 2019
T1-37	Jessica Tovar	Moving Forward Network	December 12, 2019
T1-38	Iris Verduzco	Moving Forward Network	December 12, 2019

Comment Code	Submitter	Affiliation	Date Received
T1-39	Mark Horton	Health Organizations	December 12, 2019
T1-40	William Barrett	American Lung Association	December 12, 2019
T1-41	Ryan Kenny	Clean Energy	December 12, 2019
T1-42	Jon Costantino	Tradesman Advisors Inc.	December 12, 2019
T1-43	Navarro, Lauren	Environmental Defense Fund	December 12, 2019
T1-44	Lawson, Thomas	California Natural Gas Vehicle Coalition	December 12, 2019
T1-45	Amol Phadke	Lawrence Berkeley National Laboratory	December 12, 2019
T1-46	Alex Cherin	California Trucking Association	December 12, 2019
T1-47	Noelle Cremers	California Farm Bureau Federation	December 12, 2019
T1-48	Leslie Aguayo	Greenlining Institute	December 12, 2019
T1-49	Evan Edgar	California Compost Coalition	December 12, 2019
T1-50	Carlo De La Cruz	Sierra Club	December 12, 2019
T1-51	Katherine Garcia	Sierra Club	December 12, 2019

Comment Code	Submitter	Affiliation	Date Received
T1-52	Jim O'Dea	Union of Concerned Scientists	December 12, 2019
T1-53	Olga Flores	Individual	December 12, 2019
T1-54	Lorena Rodarte	Individual	December 12, 2019
T1-55	Lilia Ulloa	Individual	December 12, 2019
T1-56	Veronica Roman	Individual	December 12, 2019
T1-57	Adu Trujillo	Individual	December 12, 2019
T1-58	Kimberly Chavez	Individual	December 12, 2019
T1-59	Miguel Rivera	Individual	December 12, 2019
T1-60	Gabriela Mendez	Center for Community Action and Environmental Justice	December 12, 2019
T1-61	Brenda Angulo	Individual	December 12, 2019
T1-62	Andrea Nidaurre	Center for Community Action and Environmental Justice	December 12, 2019
T1-63	Allen Hernandez	Center for Community Action and Environmental Justice	December 12, 2019
T1-64	Dan Sakaguchi	Communities for a Better Environment	December 12, 2019

Comment Code	Submitter	Affiliation	Date Received
T1-65	Cynthia Pinto-Cabrera	Central Valley Air Quality Coalition	December 12, 2019
T1-66	Kevin Maggay	Southern California Gas Company	December 12, 2019
T1-67	Edith Cerbreros	Communities for a New California	December 12, 2019
T1-68	Anna Lisa Vargas	Communities for a New California	December 12, 2019
T1-69	Adam Harper	California Construction and Industrial Materials Association	December 12, 2019
T1-70	Mike Tunnell	American Trucking Association	December 12, 2019
T1-71	Brittany Blanco	Comite Civico del Valle	December 12, 2019
T1-72	Isumay Sandoval	Comite Civico del Valle	December 12, 2019
T1-73	Miguel Hernandez	Comite Civico del Valle	December 12, 2019
T1-74	Sergio Valenzuela	Comite Civico del Valle	December 12, 2019
T1-75	Luis Olmedo	Comite Civico del Valle	December 12, 2019
T1-76	Joyce Xi	Union of Concerned Scientists	December 12, 2019
T1-77	Chris Shimoda	California Trucking Association	December 12, 2019

Comment Code	Submitter	Affiliation	Date Received
T1-78	Paul Cort	Earthjustice	December 12, 2019
T1-79	Meredith Alexander	CALSTART	December 12, 2019
T1-80	Sean Edgar	CleanFleets	December 12, 2019
T1-81	Eileen Tutt	California Electric Transportation Coalition	December 12, 2019
T1-82	Shayda Azamian	Leadership Counsel for Justice and Accountability	December 12, 2019
T1-83	Elodia Perez	Individual	December 12, 2019
T1-84	Julia Jordan	Leadership Counsel for Justice and Accountability	December 12, 2019
T1-85	Bill Magavern	Coalition for Clean Air	December 12, 2019
T1-86	Roxana Bekemohammadi	Ballard Power Systems	December 12, 2019
T1-87	Samuel Appel	BlueGreen Alliance	December 12, 2019
T1-88	Kathy Hoang	Partnership for Working Families	December 12, 2019
T1-89	Anthony Vallecillo	Warehouse Workers Resource Center	December 12, 2019
T1-90	Adam Diaz	Warehouse Workers Resource Center	December 12, 2019

Comment Code	Submitter	Affiliation	Date Received
T1-91	Kimberly Garcia	CAUSE Youth Committee	December 12, 2019
T1-92	Citalli Pacheco	CAUSE Youth Committee	December 12, 2019
T1-93	Evan Ochoa	CAUSE Youth Committee	December 12, 2019
T1-94	Yesenia Ponce	CAUSE Youth Committee	December 12, 2019
T1-95	Cristel Gonzalez	CAUSE Youth Committee	December 12, 2019
T1-96	Yesenia Gonzalez	CAUSE Youth Committee	December 12, 2019
T1-97	Ocil Herrejon	CAUSE Youth Committee	December 12, 2019
T1-98	Ruben Aronin	Better World Group Advisors	December 12, 2019
T1-99	Kirstin Kolpitcke	Calforests	December 12, 2019

Table F: Written Comments Received on the 30-Day Proposal

Comment Code	Submitter	Affiliation	Date Received
RP1-01	Lena Holtz	Individual	April 28, 2020
RP1-02	Drayton Tucker	Individual	April 28, 2020
RP1-03	Daniel Baldassare	Individual	April 29, 2020
RP1-04	Jon Wizard	Councilmember, City of Seaside	April 29, 2020
RP1-05	Allen Genetti	California Tank Lines Inc. and Chemical Transfer Co.	May 1, 2020
RP1-06	Claire Bleymaier	Individual	May 4, 2020
RP1-07	Richard Battersby	East Bay Clean Cities Coalition	May 5, 2020
RP1-08	Clean Air	Individual	May 6, 2020
RP1-09	Larry Wolf	Individual	May 6, 2020
RP1-10	Mihail Karamanolev	Individual	May 6, 2020
RP1-11	Kyle Berquist	Individual	May 6, 2020
RP1-12	Randy Bremer	Individual	May 6, 2020
RP1-13-Form	John Pasqua	Individual	May 8, 2020
RP1-13-Form-60	Kathy Kelly	Individual	May 8, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-13-Form-170	Sue Fox	Individual	May 8, 2020
RP1-13-Form-399	Scott Workinger	Individual	May 8, 2020
RP1-13-Form-992	Jane Stock	Individual	May 8, 2020
RP1-13-Form-1296	Michael Paul	Individual	May 8, 2020
RP1-13-Form-1746	Timothy Enloe	Individual	May 8, 2020
RP1-13-Form-2216	Michael Anderson	Individual	May 8, 2020
RP1-13-Form-2528	Paul Muns	Individual	May 8, 2020
RP1-13-Form-2583	Jennifer Nunn	Individual	May 8, 2020
RP1-13-Form-2590	M. Lesinski	Individual	May 8, 2020
RP1-13-Form-2635	Kathy OBrien	Individual	May 8, 2020
RP1-13-Form-2837	Schuyler Morgan	Individual	May 8, 2020
RP1-13-Form-3275	Josseline Diaz	Individual	May 8, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-13-Form-3346	Roger Boyer	Individual	May 8, 2020
RP1-13-Form-3374	Kate Skelly	Individual	May 8, 2020
RP1-14	Erin Rodriguez	California Legislature	May 8, 2020
RP1-15	Kenneth Wertz	Individual	May 8, 2020
RP1-16	Don White	IAASP of California	May 10, 2020
RP1-17	Don White	IAASP of California	May 10, 2020
RP1-18	Art Lewellan	Individual	May 11, 2020
RP1-19	Savannah Jimenez	Individual	May 12, 2020
RP1-20	Dan Jacobson	Environment California	May 13, 2020
RP1-21	Ms. Ann Bermingham	Individual	May 13, 2020
RP1-22	Ray Pingle	Sierra Club California	May 13, 2020
RP1-23	Sophie Castleton	Individual	May 13, 2020
RP1-24	Rory Stewart	LABC	May 13, 2020
RP1-25	Gary Nye	Individual	May 13, 2020
RP1-26	Elizabeth Hernandez	Individual	May 14, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-27	David Pedersen	Individual	May 14, 2020
RP1-28	Thomas Becker	Individual	May 16, 2020
RP1-29	Elizabeth Mittermiller	San Diego 350	May 16, 2020
RP1-30	Gretchen Newsom	IBEW Local 569	May 18, 2020
RP1-31	Chris Benz	Napa Climate NOW!	May 20, 2020
RP1-32	Urvi Nagrani	Viatec Inc.	May 21, 2020
RP1-33	Lisa Chang	Medical Society Consortium on Climate and Health	May 22, 2020
RP1-34	Staci Heaton	Rural County Representatives of CA	May 22, 2020
RP1-35	Hugh Ross	350 Bay Area Action	May 22, 2020
RP1-36	John Snell	Individual	May 22, 2020
RP1-37	David Jaber	Individual	May 22, 2020
RP1-38	Sue Lee Mossman	Individual	May 24, 2020
RP1-39	Daniel Chandler	Individual	May 24, 2020
RP1-40	Patrick Carr	Individual	May 24, 2020
RP1-41	Deborah Dukes	Individual	May 24, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-42	Brittany Caplin	Proterra	May 25, 2020
RP1-43	Linette Davis	Individual	May 25, 2020
RP1-44	David Renschler	MEMA NorCal	May 26, 2020
RP1-45	Mark Grossman	350 Silicon Valley	May 26, 2020
RP1-46	Zach Amittay	E2	May 26, 2020
RP1-47	Thomas Malzbender	Cultural Heritage Imaging	May 26, 2020
RP1-48	Gary Gero	County of Los Angeles Chief Executive Office-Chief Sustainability Office	May 26, 2020
RP1-49	Steve Schmidt	Carbon Free Silicon Valley	May 26, 2020
RP1-50	Patricia Kinney	Individual	May 26, 2020
RP1-51	Terry Nagel	Sustainable San Mateo County	May 26, 2020
RP1-52	Sandra Slater	Individual	May 26, 2020
RP1-53	Paul Miller	NESCAUM	May 26, 2020
RP1-54	Timothy Menard	SinWaves Inc.	May 26, 2020
RP1-55	Leticia Gonzalez	Individual	May 26, 2020
RP1-56	Joyce Pfenning	Individual	May 26, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-57	Samuel Appel	BlueGreen Alliance	May 26, 2020
RP1-58	Ray Pingle	Sierra Club California	May 26, 2020
RP1-59	Ted Rees	Project Green Home	May 26, 2020
RP1-60	Margaret Brosnan	Individual	May 26, 2020
RP1-61	Jeralyn Moran	Individual	May 26, 2020
RP1-62	Leane Eberhart	Project Green Home	May 26, 2020
RP1-63	Stuart Bernstein	Sustainable Capital, LLC	May 26, 2020
RP1-64	Chelsea Sexton	SPHEV	May 26, 2020
RP1-65	Fran Salisbury	Individual	May 26, 2020
RP1-66	Andrew McKercher	IBEW Member	May 26, 2020
RP1-67	Paula Fogarty	Individual	May 26, 2020
RP1-68	Linda Zagula	Individual	May 26, 2020
RP1-69	Ms. Pauline Seales	Individual	May 27, 2020
RP1-70	Karen Harrington	Climate Reality Project, 350 Bay Area	May 27, 2020
RP1-71	David Fork	Individual	May 27, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-72	Hilary Young	Etsy, Inc.	May 27, 2020
RP1-73	Daniel Yost	Former Mayor and Current Councilmember of Woodside, CA	May 27, 2020
RP1-74	Sasan Saadat	Earthjustice and Sierra Club	May 27, 2020
RP1-75	Geoffrey Smith	Individual	May 27, 2020
RP1-76	Thomas Patterson	Individual	May 27, 2020
RP1-77	Tina Chow	Individual	May 27, 2020
RP1-78	Catherine Cameron	Individual	May 27, 2020
RP1-79	Deborah Levoy	Individual	May 27, 2020
RP1-80	Glenn Choe	Toyota Motor North America	May 27, 2020
RP1-81	Wahila Wilkie	Stanford University	May 27, 2020
RP1-82	Susan Cavalieri	Individual	May 27, 2020
RP1-83	Sarah Sachs	Investors with Over $239 Billion in Assets Under Management and Advisement	May 27, 2020
RP1-84	George Licina	Individual	May 27, 2020
RP1-85	Shelby Neal	NBB and CABA	May 27, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-86	Gary Yowell	Automotive Engineer	May 27, 2020
RP1-87	Carol Ruth	Individual	May 27, 2020
RP1-88	Matt Smith	Individual	May 27, 2020
RP1-89	Gary Latshaw	Air Quality Chair of Sierra Club	May 27, 2020
RP1-90	Jeanie Bunker	Individual	May 27, 2020
RP1-91	Anne Gergory	Individual	May 27, 2020
RP1-92	Michael Roberts	Individual	May 27, 2020
RP1-93	Ellen Koivisto	Individual	May 27, 2020
RP1-94	Ms. Marilyn Zack	Individual	May 27, 2020
RP1-95	Noah Haydon	Individual	May 27, 2020
RP1-96	Frances Aubrey	Inside Tennis	May 27, 2020
RP1-97	Steven Zornetzer	Individual	May 27, 2020
RP1-98	Erin Chalmers	Individual	May 27, 2020
RP1-99	Terry Barton	Individual	May 27, 2020
RP1-100	Andrea Davis	Individual	May 27, 2020
RP1-101	Thomas Carlino	Individual	May 27, 2020
RP1-102	Joan Herbert	Individual	May 27, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-103	Thalia Lubin	Individual	May 27, 2020
RP1-104	Pradeep Rao	Individual	May 27, 2020
RP1-105	Jackie Barshak	350.org Silicon Valley, XR Silicon Valley	May 27, 2020
RP1-106	Gavin Gretter	Trillium	May 27, 2020
RP1-107	Bruce Naegel	Sustainable Silicon Valley	May 27, 2020
RP1-108	Joyce Jeckell	Individual	May 27, 2020
RP1-109	Leah Redwood	Individual	May 27, 2020
RP1-110	Gail Sredanovic	Individual	May 27, 2020
RP1-111	Mrs. Donna Davies	Individual	May 27, 2020
RP1-112	Selden Prentice	PSE	May 27, 2020
RP1-113	Nancy Arbuckle	Individual	May 27, 2020
RP1-114	David Bezanson	Physicians for Social Responsibility	May 27, 2020
RP1-115	John Reister	Individual	May 27, 2020
RP1-116	Nicole Kemeny	350 Silicon Valley	May 27, 2020
RP1-117	John Galebach	Individual	May 27, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-118	Lucas Filshill	Individual	May 27, 2020
RP1-119	Peggy Schmidt	Individual	May 27, 2020
RP1-120	Will Barrett	American Lung Association	May 27, 2020
RP1-121	Sue Tomasic	Individual	May 27, 2020
RP1-122	Brian Haberly	Individual	May 27, 2020
RP1-123	Ms. Stephanie Reader	Individual	May 27, 2020
RP1-124	Katherine Black	Benicians for a Safe and Healthy Community	May 27, 2020
RP1-125	Mary Ann Furda	Indivisible Berkeley Science & Environment Team	May 27, 2020
RP1-126	Kevin Ma	Individual	May 27, 2020
RP1-127	Marilyn Sargent	Individual	May 27, 2020
RP1-128	Elaine Maltz	San Diego 350	May 27, 2020
RP1-129	Michael Fukuyama	Bay Area 350	May 27, 2020
RP1-130	Mrs. Jane Jensen	Individual	May 27, 2020
RP1-131	Maryl Olivera	Individual	May 27, 2020
RP1-132	Pamela Brigg	Individual	May 27, 2020
RP1-133	Diana and Brian Moss	Individual	May 27, 2020
RP1-134	Jack Litewka	Individual	May 27, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-135	Rani Fischer	Individual	May 27, 2020
RP1-136	Gabriella Nightingale	Individual	May 27, 2020
RP1-137	Karen Boyd and Turner Boyd	Individual	May 27, 2020
RP1-138	Jessica Woodard	Individual	May 27, 2020
RP1-139	Christopher Lish	Individual	May 27, 2020
RP1-140	Nate Baguio	The Lion Electric Co.	May 27, 2020
RP1-141	Virginia Van Kuran	Individual	May 27, 2020
RP1-142	Noah Haydon	Individual	May 27, 2020
RP1-143	Danielle Lemaitre	Individual	May 27, 2020
RP1-144	Sarah Jumper	HEALNSD	May 27, 2020
RP1-145	J. Barazi	Zero-Emission Partners	May 27, 2020
RP1-146	Annapurna Holtzapple	Individual	May 27, 2020
RP1-147	Doug Brown	Individual	May 27, 2020
RP1-148	Amol Phadke	Lawrence Berkeley National Lab	May 27, 2020
RP1-149	Stacy Brobst	Individual	May 27, 2020
RP1-150	Mr. Roland Saher	Individual	May 27, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-151	Marios Leventopoulos	Individual	May 27, 2020
RP1-152	Savannah McLaughlin	Individual	May 27, 2020
RP1-153	J. Burchinal	Individual	May 27, 2020
RP1-154	Daniel Winger	Individual	May 27, 2020
RP1-155	Allan Campbell	Individual	May 27, 2020
RP1-156	Carol Mone	Individual	May 28, 2020
RP1-157	Charles Davidson	Rodeo Citizens Association	May 28, 2020
RP1-158	Elizabeth Garcia	Ecologist	May 28, 2020
RP1-159	Sheila Carillo	Individual	May 28, 2020
RP1-160	Pam N.	Individual	May 28, 2020
RP1-161	Peter Gang	Individual	May 28, 2020
RP1-162	Wendy Buffett	Individual	May 28, 2020
RP1-163	Paul Beeson	Individual	May 28, 2020
RP1-164	Alexa Forrester	Individual	May 28, 2020
RP1-165	Kimberly Butt	Individual	May 28, 2020
RP1-166	Sandy Emerson	Individual	May 28, 2020
RP1-167	Hoai-An Truong	Mothers Out Front South Bay	May 28, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-168	Anne Marie Tipton	Individual	May 28, 2020
RP1-169	Steven Brink	California Forestry Association	May 28, 2020
RP1-170	Kevin Conway	Individual	May 28, 2020
RP1-171	Robert Roark	BAMTECH	May 28, 2020
RP1-172	James Talavera	LADWP	May 28, 2020
RP1-173	Elaine Salinger	CCL	May 28, 2020
RP1-174	Ms. Sheila Thorne	Individual	May 28, 2020
RP1-175	Piper McNulty	SV-CAN!, APALI	May 28, 2020
RP1-176	Michael Weinhauer	Individual	May 28, 2020
RP1-177	Susan Kistin	Individual	May 28, 2020
RP1-178	Marialena Malejan-Roussere	Individual	May 28, 2020
RP1-179	Susan Harman	Individual	May 28, 2020
RP1-180	Patricia Blevins	Individual	May 28, 2020
RP1-181	Chandra Johannesson	East Bay Municipal Utility District	May 28, 2020
RP1-182	Ralph Dennis	Progressive Democrats of Benicia	May 28, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-183	Eric Knapp	Individual	May 28, 2020
RP1-184	Cheryl Westmont	Individual	May 28, 2020
RP1-185	Emily Hopkins	350	May 28, 2020
RP1-186	Ellyn Dooley	Individual	May 28, 2020
RP1-187	Rakesh Koneru	Hummingbird EV	May 28, 2020
RP1-188	Patricio Portillo	Natural Resources Defense Council	May 28, 2020
RP1-189	Yayla Sezginer	Biological Oceanographer	May 28, 2020
RP1-190	Kira Barsten	Individual	May 28, 2020
RP1-191	Cody Taylor	Garrett Advancing Motion	May 28, 2020
RP1-192	Yasmine Agelidis	LA County Electric Truck and Bus Coalition	May 28, 2020
RP1-193	Greg Martin	Ford Motor Company	May 28, 2020
RP1-194	Ashley Remillard	Agility Fuel Solutions	May 28, 2020
RP1-195	Barbara Kiss	General Motors	May 28, 2020
RP1-196	Steven Brink, Duplicate Submission of RP1-169	California Forestry Association	May 28, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-197	Kathryn Ostapuk	Department of Defense	May 28, 2020
RP1-198	Bart Beeman	Individual	May 28, 2020
RP1-199	Kenneth Russell	Individual	May 28, 2020
RP1-200	Marianna Grossman	Mountain View Resident and Business Owner	May 28, 2020
RP1-201	David Warrender	Euphonics	May 28, 2020
RP1-202	Noelle Mattock	City of Roseville	May 28, 2020
RP1-203	Sasan Saadat, Duplicate Submission of RP1-74	Earthjustice	May 28, 2020
RP1-204	Louise Herschelle	Individual	May 28, 2020
RP1-205	Laurie Holmes	Motor and Equipment Manufacturers Association	May 28, 2020
RP1-206	Suzanne Seivright-Sutherland	CalCIMA	May 28, 2020
RP1-207	D. Page	350 Silicon-Valley Telework Team	May 28, 2020
RP1-208	Chris Nevers	Rivian	May 28, 2020
RP1-209	Anika K.	Individual	May 28, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-210	Michael Lewis	Construction Industry Air Quality Coalition	May 28, 2020
RP1-211	Ann Rothschild	Individual	May 28, 2020
RP1-212	John Cordes	Sierra Club	May 28, 2020
RP1-213-Form	Katherine Garcia	Sierra Club California	May 28, 2020
RP1-213-Form-01	Frances Lux	Individual	May 28, 2020
RP1-213-Form-02	Steve Sketo	Individual	May 28, 2020
RP1-213-Form-03	Lawrence Fox	Individual	May 28, 2020
RP1-213-Form-04	Marcus Chee	Individual	May 28, 2020
RP1-213-Form-05	Mike Sisson	Individual	May 28, 2020
RP1-213-Form-07	Grace Fenton	Individual	May 28, 2020
RP1-213-Form-09	Noah and Elena Armstrong	Individual	May 28, 2020
RP1-213-Form-13	Diane Dynes	Individual	May 28, 2020
RP1-213-Form-15	Jean Szpakowski	Individual	May 28, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-213-Form-18	Kate Williams	Individual	May 28, 2020
RP1-213-Form-24	Bruce Wilson	Individual	May 28, 2020
RP1-213-Form-30	Jim Landholm	Individual	May 28, 2020
RP1-213-Form-41	Daniel Donovan	Individual	May 28, 2020
RP1-213-Form-66	Debbie Cazares	Individual	May 28, 2020
RP1-213-Form-347	Carol Scher	Individual	May 28, 2020
RP1-213-Form-435	John Sargent	Individual	May 28, 2020
RP1-213-Form-478	Tom and Darlene McCalmont	Individual	May 28, 2020
RP1-213-Form-503	Ben Trefry	Individual	May 28, 2020
RP1-213-Form-521	Amy Seliger	Individual	May 28, 2020
RP1-213-Form-556	Brook Porter	Individual	May 28, 2020
RP1-213-Form-624	Carol Herrera	Individual	May 28, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-213-Form-631	Cristal Aguilar	Individual	May 28, 2020
RP1-213-Form-813	Peter Stricker	Individual	May 28, 2020
RP1-213-Form-814	Jason Bunker	Individual	May 28, 2020
RP1-213-Form-875	Joy Sigmon	Individual	May 28, 2020
RP1-213-Form-876	Jeff and Jackie Mann	Individual	May 28, 2020
RP1-213-Form-877	Jim Davis	Individual	May 28, 2020
RP1-213-Form-952	Mary Anne Penton	Individual	May 28, 2020
RP1-213-Form-1098	Jennifer Russell	Individual	May 28, 2020
RP1-214	Dawn Fenton	Volvo Group North America	May 28, 2020
RP1-215	Janet Whittick	CCEEB	May 28, 2020
RP1-216	Kevin Maggay	SoCalGas	May 28, 2020
RP1-217	Michael Hazelton	Individual	May 28, 2020
RP1-218	Timothy Blubaugh	Truck & Engine Manufacturers Association	May 28, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-219	Chris Busch	Energy Innovation	May 28, 2020
RP1-220	Evan Carlson	Individual	May 28, 2020
RP1-221	Christine Ashley	Individual	May 28, 2020
RP1-222	Sarah Sachs	Ceres	May 28, 2020
RP1-223	Ben Schwartz	Clean Coalition	May 28, 2020
RP1-224	Harriete Berman	Individual	May 28, 2020
RP1-225	Leslie Peterson	Individual	May 28, 2020
RP1-226	Debby Belansky	UUCSR	May 28, 2020
RP1-227	Karen Jacques	Individual	May 28, 2020
RP1-228	Thomas Lawson	CNGVC & Others	May 28, 2020
RP1-229	Alison Biggs	Individual	May 28, 2020
RP1-230	Roxana Ramirez	Metropolitan Water District	May 28, 2020
RP1-231	Leela Rao	San Pedro Bay Ports Clean Air Action Plan	May 28, 2020
RP1-232	Michael Kiely	UPS	May 28, 2020
RP1-233	Veronica Pardo	Resource Recovery Coalition of CA	May 28, 2020
RP1-234	Junaid Faruq	SRECTrade	May 28, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-235	Andy Schwartz	Tesla	May 28, 2020
RP1-236	Joshua Regalado	Community Center for Environmental Justice	May 28, 2020
RP1-237	Roxana Ramirez	Metropolitan Water District of Southern California	May 28, 2020
RP1-238	Leah Silverthorn	California Chamber of Commerce	May 28, 2020
RP1-239	Roxana Ramirez, Duplicate Submission of RP1-237	Metropolitan Water District of Southern California	May 28, 2020
RP1-240	Jack Symington	Los Angeles Cleantech Incubator	May 28, 2020
RP1-241	Kristain Corby	CalETC	May 28, 2020
RP1-242	Debbie Mytels	Peninsula Interfaith Climate Action	May 28, 2020
RP1-243	Lauren Navarro	Environmental Defense Fund	May 28, 2020
RP1-244	Nate Springer	Gladstein, Neandross, and Associates	May 28, 2020
RP1-245	Sierra Barsten	Individual	May 28, 2020
RP1-246	Helen Fitzmaurice	UAW 2865	May 28, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-247	Taylor Collison	California Trucking Association	May 28, 2020
RP1-248	Martha Turner	Individual	May 28, 2020
RP1-249	Roger Hallsten	Individual	May 28, 2020
RP1-250	Jamie Minden	Silicon Valley Youth Climate Strikes, Sunrise Silicon Valley	May 28, 2020
RP1-251	Cor Van de Water	Project Green Home	May 28, 2020
RP1-252	Eric Knapp	Individual	May 28, 2020
RP1-253	Carolyn	Individual	May 28, 2020
RP1-254	Michelle Orrock	BP America	May 28, 2020
RP1-255	Chandra Johannesson	EBMUD	May 28, 2020
RP1-256	Kelly Jones	Individual	May 28, 2020
RP1-257	Nanette Diaz	Congress of the United States House of Representatives	May 28, 2020
RP1-258	David Rosenstein and Tori Nourafchan	Individual	May 28, 2020
RP1-259	Vazken Kassakhian	Southern California Edison	May 28, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-260-Form	Aguilar Josue	NRDC	May 28, 2020
RP1-260-Form-300	Lynn Goleta	Individual	May 28, 2020
RP1-260-Form-458	Dennis Bicker	Individual	May 28, 2020
RP1-260-Form-917	Chuck L.	Individual	May 28, 2020
RP1-260-Form-1068	Normand Cloutier	Individual	May 28, 2020
RP1-260-Form-1148	Tracy Talley	Individual	May 28, 2020
RP1-260-Form-1512	Robert Burlin	Individual	May 28, 2020
RP1-260-Form-1556	Frances Hinckley	Individual	May 28, 2020
RP1-260-Form-1581	Melissa Hay	Individual	May 28, 2020
RP1-260-Form-1559	John Wills	Individual	May 28, 2020
RP1-260-Form-1707	Juanita Mangan VanHam	Individual	May 28, 2020
RP1-260-Form-1739	Carole Grace	Individual	May 28, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-260-Form-1812	Karen Mathes	Individual	May 28, 2020
RP1-260-Form-1914	Phil Chandler	Individual	May 28, 2020
RP1-260-Form-2000	Jim Keltner	Individual	May 28, 2020
RP1-260-Form-2015	Sheri Cavanaugh	Individual	May 28, 2020
RP1-260-Form-2024	Daren Black	Individual	May 28, 2020
RP1-260-Form-2088	LaVive Kiely	Individual	May 28, 2020
RP1-260-Form-2129	Jill Precheur	Individual	May 28, 2020
RP1-260-Form-2197	Org and Anke Raue	Individual	May 28, 2020
RP1-260-Form-2387	Brent Larsen	Individual	May 28, 2020
RP1-260-Form-2507	Laurel Bergman	Individual	May 28, 2020
RP1-260-Form-2531	Shirley Feriks	Individual	May 28, 2020
RP1-260-Form-2778	Jim Alexander	Individual	May 28, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-260-Form-3085	Karin Uphoff	Individual	May 28, 2020
RP1-260-Form-3120	Cle Betu	Individual	May 28, 2020
RP1-260-Form-3427	Melody O'Neill	Individual	May 28, 2020
RP1-260-Form-3526	Cheryl Porter	Individual	May 28, 2020
RP1-260-Form-3583	David Sacerdote	Individual	May 28, 2020
RP1-260-Form-3718	Martin Iseri	Individual	May 28, 2020
RP1-260-Form-3838	Jennifer Kreger	Individual	May 28, 2020
RP1-260-Form-3944	Scottie Hielleaio	Individual	May 28, 2020
RP1-260-Form-4164	Peter Warren	Individual	May 28, 2020
RP1-260-Form-4701	Susan Bradfield	Individual	May 28, 2020
RP1-260-Form-5418	Georgette Cora	Individual	May 28, 2020
RP1-261	Karla Briseno	Individual	May 28, 2020
RP1-262	Peri Plantenberg	Individual	May 28, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-263	Katia Bravo	Individual	May 28, 2020
RP1-264	Michael Nagler	Metta Center for Nonviolence	May 28, 2020
RP1-265	Meredith Alexander	CALSTART	May 28, 2020
RP1-266	Amol Phadke	LBNL	May 28, 2020
RP1-267	Maia L.	Individual	May 28, 2020
RP1-268	Emma Grant-Bier	Individual	May 28, 2020
RP1-269	Gladwyn D'Souza	Individual	May 28, 2020
RP1-270	Marie Judson	Individual	May 28, 2020
RP1-271	Steve White	Individual	May 28, 2020
RP1-272	Tiffany Roberts	WSPA	May 28, 2020
RP1-273	Thai Nguyen	Caltrans	May 28, 2020
RP1-274	Deborah Garvey	Economist	May 28, 2020
RP1-275	Sven Thesen	Project Green Home	May 28, 2020
RP1-276	Mallory Mitton	Individual	May 28, 2020
RP1-277	Laurie-Ann Barbour	Project Green Home	May 28, 2020
RP1-278	Carola Barton	Individual	May 28, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-279	Janelle London	Coltura	May 28, 2020
RP1-280	Sarah Sachs, Duplicate Submission of RP1-222	California Health Care Climate Alliance	May 28, 2020
RP1-281	Jaron Weston	San Diego Gas and Electric	May 28, 2020
RP1-282	Jennifer Steck	Individual	May 28, 2020
RP1-283	Tim Sullivan, Eric Garcetti	Los Angeles Mayor	May 28, 2020
RP1-284	Michael Geller, Rasto Brezny	MECA	May 28, 2020
RP1-285	Jack Symington, Matt Peterson	Los Angeles Cleantech Incubator	May 28, 2020
RP1-286	Veronica Roman	Individual	May 28, 2020
RP1-287	Susan Larsen, Katherine Hoff	Center for Biological Diversity	May 28, 2020
RP1-288	Alison Torres, Alfred Javier	Eastern Municipal Water District	May 28, 2020
RP1-289	Brenda Huerta	Individual	May 28, 2020
RP1-290	Joann Ames	Individual	May 28, 2020
RP1-291	John Mulhern	Individual	May 28, 2020
RP1-292	Erica Stanojevic	Individual	May 28, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-293	Eileen Bill	Individual	May 28, 2020
RP1-294	Jimmy O’Dea	Union of Concerned Scientists	May 28, 2020
RP1-295	Serena Zhao	350 Silicon Valley	May 28, 2020
RP1-296	Sybil Cramer	EAASV	May 28, 2020
RP1-297	Andrea Vidaurre	CCAEJ	May 28, 2020
RP1-298	Belen Gutierrez	Individual	May 28, 2020
RP1-299	Carmen Lua	Individual	May 28, 2020
RP1-300	William Benson	Individual	May 28, 2020
RP1-301	Christine Welter	Individual	May 28, 2020
RP1-302	Frank Harris	California Municipal Utilities Association	May 28, 2020
RP1-303	Vazken Kassakhian, Duplicate Submission of RP1-259	Southern California Edison	May 28, 2020
RP1-304	Carol Kiparsky and Ian Irwin	Individual	May 28, 2020
RP1-305	Nathan Chan	Urban Environmentalists	May 28, 2020
RP1-306	Joyce Xi	Union of Concerned Scientists	May 28, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-307	Amol Phadke, Duplicate Submission of RP1-148	LBNL	May 28, 2020
RP1-308	Joyce Xi	Union of Concerned Scientists	May 28, 2020
RP1-309	Sophie Babka	Individual	May 28, 2020
RP1-310	Liset Flores	Individual	May 28, 2020
RP1-311	Kenneth Higa	Individual	May 28, 2020
RP1-312	Noelle Mattock, John B. Allard II	City of Roseville	May 28, 2020
RP1-313	Susan Larsen	Center for Biological Diversity	June 3, 2020
RP1-314	Gabriela Mendez	Individual	June 5, 2020
RP1-315	Elby Chali	Individual	June 5, 2020
RP1-316	Katherine Palomares	Individual	June 5, 2020
RP1-317	Elena Reyes Martinez	University of California, Riverside	June 5, 2020
RP1-318	Kristin Penner	Individual	June 5, 2020
RP1-319	Sally Ahnger	Individual	June 5, 2020
RP1-320	Alex Oseguera	Waste Management	June 5, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-321	Justine Burt	UUCPA	June 5, 2020
RP1-322	Stephen Rosenblum	Individual	June 5, 2020
RP1-323	Judy Young	Individual	June 5, 2020
RP1-324	Michael Fukuyama	350 Bay Area Action	June 5, 2020
RP1-325	Molly Cox	Individual	June 5, 2020
RP1-326	Will Toor	Colorado Energy Office	June 5, 2020
RP1-327	Sophia Wang	Individual	June 5, 2020
RP1-328	Jeb Eddy	Individual	June 5, 2020
RP1-329	Alison Hicks	Mountain View City Council	June 5, 2020
RP1-330	Lucia Marquez	CAUSE	June 5, 2020
RP1-331	Barbara Fukumoto	Individual	June 5, 2020
RP1-332	Bruce Naegel	Individual	June 5, 2020
RP1-333	Mike Balma	Individual	June 5, 2020
RP1-334	Alexa Forrester	Individual	June 5, 2020
RP1-335	Constance Roberts	Individual	June 5, 2020
RP1-336	Mary Dateo	Individual	June 5, 2020

Comment Code	Submitter	Affiliation	Date Received
RP1-337	Debbie Mytels	Peninsula Interfaith Climate Action Organization	June 5, 2020
RP1-338	Susan Dunlap	Project Green Home	June 5, 2020
RP1-339	Suzanne Lande	Individual	June 5, 2020
RP1-340	Gerald Gras	Individual	June 5, 2020
RP1-341	Pradeep Rao	Individual	June 5, 2020
RP1-342	Kurt Kelty	Project Green Home	June 23, 2020

Table G: Written Comments Received at the Second Board Hearing - June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
B2-01	Neyda Gonzalez	Individual	June 25, 2020
B2-02	Erik Casillas	Individual	June 25, 2020
B2-03	Pamela Amaya	Individual	June 25, 2020
B2-04	Sarah Sachs	Ceres	June 25, 2020
B2-05	Sarah Sachs	Ceres	June 25, 2020
B2-06	Derrick Robinson and Joy Williams	Center on Policy Initiatives, Environmental Health Coalition	June 25, 2020
B2-07	Alejandro Amador	Casa Familiar	June 25, 2020
B2-08	Dawn Fenton	Volvo Group North America	June 25, 2020
B2-09	Jane Franch	Numi Organic Tea	June 25, 2020
B2-10	Raj Dhillon	BREATHE California of Los Angeles County	June 25, 2020
B2-11	Jed Mandel	EMA	June 25, 2020
B2-12	Ruby MacDonald	Individual	June 25, 2020
B2-13	Jessica Geiger	Individual	June 25, 2020
B2-14	Jessica Craven	LACDP	June 25, 2020
B2-15	Misha Askren, MD	Sierra Club	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
B2-16	Chris Gilbert	Individual	June 25, 2020
B2-17	Whitney Amaya	Individual	June 25, 2020
B2-18	Stephanie Morris	Mothers Out Front	June 25, 2020
B2-19	Sarah Sachs, Duplicate Submission of B2-04	Ceres	June 25, 2020
B2-20	Jason Spokes	NELA Climate Collective	June 25, 2020
B2-21	Bridget Cole	LAForward	June 25, 2020
B2-22	Erin Pierce	Individual	June 25, 2020
B2-23-Form	Megan Friend	NRDC	June 25, 2020
B2-23-Form-115	David Patterson	Individual	June 25, 2020
B2-23-Form-190	Georgette Cora	Individual	June 25, 2020
B2-23-Form-971	Susan Bradfield	Individual	June 25, 2020
B2-23-Form-1008	Christian Blackburn	Individual	June 25, 2020
B2-23-Form-1162	Jim Stewart	Individual	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
B2-23-Form-1291	Richard Star	Individual	June 25, 2020
B2-23-Form-1404	Lynne Latham	Individual	June 25, 2020
B2-23-Form-1467	Dennis Uhlken	Individual	June 25, 2020
B2-23-Form-1503	Peter Warren	Individual	June 25, 2020
B2-23-Form-1725	Scottie Hilleioa	Individual	June 25, 2020
B2-23-Form-1950	Martin Iseri	Individual	June 25, 2020
B2-23-Form-2138	David Sacerdote	Individual	June 25, 2020
B2-23-Form-2194	Cheryl Porter	Individual	June 25, 2020
B2-23-Form-2297	Melody O’neill	Individual	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
B2-23-Form-2350	Steve Buckley	Individual	June 25, 2020
B2-23-Form-2604	Cle Betu	Individual	June 25, 2020
B2-23-Form-2634	Elaine Cefola	Individual	June 25, 2020
B2-23-Form-2639	Karin Uphoff	Individual	June 25, 2020
B2-23-Form-2711	Rocco Orsini	Individual	June 25, 2020
B2-23-Form-2714	Rodney Hill	Individual	June 25, 2020
B2-23-Form-2943	Jim Alexander	Individual	June 25, 2020
B2-23-Form-3183	Shirley Freriks	Individual	June 25, 2020
B2-23-Form-3208	Laurel Bergman	Individual	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
B2-23-Form-3327	Brent Larsen	Individual	June 25, 2020
B2-23-Form-3517	Jorg and Anke Raue	Individual	June 25, 2020
B2-23-Form-3583	Jill Precheur	Individual	June 25, 2020
B2-23-Form-3685	Daren Black	Individual	June 25, 2020
B2-23-Form-3695	Sheri Cavanaugh	Individual	June 25, 2020
B2-23-Form-3797	Phil Chandler	Individual	June 25, 2020
B2-23-Form-3900	Karen Mathes	Individual	June 25, 2020
B2-23-Form-3973	Carole Grace	Individual	June 25, 2020
B2-23-Form-4108	John Wills	Individual	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
B2-23-Form-4126	Melissa Hay	Individual	June 25, 2020
B2-23-Form-4151	Frances Hinckley	Individual	June 25, 2020
B2-23-Form-4195	Robert Burlin	Individual	June 25, 2020
B2-23-Form-5242	Dennis Bicker	Individual	June 25, 2020
B2-24	Frances Armstrong	Individual	June 25, 2020
B2-25	Joseph Dalum	Odyne	June 25, 2020
B2-26	Cheryl Auger	Individual	June 25, 2020
B2-27	Holly Kretschmar	Individual	June 25, 2020
B2-28	Lisa Beebe	I Vote in Every Election	June 25, 2020
B2-29	Elease Stemp	Northeast LA Climate Collective	June 25, 2020
B2-30	Elise Flashman	Individual	June 25, 2020
B2-31	Adam Frankel	Individual	June 25, 2020
B2-32	Jennifer Levin	Individual	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
B2-33	Rachel Traub	Individual	June 25, 2020
B2-34	Valerie Hurt	Individual	June 25, 2020
B2-35	Kristy McInnis	Individual	June 25, 2020
B2-36	Bonnie Ho	Individual	June 25, 2020
B2-37	Jack Edit	SoCal 350 Climate Action	June 25, 2020
B2-38	Anna Magnuson	Individual	June 25, 2020
B2-39	Donald Stemp	Individual	June 25, 2020
B2-40	Ryan Kenny	Clean Energy	June 25, 2020
B2-41	Jessica Eason	Individual	June 25, 2020
B2-42	Sharon Lord Greenspan	Individual	June 25, 2020
B2-43	Warren McEwan	Individual	June 25, 2020
B2-44	Amy Francis	Individual	June 25, 2020
B2-45	Scott Miningham	Individual	June 25, 2020
B2-46	Yvonne Martinez Watson	Sierra Club	June 25, 2020
B2-47	Kate Grodd	Individual	June 25, 2020
B2-48	Emily Spokes	NELA Climate Collective	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
B2-49	Daryl Gale	Individual	June 25, 2020
B2-50	David Loughnot	Individual	June 25, 2020
B2-51		This comment was posted then deleted because it was unrelated to the Board item or it was a duplicate.	
B2-52	Laura Shady	NELA Climate Collective, Los Angeles	June 25, 2020
B2-53	Erik Desiderio	Individual	June 25, 2020
B2-54	Tamsin Rawady	Individual	June 25, 2020
B2-55	Rachel Gold	Individual	June 25, 2020
B2-56	Jesse Sanford	Individual	June 25, 2020
B2-57	Ms. Eirene Donohue	Individual	June 25, 2020
B2-58	Joani Woelfel	FARWEST Equipment Dealers Association	June 25, 2020
B2-59	Bridget Moloney-Sinclair	Individual	June 25, 2020
B2-60	Stefanie Leder	Individual	June 25, 2020
B2-61	Kathleen Van Dyk	Individual	June 25, 2020
B2-62	Genevieve Matthews	Individual	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
B2-63	Luis Montes	Inside Sustainability SoCal	June 25, 2020
B2-64	Jessica Tardieu Haines	Individual	June 25, 2020
B2-65	Mrs. Tara Strand	Individual	June 25, 2020
B2-66	Amelie Cherlin	Individual	June 25, 2020
B2-67	Leslie Campbell	Sustain LA	June 25, 2020
B2-68	Minta Mullins	Individual	June 25, 2020
B2-69	Nora Goudsmit	Individual	June 25, 2020
B2-70	Ekaterini Kottaras	Individual	June 25, 2020
B2-71	Jessica Judd	Individual	June 25, 2020
B2-72	Nadine Gomes	Individual	June 25, 2020
B2-73	Elizabeth Anderson	Individual	June 25, 2020
B2-74	Sarah Masslon	Individual	June 25, 2020
B2-75	Tara Trudel	Individual	June 25, 2020
B2-76	Mary Lambert	Individual	June 25, 2020
B2-77	Janny Chang	Individual	June 25, 2020
B2-78	Michelle Stockwell	Individual	June 25, 2020
B2-79	Erica Rosbe	Individual	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
B2-80	Caitlin Brady	Individual	June 25, 2020
B2-81	Elise Kalfayan	Individual	June 25, 2020
B2-82	Caillie Roach	Individual	June 25, 2020
B2-83	Katharine Reich	Individual	June 25, 2020
B2-84	Joanna Lovinger	Individual	June 25, 2020
B2-85	Colleen Englestein	Individual	June 25, 2020
B2-86	Elizabeth McNamara	Individual	June 25, 2020
B2-87	Sharon Weisman	Individual	June 25, 2020
B2-88	Sara Lee	Individual	June 25, 2020
B2-89	Rachel Angones	Individual	June 25, 2020
B2-90	Lou Rosenberh	Individual	June 25, 2020
B2-91	Brittan Dunham	Individual	June 25, 2020
B2-92	Alissa Dean	Momtivist	June 25, 2020
B2-93	Elisabeth Averick	Individual	June 25, 2020
B2-94	Tiffany Matula	1974	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
B2-95	David Ihlenfeld	Individual	June 25, 2020
B2-96	Christine Cerven	Tobacco Control and Prevention Program, Los Angeles County Department of Public Health	June 25, 2020
B2-97	Jessie Parks	Individual	June 25, 2020
B2-98	Veronica Jauriqui	Individual	June 25, 2020
B2-99	Emiliana Dore	Individual	June 25, 2020
B2-100	Mia Porter	Individual	June 25, 2020
B2-101	Marissa Pinson	Individual	June 25, 2020
B2-102	Monica Campagna	Individual	June 25, 2020
B2-103	Leila Forouzan	Individual	June 25, 2020
B2-104	Alana Langdon	Nikola Corporation	June 25, 2020
B2-105	Katie Covell	NELA Climate Collective	June 25, 2020
B2-106	Julie Mann	Individual	June 25, 2020
B2-107	Maria Kohn	Individual	June 25, 2020
B2-108	Becky Lowitt	Individual	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
B2-109	Morgan Walsh	Individual	June 25, 2020
B2-110	Jessie Parks, Duplicate Submission of B2-97	Individual	June 25, 2020
B2-111	Candace Nycz	Individual	June 25, 2020
B2-112	Brooke Purdy	Individual	June 25, 2020
B2-113	Noelle Lewis	Individual	June 25, 2020
B2-114	Linda Hutchins-Knowles	Mothers Out Front	June 25, 2020
B2-115	Janelle Randazza	Individual	June 25, 2020
B2-116	Guenevere Mesco	Individual	June 25, 2020
B2-117	Andreya Garcia-Ponce De Leon	Individual	June 25, 2020

Table H: Oral comments received at the Second Board Hearing - June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
T2-01	Ms. Dykes	Commissioner of the Connecticut Department of Energy and Environmental Protection	June 25, 2020
T2-02	Ms. Kirby	Assistant Commissioner of the Massachusetts Department of Environmental Protection	June 25, 2020
T2-03	Ms. Hanna	New Jersey	June 25, 2020
T2-04	Mr. Flint	Air Resources in New York State’s Department of Environmental Conservation	June 25, 2020
T2-05	Mr. Van Amburg	CALSTART	June 25, 2020
T2-06	Mr. Baguio	Lion Electric Company	June 25, 2020
T2-07	Ms. Fenton	Volvo Group North America	June 25, 2020
T2-08	Mr. Peeples	Alameda Contra Costa Transit District	June 25, 2020
T2-09	Mr. Kenny	Clean Energy	June 25, 2020
T2-10	Mr. Robinson	San Diego Center on Policy Initiatives	June 25, 2020
T2-11	Mr. Magavern	Coalition for Clean Air	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
T2-12	Mr. Mandel	EMA	June 25, 2020
T2-13	Ms. Rosenberger	Fresnans Against Fracking	June 25, 2020
T2-14	Ms. Remillard	Agility Fuel Solutions	June 25, 2020
T2-15	Ms. Marquez	CAUSE	June 25, 2020
T2-16	Mr. Sasseen	Ballad Power Systems	June 25, 2020
T2-17	Ms. Pinto-Cabrerra	CVAQ	June 25, 2020
T2-18	Mr. Pingle	Sierra Club California	June 25, 2020
T2-19	Mr. Arago	IBEW Local 11, Latin America Electrical Workers Association	June 25, 2020
T2-20	Ms. Dembrowski	SoCal 350 Climate Action	June 25, 2020
T2-21	Ms. Navarro	Environmental Defense Fund	June 25, 2020
T2-22	Mr. Regalado	Individual	June 25, 2020
T2-23	Ms. Holmes	MEMA	June 25, 2020
T2-24	Mr. Amittay	E2	June 25, 2020
T2-25	Ms. Merrow	Natural Gas Vehicles for America	June 25, 2020
T2-26	Ms. Taylor	Air Quality Program at Washington State Department of Ecology	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
T2-27	Ms. Ponce	CAUSE	June 25, 2020
T2-28	Ms. Agelidis	Los Angeles County Electric Truck and Bus Coalition	June 25, 2020
T2-29	Mr. Munoz	Our People Our Ports Campaign at the Los Angeles Alliance for a New Economy	June 25, 2020
T2-30	Mr. Graham	Coalition of Over 20 Electric Transportation Champions	June 25, 2020
T2-31	Ms. Correa	Brightline Defense	June 25, 2020
T2-32	Mr. McNamara	CR&R	June 25, 2020
T2-33	Mr. Shears	CEERT	June 25, 2020
T2-34	Mr. Corby	CalETC	June 25, 2020
T2-35	Ms. Hoang	Partnership for Working Families	June 25, 2020
T2-36	Mr. Kassakhian	Southern California Edison	June 25, 2020
T2-37	Ms. Austria-Lozoya	IBEW Local 11	June 25, 2020
T2-38	Ms. Bello	CAUSE	June 25, 2020
T2-39	Ms. Lynch	California Waste Haulers Council	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
T2-40	Mr. Flores	Environmental Health Coalition	June 25, 2020
T2-41	Mr. Bouwkamp	California Fuel Cell Partnership	June 25, 2020
T2-42	Mr. Faavae	IBEW Local 11	June 25, 2020
T2-43	Mr. Carmichael	Southern California Gas Company	June 25, 2020
T2-44	Mr. Clements	Hummingbird EV	June 25, 2020
T2-45	Ms. Munguia	CAUSE	June 25, 2020
T2-46	Ms. Sachs	Ceres	June 25, 2020
T2-47	Mr. Schwartz	Tesla	June 25, 2020
T2-48	Mr. Aronin	California Business Alliance for a Clean Economy	June 25, 2020
T2-49	Mr. Zobel	Hydrogen Business Council	June 25, 2020
T2-50	Ms. Camacho	CAUSE	June 25, 2020
T2-51	Mr. Barrett	American Lung Association	June 25, 2020
T2-52	Mr. Lawson	California Natural Gas Vehicle Coalition	June 25, 2020
T2-53	Ms. Donis	East Yard Communities for Environmental Justice	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
T2-54	Mr. Campbell	Clean Energy	June 25, 2020
T2-55	Ms. Aguayo	Greenlining Institute	June 25, 2020
T2-56	Ms. Solomon	Motiv Power Systems	June 25, 2020
T2-57	Mr. Nevers	Rivian Automotive	June 25, 2020
T2-58	Ms. Kropke	Over 400 Union Electrical Contractors	June 25, 2020
T2-59	Ms. Calzada	Individual	June 25, 2020
T2-60	Mr. Kotlier	IBEW and National Electrical Contractors Association of California	June 25, 2020
T2-61	Ms. Williams	Environmental Justice Coalition	June 25, 2020
T2-62	Mr. Sarmiento-Darkin	Hydrogen Mobility	June 25, 2020
T2-63	Mr. Yang	Sierra Club	June 25, 2020
T2-64	Ms. Vidaurre	Center for Community Action and Environmental Justice	June 25, 2020
T2-65	Mr. Wooley	Goldmann School of Public Policy at UC Berkeley	June 25, 2020
T2-66	Ms. Kiliccote	eIQ Mobility	June 25, 2020
T2-67	Mr. Cort	Earthjustice	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
T2-68	Mr. Canon	Port of Los Angeles	June 25, 2020
T2-69	Mr. Harper	California Construction Industrial Materials Association	June 25, 2020
T2-70	Ms. Whittick	California Council for Environmental and Economic Balance	June 25, 2020
T2-71	Mr. O’Dea	Union of Concerned Scientists	June 25, 2020
T2-72	Mr. Portillo	Natural Resources Defense Council	June 25, 2020
T2-73	Ms. Mendez	Center for Community Action Environmental Justice	June 25, 2020
T2-74	Ms. Caplin	Proterra	June 25, 2020
T2-75	Mr. Geller	Manufacturers of Emission Controls Association	June 25, 2020
T2-76	Ms. Dietzkamei	Individual	June 25, 2020
T2-77	Ms. Gonzalez	CAUSE	June 25, 2020
T2-78	Mr. Pickles	Green Grid, Inc.	June 25, 2020
T2-79	Ms. Pardo	Resource Recovery Coalition of California	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
T2-80	Ms. Roberts	Regulatory Affairs for Western States Petroleum Association	June 25, 2020
T2-81	Ms. Dela Cruz-Perez	East Yard Communities for Environmental Justice	June 25, 2020
T2-82	Mr. Maggay	SoCalGas	June 25, 2020
T2-83	Ms. Caswell	Air Quality Practices for the Port of Long Beach	June 25, 2020
T2-84	Ms. Thomas	East Yard Communities for Environmental Justice	June 25, 2020
T2-85	Ms. Silverthorn	Chamber of Commerce	June 25, 2020
T2-86	Ms. Mohan	California Environmental Justice Alliance	June 25, 2020
T2-87	Ms. Deniz-Zaragoza	Warehouse Worker Resource Center	June 25, 2020
T2-88	Ms. Ly	Transpower Meritor	June 25, 2020
T2-89	Ms. Yesenia G.	CAUSE	June 25, 2020
T2-90	Ms. DesChaux	Electric Auto Association of the Central Coast	June 25, 2020
T2-91	Mr. Granholm	Western Propane Association	June 25, 2020
T2-92	Mr. Yow	Port of San Diego	June 25, 2020
T2-93	Ms. Martinez	CAUSE	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
T2-94	Mr. Costantino	Trillium	June 25, 2020
T2-95	Mr. Shimoda	California Trucking Association	June 25, 2020
T2-96	Ms. Nagrani	Individual	June 25, 2020
T2-97	Mr. Marquez	Individual	June 25, 2020
T2-98	Ms. Sandoval	County Member, Youth Leader in San Bernardino, Sierra Club	June 25, 2020
T2-99	Ms. Martinez Watson	Sierra Club	June 25, 2020
T2-100	Ms. Kerridge	350 Bay Area	June 25, 2020
T2-101	Mr. Smith	Teamsters Union	June 25, 2020
T2-102	Mr. Appel	BlueGreen Alliance	June 25, 2020
T2-103	Mr. Ellis	American Honda Motor Company	June 25, 2020
T2-104	Ms. Langdon	Nikola Corporation	June 25, 2020
T2-105	Mr. DeLizo	Individual	June 25, 2020
T2-106	Mr. Abramowitz	Community Environmental Services	June 25, 2020
T2-107	Mr. Sheldon	Individual	June 25, 2020
T2-108	Mr. Villa	Individual	June 25, 2020

Comment Code	Submitter	Affiliation	Date Received
T2-109	Mr. Dalum	Odyne Systems	June 25, 2020
T2-110	Mr. Carr	Shell	June 25, 2020
T2-111	Mr. Benavidez	CAUSE	June 25, 2020
T2-112	Ms. Sanchez	Individual	June 25, 2020
T2-113	Ms. Katherine Garcia	Sierra Club	June 25, 2020
T2-114	Ms. Azamian	Leadership Counsel for Justice and Accountability	June 25, 2020
T2-115	Ms. Balderas	My Generation Campaign	June 25, 2020
T2-116	Mr. Symington	Los Angeles Cleantech Incubator	June 25, 2020
T2-117	Ms. McGhee	GreenPower Motor Company	June 25, 2020
T2-118	Ms. Moran	CAUSE	June 25, 2020
T2-119	Ms. Kavezade	Sierra Club	June 25, 2020
T2-120	Mr. Ross	350 Bay Area Transportation	June 25, 2020
T2-121	Mr. Edgar	Clean Fleets	June 25, 2020
T2-122	Commissioner Lara	ARB Board Member 2017 and 2018	June 25, 2020
T2-123	Ms. Kimberly Garcia	CAUSE	June 25, 2020

Table I: Written Comments Received on the Second 15-Day Changes

Comment Code	Submitter	Affiliation	Date Received
RP2-01	Michael Lee	Individual	October 5, 2020
RP2-02	Doug Scheel	Individual	October 5, 2020
RP2-03	Dwight Johnson	Individual	October 5, 2020
RP2-04	Julie Beer	Individual	October 19, 2020
RP2-05	Ranji George	Individual	October 20, 2020
RP2-06	Socorro Pantaleon	Cucamonga Valley Water District	October 20, 2020
RP2-07	Timothy Blubaugh	Truck and Engine Manufacturers Association	October 20, 2020
RP2-08	Gail Lee	Individual	October 20, 2020

COMMENTS RECEIVED DURING ORIGINAL PROPOSAL'S 45-DAY COMMENT PERIOD

Manufacturer ZEV Sales – Strengthen the ACT Proposal by Including Pickups Earlier and/or Increasing Sales Percentage Requirements

Comment: Commenter states the ACT regulation should be stronger, making at least 15% of the California fleet ZEVs by 2030 and should include all medium- and heavy-duty vehicles in the requirements starting in 2024. [OP-01, OP-13, OP-28, OP-59, OP-72, OP-78, OP-96, OP-119, OP-123-Form, OP-124-Form, T1-56]

Comment: Commenter states CARB should set a standard to achieve 15% trucks on the road as zero-emission by 2030 to address pollution and climate concerns, as well as helping disadvantaged communities. [OP-01, OP-08, OP-45, OP-55, OP-56, OP-60, OP-62, OP-67, OP-68, OP-73, OP-77, OP-111, OP-112, OP-113, OP-118, B1-13, T1-17, T1-28, T1-33, T1-36, T1-37, T1-48, T1-49, T1-52, T1-53, T1-54, T1-55, T1-58, T1-59, T1-60, T1-61, T1-62, T1-65, T1-72, T1-74, T1-82, T1-88, T1-91, T1-92, T1-94, T1-95, T1-96, T1-97]

Comment: Commenter states that ACT regulation should be stronger, achieving at least 15% of the California fleet as ZEVs by 2030, and should include all medium- and heavy-duty vehicles in the requirements starting in 2024. Commenter outlines examples of how this can be done, discusses the need, supporting ZEV market, and policy drivers. Commenter also provides supporting comments regarding vehicle electrification suitability and model availability, ZEV market updates, favorable ZEV total cost of ownership, utility investments in ZEV infrastructure, and points out health and economic benefits from a stronger regulation.

Additionally commenter states that 15% ZEVs on-road by 2030 is feasible for 8 main reasons: total cost of ownership is positive today for some classes of electric trucks and is becoming more favorable for others; zero-emission trucks are rapidly becoming available; others are already electrifying faster than this proposal, providing Shenzhen's rapid turnover rates as an example; 80% of vehicles needed to meet this goal are currently suitable based on CARB's market assessment, and forecasted improvements make this goal achievable; urgent climate impacts can be mitigated by transitioning to ZEVs; ZE trucks could be outpaced by growth in combustion trucks; air quality and health benefits from transitioning to ZEVs are enormous.

Finally, Commenter states CARB's feasibility concerns about the state of readiness of ZEV technologies are unreasonable, as more vehicle sales could come from Class 4 through 8 category, CARB's feasibility study states more vehicle classes could be electrified if the whole population of all "1 or 2"'s were included, and new announcements demonstrate movement in the electric market for sectors CARB deemed less feasible. Additionally, anticipated demand for replacing drayage tractors would exceed commenter's "stronger" scenarios. Commenter states that strengthening

2b-3 category does not necessarily require electrification of pickup trucks. Commenter states CARB's caution due to "edge case assumptions" are unfounded, as commenter's strengthened proposal would only require electrification of less than 15% of pickups on the road by 2030, many of which belong to public fleets or commercial private fleets with use patterns suitable for electrification. Commenter also states that a conservative approach is unreasonable in light of Amazon's order of over 100,000 electric delivery vans to be deployed by 2024. Commenter provided supporting documentation, articles, and references to support their comment. [OP-02, OP-46, T1-10]

Comment: Commenter states CARB should set a more stringent manufacturer standard to get hundreds of thousands of ZEV trucks on the road by 2030 to address increases in goods movement and VMT, and to improve public health. Additionally, commenter states that all truck categories should be included starting 2024. Commenter also states CARB should set a stronger model for other states to adopt. [OP-15]

Comment: Commenter states that 15% ZEVs on-road by 2030 is feasible and necessary for the following reasons: trucks in the San Joaquin valley have easily electrifiable operations; ZE trucks could be outpaced by growth in combustion trucks; to protect environmental justice communities that are disproportionately affected by air quality issues; ZEVs provide air quality and health benefits; the Mobile Source Strategy deficits in PM 2.5 attainment are an opportunity to justify stronger, earlier action in the ACT regulation; and staff rejected the more cost-effective and more health-effective stringent alternative in the SRIA, but commenter believes the ACT regulation has the capacity to provide more relief than the current proposal.

Commenter also states the crediting mechanism coupled with the low sales targets would result in large manufacturers having no incentive to begin development as early as possible, as they could just buy credits from smaller manufacturers to delay product lines. Therefore, stronger sales targets are needed. [OP-28]

Comment: Commenter states CARB should consider increasing the sales requirements for 2b-3 and Tractor categories. [OP-33]

Comment: Commenter states that the regulation should be stronger, achieving higher sales percent targets of the California fleet being ZEVs by 2030 and should include all medium- and heavy-duty vehicles in the requirements starting in 2024. [OP-40, OP-85, OP-86, OP-88, OP-89, OP-90, OP-91, OP-92, OP-114, OP-120, B1-14, B1-15, T1-76]

Comment: Commenter requests that at least 15% of medium- and heavy-duty trucks on the road be zero-emission by 2030, and that Class 2b pickups should be included in the requirement beginning 2024. [OP-41, OP-48, OP-83, OP-117, OP-122, T1-13, T1-17, T1-40, T1-48, T1-98]

Comment: Commenter states CARB needs to move faster on acting on the health problems caused by diesel trucks. [OP-43]

Comment: Commenter states that regulation should be stronger, making at least 15% of the California fleet ZEVs by 2030 and requiring all trucks to comply sooner than 2027. [OP-64, OP-70]

Comment: Commenter states that regulation should be stronger, achieving commitment made by Governor Newsom in December 2017 to have “zero diesel pollution by 2030.” [OP-66]

Comment: Commenter states CARB should expand sales targets for Class 2b-3 pickup trucks to 15% and 60% by 2024 and 2030, respectively. Commenter also states Amazon’s recent purchase of Class 3 delivery vans from Rivian dwarfs the current proposal for the Class 2b-3 sales requirement and threatens to swamp the entire ACT regulation by creating a ZEV credit glut. Commenter states that Class 2a and 2b pick trucks, vans, and SUVs will be unable to rely as heavily on fleet mandates because they are part of a large category that are personal vehicles. For this reason, commenter recommends Class 2b pickup trucks should mirror the Advanced Clean Cars regulation in being the primary driver. Commenter provided supporting documentation, articles, and references to support their comment. [OP-72]

Comment: Commenter states the ACT regulation should be stronger. [OP-75, T1-29, T1-32, T1-34, T1-38, T1-57, T1-63, T1-64, T1-71, T1-73, T1-75, T1-81, T1-83, T1-84]

Comment: Commenter states that regulation should be accelerated, achieving California’s goal of deploying 1.5 million zero-emission vehicles by 2025. [OP-82]

Comment: Commenter states that public investment in infrastructure can support more zero-emission trucks than Staff's proposal would require. Commenter states setting weak mandates will be detrimental because ZEVs will be outpaced by growth of the freight industry, allow OEM to delay investments in ZE market, and low targets don’t align with California attainment commitments. Commenter states that stronger regulation is achievable by CARB's own estimates because more trucks are highly suitable for electrification and total cost of ownership shows more indirect cost savings for truck categories. [OP-83]

Comment: Commenter states CARB should adopt regulation to achieve 25% of all trucks as electric by 2030 to meet United Nations IPCC findings that CA must reduce GHG emissions by 50% by 2030. [OP-93]

Comment: Commenter states CARB should consider where the percentages of ZEV trucks sold in each medium- and heavy-duty class can be strengthened and to adopt those higher percentages. Commenter states that medium- and heavy-duty vehicles making up just seven percent of vehicles on the road, release 35 percent of total statewide NOx, 25 percent of statewide diesel PM emissions, and 23 percent of all on-road greenhouse gas emissions, all of which must be greatly reduced to reach California's greenhouse gas and air quality goals. [OP-94, T1-43]

Comment: Commenter states the proposed ACT regulation could be stronger, as a study commenter conducted comparing the ACT proposal to an alternative that achieves carbon-neutrality for California by 2045 shows potentially up to $62 billion more savings to California. Additionally, the study shows that ZEVs could be outpaced by growth in combustion trucks. The alternative would result in zero ICE trucks on the road by 2045. CARB should rigorously evaluate a more stringent alternative to consider adopting. Commenter provided supporting documentation, articles, and references to support their comment. [OP-97]

Comment: Commenter states CARB should strengthen the proposed regulation by starting the sales requirement for class 2b-3 pick-ups in 2024, altering the sales requirement to 20% of medium- and heavy-duty vehicles on the road by 2030 are zero-emission. [OP-109]

Comment: Commenter states that regulation should be stronger, making only 4% of the California fleet ZEVs by 2030 is not acceptable and the regulation should include all medium- and heavy-duty vehicles in the requirements starting in 2024. [OP-121-Form]

Comment: Commenter states the ACT regulation should be stronger, making at least 10-15% of the California fleet ZEVs by 2030 and 100 percent of the California fleet as ZEVs by 2045, respectively. [OP-125-Form]

Comment: Commenters in form letter state the ACT regulation should be stronger, committing to higher sales targets for zero-emissions trucks ranging from no specific suggestion up to 50% by 2030 on the road. Commenters also state that pickups should be included starting 2024. [OP-126-Form]

Comment: Commenter states the ACT regulation should be stronger, making at least 15% of the California fleet ZEVs by 2030 is the bare minimum and CARB should aim for 50% by 2025 instead. [OP-126-Form-3484]

Comment: Commenter states the ACT regulation should be stronger, making at least 20% to 30% of the California fleet ZEVs by 2030 and 2035, respectively. [OP-126-Form-3353]

Comment: Commenter urges CARB to strengthen the regulation to result in 15% of trucks on the road in California being zero-emission by 2030. Commenter states that ambitious sales requirements for zero-emission vehicles will feed commercial demand and improve the business case for electric trucks, allowing automakers and companies to capture savings from economies of scale. [B1-09]

Comment: Commenter recommends that the Board identify where the percentages of ZEV trucks to be sold in each medium- and heavy-duty class can be strengthened and to adopt those higher percentages. One example would be to require pickup trucks in Class 2b/3 to be available in 2024, along the same timeline as all of the other classes of trucks, by eliminating their 3-year exemption. [B1-10]

Comment: Comment states concern the current proposal will not be sufficient to reach California's clean air goals and recommends increasing the 15% sales requirement in Class 2b, 3, 7, and 8 categories. Also recommends sales requirement to be periodically reviewed and increased. [T1-02]

Comment: Comment states CARB should aim for 15 percent of medium- and heavy-duty vehicles on the road being zero-emission by 2030 to create jobs. [T1-14]

Comment: Commenter states CARB should mandate ZEV production for all vehicle types beginning in 2024. CARB should adopt higher sales requirements across all vehicle classes. CARB should aim for a rule that targets the market based on where it should be, not a rule that targets simply a floor. [T1-18]

Comment: Commenter states CARB should adopt a stronger rule resulting in hundreds of thousands of zero-emission trucks on the road by 2030. [T1-39, T1-40]

Comment: Commenter states CARB should propose a stronger sales requirement (four to five times the proposed requirement) as battery technology has improved more than Lawrence Berkeley National Labs expected, price reductions are 10 to 15 years ahead of schedule, total cost of ownership is lower than diesel given the right ecosystem. The current proposal is inconsistent with the carbon neutrality order, which requires four to five-fold increase in ZEV sales mandate. The net present value of a climate consistent, stronger proposal would result in benefits of $60 billion. [T1-45]

Comment: Commenter states that with a low target rule CARB is ensuring that costs will not be brought down as quickly as they could with scaled production and it would allow big trucking fleets to buy all the trucks in the market, while excluding small businesses. The ACT regulation should be stronger because it is feasible, trucks are ready to be electrified, costs are competitive, infrastructure investment are there, and the consumer demand is there. [T1-78]

Comment: Commenter states CARB should include ZEV sales requirement for all truck classes beginning in 2024 and increase the yearly and final percent target goals from 2024 to 2030. Additionally, companies, especially utilities, are eager to electrify their fleets, but are limited by the lack of EV models. [T1-98]

Agency Response: The approved regulation includes a number of modifications to the original proposal in response to comments to significantly increase the number of ZEVs sold in California across all vehicle groups from 2024 to 2030 and to increase the percentage requirements from 2030 to 2035 rather than keeping them constant during that period. In the Class 2b-3 vehicle group, the ZEV sales requirement for pickups now begins with the 2024 model year rather than excluding pickups until 2027. This change will increase the minimum number of ZEVs required to be sold in the Class 2b-3 vehicle group in 2024 through 2026 and is supported by new information in recent market announcements showing that a number of zero-emission pickup and additional van models will be commercially available from several manufacturers well before the 2024 model year. Changes in the Class 2b-3 vehicle group are necessary to ensure strong market signals align with future demand for ZEVs. The increases in the Class 7 and 8 tractor group sales percentages are necessary to ensure there are sufficient tractor sales to meet the goal of achieving an all zero-emission drayage fleet by 2035 which would directly benefit disadvantaged communities as numerous commenters have requested and to accelerate emission reductions in other areas with high concentrations of truck traffic. In combination, these changes would increase ZEV sales in all vehicle size categories and would provide a clear path towards achieving carbon neutrality by 2045.

In total the approved regulation would result in ZEVs for 15% of the fleet by 2035. The approved regulation does not achieve the same total vehicle sales goal some commenters suggest due to concerns about the feasibility of manufacturers to comply with even higher sales requirements especially for Class 2b-3 vehicles and tractors. At this time, both Class 2b-3 and Class 7-8 tractors have more focused concerns about payload, range, towing, charging/refueling infrastructure, and model availability than other vehicles. These issues will present more challenges in identifying suitable applications for their deployment in the early market. Increasing the number of ZEV sales further also increases the likelihood that manufacturers would need to produce more costly long-range vehicles, and that vehicles may need to be placed in applications where they may not be fully suitable. Therefore, the Board determined that the approved regulation is the most feasible path to meet ZEV deployment goals at this time.

Manufacturer ZEV Sales – Reduce the Number of ZEVs Deployed

Comment: Commenter requests penetration rates of class 8 vocational vehicles be the same as class 7 and 8 tractors. [OP-74]

Agency Response: No changes were made in response to this comment. This suggestion would reduce the number of ZEVs sold in the Class 4-8 category and is counter to the Board direction from the first hearing. At the hearing, the Board directed staff to increase the number of ZEVs deployed in California in all categories. See rationale for increasing ZEV sales in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Manufacturer ZEV Sales – Strengthen the ACT Proposal by Including Pickups Earlier and/or Increasing Sales Percentage Requirements”.

Manufacturer ZEV Sales – Pair Manufacturer and Fleet Requirements

Comment: Commenter states CARB needs to analyze the vocational vehicle sector and examine additional factors to determine how quickly a transition to ZEVs technology can occur in different classes. [OP-84]

Comment: Commenter states specific commercial fleet types and applications should be identified and prioritized for an optimized introduction of ZEV trucks. If CARB continues down the current two-track regulatory path for MD and HD vehicles, there is a real chance that manufacturers will be forced out of California market. Low product volume and the high number of different commercial vehicles applications makes unilateral, broad-based and naked ZEV sales mandate inherently impractical. CARB should direct staff to develop a more strategically focused regulation coupling ZEV sales mandate with specific fleet applications, including provisions and incentives to cover marginal costs of purchasing ZEVs and infrastructure, and better coordinate and take into consideration adverse impacts of both a heavy-duty duty on highway ZEV sales mandate and Low NOx Omnibus regulation. Sales mandates directed at beachhead markets should be coupled with a ZEV purchase mandate applicable to the operators of the target fleets of commercial trucks. [OP-87]

Comment: Commenter recommends pairing incentives and fleet requirements with manufacturer requirements to promote market acceptance of electrified products. Commenter urges CARB to execute market-enhancing policies such as incentives, to promote electrification purchases in all segments affected, and invest in the needed infrastructure for the high energy requirements of heavy-duty use cases and ensure availability in both urban and rural areas. Commenter states that a stable policy implemented alongside the ACT rule that hits all market segments impacted, especially in the pickup segments with its large share, would establish a market for electrified heavy-duty product and a more successful ACT regulation. Commenter states that if staff cannot implement the needed (and promised) fleet purchase mandates in time, ACT requirements should be reevaluated. [B1-11]

Agency Response: No changes were made to the regulation in response to these comments. Staff recognizes that some use cases may be more favorable than others and considered this in establishing the minimum ZEV sales requirement and the framework of the regulation. The approved regulation includes flexibility for manufacturers to produce and sell ZEVs into the market segments they deem to be most suitable for the products they manufacture. Specifically, the regulation provides flexibility for manufacturers to shift sales between weight classes, to bank and trade credits, to earn early credits, and to meet part of their compliance obligation with near-zero-emission vehicle sales that have a minimum all-electric range. This approach also recognizes that a single chassis can be used in multiple configurations and sold into multiple vehicle market segments. In summary, the approved regulation will ensure that manufacturers develop competitive ZEV products at price points that will meet fleet needs.

The Board directionally agrees with the concept of using both manufacturer and fleet rules to develop the medium- and heavy-duty ZEV market; however, the Board does not agree they need to be approved at the same time. The Board provided direction in the resolution to return with a ZE fleet rule by the end of 2021 that would begin implementation in 2024, the same initial implementation date as the manufacturer rule. In the resolution, the Board directed staff to work towards a goal to transition key market segments to zero-emission including drayage, first/last mile delivery, refuse, buses, utility, and government fleets.

Before fleets can purchase zero-emission vehicles, they need products available from major manufacturers that will be supported by a robust service and maintenance network. But to date, the major manufacturers have been relatively absent in this space despite the need for zero-emission technology. Up to this point, smaller startup truck manufacturers have stepped in to fulfill market demand and have been designing zero-emission trucks for a number of years. The majority of these startup companies do not have broad dealer networks or regional service facilities that can be leveraged quickly to provide support and maintenance services for zero-emission technology. Many have also lacked the ability to deliver very large orders for major fleets; additionally, several of these start-ups have failed and gone out of business despite having large orders. This has hampered ZEV expansion for early adopter fleets.

The manufacturer sales requirement was developed first because manufacturers need sufficient lead time to research and develop products, perform validation, work with suppliers and establish production lines and a suitable repair and maintenance network prior to production and sale of ZEVs.

Manufacturer ZEV Sales - EMA Proposal

Comment: Commenter states that it wishes for CARB to work with the EMA and other interested stakeholders through the 30-Day Notice process to identify those specific segments of the heavy-duty market that are more readily amenable to electrification, and move forward with 100 percent sales mandates in those segments. The 100 percent mandates would achieve or even overachieve the volumes and time frames the staff is proposing. Commenter believes that the ACT regulation should be focused on mandating the use of ZEV technologies in prioritized, specific segments that are more readily suited to that technology, even earlier than the staff is proposing. Commenter believes this approach would allow specific markets to identify incentives and infrastructure needs while creating beachheads for ZEVs in California. Commenter states that new school buses and municipal fleet step vans could be 100 percent ZEVs in 2023. That in 2024, a 100 percent of new public utility vehicles and yard tractors can be ZEVs. That in 2025, 100 percent of the new step vans, airport service vehicles, and non-airport shuttle buses can be ZEVs. And that in 2026, 100 percent of refuse trucks can be ZEVs. [B1-05, T1-19]

Comment: Commenter states CARB should work with industry and other stakeholders to develop a more focused approach to the ZEV sales requirement which focuses on early adoption in best fit markets, and couples incentive policies to the rule. [T1-11]

Comment: Commenter agrees with Volvo, the rule should have used a focused approach based on certain categories. Commenter agrees with the EMA proposal specifically regarding further segmentation. [T1-79]

Comment: Commenter states CARB should to continue to work on the EMA proposal "beachhead strategy" moving forward with the regulation. Commenter states that the average fleet is struggling to comply with the Truck and Bus regulation and there are approximately 82,000 non-compliant vehicles. Commenter states that the Truck and Bus Regulation is dominated by small businesses and they will have trouble adjusting to the ACT rule. [T1-80]

Agency Response: No changes were made to the regulation in response to these comments. Staff worked with EMA at the Board’s direction to assess the feasibility of EMA's proposal. Several key issues make the EMA proposal unfeasible. First, because the proposal requires 100% of sales and purchases be ZEV, it would by default necessitate a fleet rule. Modifying staff’s proposal to incorporate the EMA proposal would require expanding the rule’s scope to include an entirely new set of stakeholders that have not been noticed about this rulemaking. This would require an entirely new rulemaking and delay the proposal until at least mid-2021 to allow for re-noticing to a much broader population of stakeholders. This is inconsistent with the Board direction for a swift and strengthened proposal to be brought forth.

Additionally, staff and EMA could not find a way to ensure 100 percent of all affected fleets would be able to meet their operational needs with available vehicles. A 100 percent requirement in any sector would mean all fleets must purchase only ZEVs, including small fleets, fleets who cannot install infrastructure to electrify, fleets who have variable operation or must respond to emergencies require widespread infrastructure buildout to account for all use-cases, which would not be feasible by the suggested beginning timeframes in 2023. Some sectors including pickups, vans, and tractors do not easily fit in a 100 percent requirement as the vehicles produced can be used in a wide variety of applications. Finally, staff expects the market to gravitate toward beachhead categories on its own, as the nexus of favorable economics, centralized infrastructure, and ZEV-friendly use cases would create market opportunities for businesses to capitalize on.

Manufacturer ZEV Sales – Add Off-Ramps to the Proposal

Comment: Commenter states CARB should add off-ramps to suspend the ZEV sales mandate if adequate fleet-rule purchase mandates and ZEV infrastructure installations are not in place by 2024. [OP-87]

Comment: Commenter recommends the incorporation of review mechanisms into the regulation that assess both market acceptance of electrified products and infrastructure (lead time and availability), and adjust requirements accordingly. Commenter recommends that CARB consider battery technology (cost, capacity, energy density, specific energy, etc.), customer demand, purchase mandates, and the number of charging stations as objective metrics to assess rule success. If these metrics fall short of expectations, commenter recommends that CARB postpone implementation of the heavy-duty mandate or reduce the number of ZEVs required. Commenter provided supporting documentation, articles, and references to support their comment. [B1-11]

Agency Response: No changes were made to the regulation in response to these comments. The Board determined that developing regulatory off-ramps as suggested is unnecessary and is counter to the goal of providing certainty to the market. The Board approved the regulation without off-ramps to ensure that vehicle manufacturers, suppliers, and infrastructure manufacturers have certainty in making long-term investments needed to ensure large-scale deployment of ZEVs in California.

The regulation's structure gives manufacturers flexibility to bank credits, shift sales between weight classes, and trade credits with other manufacturers. These flexibility provisions give manufacturers assurance that they can comply and does not introduce the uncertainty associated with potential off-ramps.

Manufacturer ZEV Sales – Total Cost of Ownership Concerns for Pickups

Comment: Commenter states that even with the overly optimistic assumptions in CARB's Total Cost of Ownership (TCO) calculator, a conventional Class 2B-3 pickup truck is still less expensive to operate than a ZEV pickup in the 2024 through 2030 timeframe. When CARB's assumptions are corrected to maintain the towing and hauling capacity, the battery size increases 2.5 times. Using the TCO calculator default assumptions with the increased battery size, a Class 3 pickup truck would cost $32,000 more than a conventional truck (a 66% increase). [OP-87]

Comment: Commenter recommends aligning phase-in of pickup and pickup-based products with cost of ownership based on true heavy-duty hauling and towing capability. Commenter states that CARB's analysis was missing for the pickup based portion of the heavy-duty market that span Class 2b-5 segments which make up more than one-third of California's total heavy-duty sales. Commenter states that this analysis, shows that BEV pickup applications are cost negative, even when assuming small battery sizes that limit capability and purchase incentives unlikely to be available to most pickup purchasers. Commenter states that when assumptions are corrected, the cost penalty for BEV heavy-duty pickups increases and capability is still compromised. Commenter recommends that that Class 2b/3 pickup sales requirements start in 2027MY and also recommends the Board consider expanding this timing decision to pickup-based Class 4/5 vehicles. Commenter provided supporting documentation, articles, and references to support their comment. [B1-11]

Comment: Commenter states that CARB's analysis indicates higher lifetime costs for electrified HD pickup trucks. Commenter states that CARB's TCO model suggests that electrified class HD pickup trucks have higher costs than their conventional counterparts throughout the entire period of the ACT policy (2030), even when considering LCFS savings. Commenter states that the lack of a positive total cost of ownership for prospective HD pickup truck consumers even in 2030 is particularly striking given the assumptions that favor electrification throughout the analysis. Commenter states that there are several TCO assumptions that are unrealistic for HD pickup trucks, suggesting that the actual lifetime costs for a fully electric pickup is even less favorable. These unrealistic TCO assumptions include inadequate range and battery capacity, the lack of resources by small fleets to monetize LCFS credits, and the 12-year vehicle lifetime is overstated. [B1-16]

Agency Response: No changes were made to the regulation in response to these comments. Staff disagrees with the premise that the early ZE truck market will need to serve use cases that require the maximum possible range and hauling capacity for a given vehicle type and for that reason did not include it as a representative scenario in the cost analysis. To the extent that some applications such as pickups used for towing and hauling are not suitable to electrify or are significantly more costly, manufacturers can focus their efforts on other use cases that are more suitable for electrification. The approved regulation will ensure that manufacturers develop competitive ZEV products at price points that will meet fleet needs.

The Class 2b-3 costs listed in the Staff Report were estimated based on lower range vans because vans commonly travel shorter distances, often return to base and have lower towing demands than other trucks. Staff foresaw this as being the most likely market for early ZEV deployments and based the cost assumptions on this. However, in the months since the Staff Report was released, there have been a number of announcements regarding zero-emission pickup trucks, described in further detail in Attachment B of the 30-Day Changes, indicating staff may have been too conservative in assuming the possible number of Class 2b-3 sales.

Furthermore, the regulation's structure gives manufacturers flexibility to bank credits, shift sales between weight classes, and trade credits with other manufacturers. This means that a manufacturer who sells pickups, vans, and trucks can meet their compliance obligation by producing ZE vans and trucks without producing any ZE pickups for a number of years if there are better markets to serve or can purchase credits from other manufacturers regardless of the truck types they sold to earn their credits.

Manufacturer ZEV Sales – Operational Challenges for Electrification of HD Pickups

Comment: Commenter states that CARB's analysis shows barriers to near-term electrification of HD pickups. For example, CARB's analysis shows that 99% of California pickups by end use and annual sales volume are not well suited to near-term electrification. As shown in CARB analysis, the relatively poor scores for pickups are due to a combination of factors including range, route variability, infrastructure, and battery space constraints. Commenter states that has been some confusion in workshops and stakeholder meetings about the distinction between fully capable HD pickups used as "work trucks" and their light-duty (LD) counterparts. Commenter states that it is important for policymakers to continue to distinguish the very different abilities, requirements, and use cases of LD (class 2a) pickup trucks vs. HD (class 2b/3) pickup trucks, and to avoid conflating the near-term promise of greater LD electrification with the ill-suited nature of most HD pickup trucks. [B1-16]

Agency Response: No changes were made in response to this comment. As noted in Appendix E to the Staff Report, staff recognizes that Class 2b-3 pickups face additional challenges to electrification. However, staff's updated analysis in Attachment C to the 30-Day Changes shows that Class 2b-3 pickups are showing greater feasibility than modelled in the Staff Report. Based on this updated analysis, higher requirements on Class 2b-3 vehicles are feasible.

Furthermore, the regulation's structure gives manufacturers flexibility to bank credits, shift sales between weight classes, and trade credits with other manufacturers. This means that a manufacturer who sells pickups, vans, and trucks can meet their compliance obligation by producing ZE vans and trucks without producing any ZE pickups for a number of years if there are better markets to serve or can purchase credits from other manufacturers regardless of the truck types sold to earn their credits.

Manufacturer ZEV Sales – Higher Costs Are Barrier to ZEV Deployment

Comment: Commenter states that the most widely recognized barrier to the deployment of ZEV MD and HD vehicles is their substantially higher cost compared to their conventional counterparts. Commenter states that the cost to purchase and deploy an advanced technology vehicle is greater than just the incremental cost. Fleets pay increased sales tax on a more expensive vehicle and face other costs associated with new technologies, such as training and adapting to new maintenance procedures. Commenter states the ability to support California's transportation needs has not been demonstrated for electric MD and HD vehicles. [B1-07]

Agency Response: No changes were made to the regulation in response to this comment.

Staff's methodology to evaluate costs was to look at both the cost to the state as a whole and to look at the total cost of ownership for a vehicle. This method illustrates the costs to both California and a typical fleet. Through these analyses, staff found that while zero-emission vehicles will cost more upfront due to higher vehicle costs and additional infrastructure costs, they will cost less over their lifetime due to lower fuel costs, LCFS revenue, and reduced maintenance expenses. ZEVs placed into well-suited applications will see a positive TCO versus their diesel counterparts, and more applications will show a payback over time as ZEV costs decline.

Staff held numerous workgroup meetings to discuss what cost assumptions to use and what applications to evaluate. Staff used the best available information to evaluate costs. While there are many unknowns regarding future costs, staff does not agree that is too premature to develop a cost model to inform the Board's decision.

Lastly, the regulation does not place a requirement on fleets to purchase ZEVs. Therefore, fleets will only purchase ZEVs if it is economical to do so or if they have a different reason e.g. sustainability goals.

Manufacturer ZEV Sales – Maintain Delayed Timeline for Pickups

Comment: Commenter supports exempting pickup trucks in class 2b-3 group until 2027. [OP-99] [B1-11]

Comment: Commenter states that the incorporation of HD pickup trucks should not occur any earlier than proposed by CARB staff. Commenter states that the ACT policy as proposed would fall unevenly in volume on HD pickup trucks due to the disproportionate number of these vehicles within the combined class of heavy-duty vehicles targeted by the ACT policy (~8,500 lbs. GVWR). For example, national registration data obtained by General Motors for the 2018 calendar year suggests that approximately 65% of the vehicles targeted by the ACT would be made up of class 2b/3 pickup trucks alone. Commenter states that arguably, the proposed MY 2027 start date is insufficient given the unique challenges of this market, and commenter encourages the Board to consider a start date such as the 2030 model year or a slower phase-in given operational challenges, total cost of ownership, and a relative lack of policies to support demand in the HD pickup market. [B1-16]

Agency Response: No changes were made to the regulation in response to these comments, but changes were made to the 2b-3 group in response to Board direction. Staff modified the original proposed start date for Class 2b-3 pickups to be consistent with Board direction and new information about zero-emission pickups. For staff's justification for removing the delayed timeline for pickup trucks, see chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer

ZEV Sales – Strengthen the ACT Proposal by Including Pickups Earlier and/or Increasing Sales Percentage Requirements".

Manufacturer ZEV Sales – Insufficient Lead Time

Comment: Commenter referenced section 202(a) (42 U.S.C. § 7521(a)) of the Clean Air Act that requires that EPA give a minimum of four full years of lead time before new heavy-duty vehicle emission standards can take effect and because of this requirement, the proposed regulation would be invalid under federal law. [OP-87]

Agency Response: No changes were made to the regulation in response to this comment. The lead-time provisions of section 202(a)(3)(C) of the Clean Air Act (CAA) do not apply to the ACT regulation. Section 202(a)(3)(C) only applies to standards "promulgated or revised under this paragraph [section 202(a) of the CAA]," that is, to standards promulgated by the Administrator of the U.S. EPA. Since CARB adopted the ACT regulation pursuant to authority of California state law and the waiver provisions of section 209(b) of the CAA, the lead-time requirement simply does not apply.

Since 1970, U.S. EPA has typically applied a "2-pronged" test of whether California standards are consistent with CAA section 202(a) as required by section 209(b)(1)(C). The standards must be: (1) technologically feasible in the lead time provided considering the cost of compliance, and (2) compatible with the federal test procedures so that a single vehicle could be subjected to both tests. No more should be required. This is in accord with the legislative history of section 209. When the California waiver provisions and the "consistent with section 202(a)" language were first placed in the CAA in 1965, section 202(a) consisted of just one sentence requiring adequate lead time in consideration of technological feasibility and economic costs. In the 1977 CAA amendments, Congress amended section 209 "to afford California the broadest possible discretion in selecting the best means to protect the health of its citizens and the public welfare." (H. R. Rep. No. 294, 95th Cong., 1st Sess. 301 (1977), reprinted in 4 Leg. Hist. at 2768.) At the same time, Congress expanded section 202(a) to add several directives to U.S. EPA regarding its adoption of emission standards, including the 4-year lead time requirement for heavy-duty vehicles. Given Congress's expressed intent to strengthen the waiver provisions, it is unlikely Congress intended to apply the specific 4-year requirement to California.

Moreover, the Board directed staff, to the extent it is necessary, to either request a waiver or a confirmation that the regulations are within the scope of an existing waiver of federal preemption pursuant to section 209(b) of the Clean Air Act.

Manufacturer ZEV Sales – Exempt Class 8 Vocational Vehicles

Comment: Commenter states that Class 8 vocational vehicles have general operational characteristics that are less favorable for electrification because they have multiple types of unpredictable routes, greater concerns about payload, varied daily range needs, stop-and-go operations, and return to multiple locations daily where they can be charged or fueled. Therefore, they should not be included. [OP-81]

Agency Response: No changes were made to the regulation in response to this comment. As part of the rulemaking process, staff worked closely with stakeholders to develop a market segment analysis that can be found in Appendix F to the Staff Report. This analysis assessed 87 market segments in the Class 2b-8 market and assessed their suitability for electrification based on payload issues, daily range, infrastructure access, and space considerations. The analysis found that while many segments present challenges, there are a large number of segments that are well suited for electrification across the medium- and heavy-duty truck market. In particular, refuse trucks, yard trucks and box trucks are well-suited for electrification within the Class 8 vocational market. The suitable market for ZEVs is expected to expand further as ZEV technology improves, access to infrastructure expands and ZEV weights decline. Excluding all Class 8 vocational vehicles is unnecessary and is counter to the Board direction because it would reduce the number of ZEVs deployed. Furthermore, the regulation’s structure gives manufacturers flexibility to bank credits, shift sales between weight classes, and trade credits with other manufacturers to meet their compliance obligations.

Manufacturer ZEV Sales – Exempt Agricultural Trucks and Other Vehicles with Potential Barriers

Comment: Commenter asks for an exemption from sales requirement for "vehicles such as agricultural light duty trucks, which will likely face challenges with infrastructure". [OP-108]

Agency Response: No changes were made to the regulation in response to this comment. The ACT regulation does not define vocation-specific requirements for manufacturers; instead, it allows manufacturers to evaluate their product portfolio and customer base to determine which vehicles they should electrify. As a result, the proposal does not require manufacturers to sell to vocations that are not well-suited for electrification. To the extent that some applications such as agricultural trucks are not easy to electrify, manufacturers can focus their efforts elsewhere. As a result, there is no need to exempt specific vehicles as the proposal does not pigeonhole manufacturers into selling any particular vehicle.

Manufacturer ZEV Sales – Credit for Low NOx Engines and Renewable Fuels

Comment: Commenter states that the ACT regulation could achieve 25-50% market penetration by 2025 by including class 7-8 low NOx trucks with renewable fuel that meet or exceed the 0.02 g/bhp-hr NOx standard. Commenter states that including such low NOx trucks would help to surpass the projected emission reductions sought by the ACT regulation. Commenter recommends adding a partial credit for the inclusion of heavy-duty low NOx trucks. Commenter recommends that the proposed credit generation system exist up until CARB implements a new heavy-duty emission standard for internal combustion engines that meets or exceeds the 0.02 g/bhp-hr NOx standard. Commenter states that the proposed credit generation system would expire when the heavy-duty ZEV market has matured in cost, performance, infrastructure, and availability metrics. [OP-07, B1-12]

Comment: Commenter states that low NOx engines using renewable fuels should be included in the ACT regulation, as they are one of the most cost-effective near-term remedies for existing NOx and GHG emissions. [OP-11, T1-42]

Comment: Commenter states CARB should encourage all low carbon/sustainable fuels rather than focusing exclusively on zero-emission technology solutions. Commenter states CARB should allow ultra-low NOx vehicles to acquire credits, at least in the short term, as a single transportation technology may not be not be the correct strategy in many instances. [OP-32, T1-12]

Comment: Commenter states that Low NOx engines should be included in the rule strategy. [OP-44]

Comment: Commenter states that Low NOx engines should generate credits if deployed sooner than the proposed Low NOx Omnibus rule. [OP-60]

Comment: Commenter states that Low NOx trucks running on renewable gas should generate manufacturing credits just like plug-in hybrid electric vehicles. [OP-63]

Comment: Commenter suggests that both Zero-emission and Low NOx truck strategies be included in the proposed ACT Regulation. [OP-79, OP-80]

Comment: Commenter states that including low NOx class 4 - 8 trucks that meet or exceed the 0.02 g/bhp-hr NOx standard and use renewable fuel could achieve 25-50% market penetration by 2025 while surpassing the projected emission reductions sought by the regulation. [OP-80]

Comment: Commenter suggests the ACT regulation and the Low NOx Omnibus rule should be coordinated to better assess the combined aggregate costs and feasibility issues. [OP-87]

Comment: Commenter states they believe that near-zero technologies are being overlooked and need to be considered as an important pathway to achieving the goals from the proposed regulation. [OP-105]

Comment: Commenter suggest that alternative fuel vehicles should be included in the rule until a secure reliable updated electrical grid is in place, as the commenter doesn’t want to be enslaved by an electric choice that does not address the reality that oil-based fuel has been reliable. [OP-121-Form-277]

Comment: Commenter recommends CARB remain open to additional technology options in its pursuit of a net-zero vehicle emission future and that additional compliance pathways are included into the ACT proposal. Commenter suggests that CARB consider partial compliance of ZEV mandates via ultra-low NOx trucks fueled by low to net zero carbon fuels under the ACT or a complementary in-use fleet regulation. [B1-04, T1-08]

Comment: Commenter recommends CARB staff work with SCAQMD staff to determine fleet makeup to reach the 2023 standard and the 2031 standard for ozone attainment through strong incentive programs to replace diesel vehicles with commercialized technologies that are currently available, like ultra-low NOx natural gas engines. [T1-01]

Comment: Commenter states that renewable propane has carbon intensity similar to that of electric and including this with low NOx vehicles would significantly decrease carbon and NOx emissions. Commenter recommends including both zero-emission and low NOx strategies in the ACT regulation. [T1-16]

Comment: Commenter states CARB should include SCAQMD's definition of near-zero which includes the strictest optional low NOx standards for Class 7-8 trucks. Commenter states that incorporating ultra-low NOx trucks into the proposed near-zero standards means more choice and flexibility for fleet operators, addresses impacts to communities, meets CARB's main objective cleaning the air, and provides a pathway for the rule to be strengthened. [T1-21]

Comment: Commenter states that drayage industry already invested in near-zero (not CARB's definition) vehicles in Southern California so they should be allowed to fulfill operational obligations. The CTA would like to include all modes of zero and near-zero (not CARB's definition) technology. [T1-46]

Comment: Commenter states that instead of getting 15 percent by 2030, by doing near-zero and RNG in-state, we can get 50 percent by 2025 and implement SB 1383. [T1-49]

Comment: Commenter states that Low NOx engines have already been invested in and they provide significant benefits. There is uncertainty that commenter will get full lifecycle out of investments made in natural gas. [T1-69]

Agency Response: No changes were made to the regulation in response to these comments. This regulation constitutes one component of CARB's measures intended to achieve emissions reductions from medium- and heavy-duty vehicles, and the fuels they use. The purpose of the ACT regulation is to accelerate the widespread adoption of zero-emission vehicles (ZEVs) in the medium- and heavy-duty truck sector to reduce harmful emissions from on-road mobile sources beginning with the 2024 model year. The primary objectives of the ACT regulation identified in the Staff Report include the following:

- Accelerate first wave of zero-emission (ZE) truck deployments in best suited applications;
- Achieve 100 percent zero-emission pickup-and-delivery in local applications by 2040;
- Support the Ports of Los Angeles and Long Beach Clean Air Action Plan for 100 percent zero-emission drayage trucks by 2035;
- Support AB 739 requiring California state government fleets to purchase ZEVs;
- Enable a large-scale transition to zero-emission technology;
- Maximize the total number of ZEVs deployed;
- Complement existing and future programs;
- Provide environmental benefits, especially in disadvantaged communities thereby supporting the implementation of AB 617;
- Ensure requirements are technologically feasible and cost effective; and
- Foster a self-sustaining zero-emission truck market.

Emissions associated with new heavy-duty diesel and Otto-cycle engines used in on-road heavy-duty vehicles are being addressed by other policies and rulemaking actions, including the Low NOx Omnibus rulemaking and the existing Low Carbon Fuel Standard regulation.

The Low NOx Omnibus rulemaking primarily requires engine manufacturers to reduce the emissions of their new heavy-duty engines starting in the 2024 model year, and includes provisions for manufacturers to earn credit for the early introduction of cleaner engines or certifying engines to more stringent emission standards. The new standards would reduce emissions from all combustion engines sold in California, so that all engines will have similar emissions to those that are being referred to as low NOx engines today. By 2024 when the ACT regulation begins, all conventional internal combustion engines will be required to certify to a 0.05 gram of NOx per brake horsepower-hour standard, by 2027 all conventional internal combustion engines will be required to certify to a 0.02 gram of NOx per brake horsepower-hour standard. To the extent that manufacturers elect to certify and introduce engines that meet more stringent NOx emission standards or that meet more stringent NOx emission standards before specified timelines, they can generate credits under the credit provisions established by the Low NOx Omnibus rulemaking. Allowing manufacturers to also generate credits under the ACT regulation would unreasonably allow manufacturers to double the quantity of credits they are entitled to, which would in effect undermine CARB's goals in enacting both the Low NOx Omnibus and the ACT regulation – to significantly decrease emissions from on-road heavy-duty vehicles operating in California.

Furthermore, providing credit in the ACT regulation for engines that simply meet the NOx emission standards set by the Low NOx Omnibus rulemaking would offset ZEV sales that have no exhaust emissions, and would accordingly achieve fewer emission benefits and would be counter to the Board direction to maximize the number of zero-emission vehicles sold.

As for comments about low carbon fuels, the Low Carbon Fuel Standard regulation is already reducing lifecycle emissions from transportation fuels and the benefits resulting from that regulation cannot be claimed again as suggested by several commenters. The LCFS requires fuel producers and importers to reduce the carbon intensity of their transportation fuels and includes a credit mechanism to provide flexibility to regulated parties to meet the standard. This framework results in a strong market-based incentive for low carbon fuels including biofuels, electricity, and hydrogen which can generate credits to be sold to other regulated parties for their compliance. However, the benefits from switching from conventional fuels to a low carbon fuel of the same type have already been attributed to the LCFS regulation as described in the 2018 LCFS Staff Report and cannot be counted again in another regulation. Therefore, RNG and other low carbon fuels that are produced and sold as a result of the LCFS regulation would not result in new benefits by including these fuels in the ACT regulation. Conversely, when estimating the benefits of the LCFS regulation and its amendments, staff recognized that the LCFS regulation by itself would not be sufficient to encourage fleets to switch to zero-emission vehicles because it means fleets would need to switch to a new vehicle technology and a new fuel type rather than switch to a low carbon variant of the same fuel. Therefore, the low carbon fuel benefits from operating ZEVs was not included in the LCFS and are properly attributed to the ACT regulation and results in benefits that have not been previously claimed by another regulation. Therefore, the commenter's suggestions to include low NOx engines and low carbon fuels would only duplicate what is already expected from the LCFS and the Low NOx Omnibus rulemaking and would not result in any new emission benefits for NOx nor GHG emissions beginning in 2024 which is the timeframe of the approved regulation.

Manufacturer ZEV Sales – Allow More Technologies and/or Fuel Options

Comment: Commenter states that the proposed sales mandates in the ACT are extremely ambitious. Commenter states that until CARB and the manufacturers are able to collaboratively show that these goals are achievable at some reasonable point in time, commenter urges CARB not to shut the door on continued advances in the portable transportation fuels market. Commenter states that putting all of California transportation fuel needs in one basket is a mistake, at least until it can be adequately demonstrated that ZEVs are cost-effective, reliable and feasible. [B1-07]

Agency Response: No changes were made to the regulation in response to this comment. See staff discussion on how the ACT regulation has the primary purpose of expanding electrification in California, but is one of a suite of CARB efforts to reduce emissions from vehicles and fuels, in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Credit for Low NOx Engines and Renewable Fuels".

Manufacturer ZEV Sales – Low NOx Needed for Long-Haul

Comment: Commenter states that Low NOx engines provide a backstop if commercial ZEVs are not available by 2024 for long-haul fleets. [OP-07]

Agency Response: No changes were made to the regulation in response to this comment. Staff recognizes that long-haul will be one of the more challenging sectors to electrify. Staff evaluated that long-haul fleets are challenging to electrify in Appendix E to the Staff Report due to the range and infrastructure concerns associated with long-haul. Due to these challenges, staff proposed lower requirements in the Class 7-8 tractor requirements than in other categories. To the extent that some applications such as long-haul tractors trucks are not easy to electrify, manufacturers can focus their efforts elsewhere. Staff anticipates manufacturers can meet the requirements with drayage and short-haul trucks in the near-term and expanding to regional haul over time.

In August, staff presented a complementary Low NOx Omnibus rulemaking to the Board which requires the remaining combustion-powered vehicles to transition to cleaner possible combustion technologies. This supporting regulation will work in conjunction with the ACT regulation to reduce the emissions of hard-to-electrify segments such as long-haul.

Manufacturer ZEV Sales – Near-Zero-Emissions Vehicle Definition

Comment: Commenter states that the proposed ACT regulation restricts the definition of "near-zero" to only "plug-in hybrids with some all-electric range", purposely omitting low NOx vehicles. Commenter states that there is a long history of low NOx vehicles being included in the definition of "near-zero". For instance, the South Coast Air Quality Management District includes it in the definition of the Indirect Source Rules. CARB in agency documents have also included it at various times. And even opponents do refer near-zero -- as near-zero for low NOx vehicles. [OP-07, T1-41]

Comment: Commenter states that any new definition of "near-zero" should be vetted through a separate public process because the ACT usage is inconsistent with generally accepted use and severely limits its application. [OP-44]

Comment: Commenter states the redefining the definition "near-zero" should be reconsidered. Commenter states that several agencies use “near-zero” as having 90 percent reduction or better. Using the definition outlined in funding plan would redefine what “near-zero" means to the general public and state and local policymakers. [OP-63, T1-66]

Comment: Commenter is perplexed why the regulation interprets the term "near-zero" to apply only to plug-in hybrids with some "all-electric range". Commenter requests current proposed regulation emulate the current definition of near-zero. [OP-81]

Comment: Commenter states it is time to reinforce the existing ‘near-zero’ definition in statute coupled with an in-state RNG requirement to restore the HVIP funding that was discontinued at the October 2019 CARB meeting. Commenter states the need to include the low NOx engine into the near-zero definition. Commenter also supports the comments submitted by Solid Waste Association of North America (SWANA) and the California Refuse Recycling Council (CRRC). [OP-101, T1-49]

Comment: Commenter states CARB should revise the definition of "near-zero" to include low NOx engines. [OP-106]

Comment: Commenter states that the ACT regulation restricts the definition of "near-zero" to only "plug-in hybrids with some all-electric range", purposely omitting low NOx vehicles. Commenter states that there is a long history of low NOx vehicles being included in the definition of "near-zero". Commenter states the proposal's definition of near-zero should change because it conflicts with zero and near-zero definitions in AB 2061, which provides a weight exemption for alternative fuel vehicles. Commenter states that the conflicting definitions could result in confusion for CHP enforcement at weight scales. [B1-12, T1-44]

Comment: Commenter states CARB should include SCAQMD's definition of near-zero which would include low NOx and offer more choice and flexibility for fleet operators to offset diesel. [T1-21]

Agency Response: No changes were made to the regulation in response to these comments. The term “near-zero” has been used in different ways depending on the specific program and its meaning has evolved over time. For the purpose of this regulation, near-zero-emission vehicles (NZEV) are plug-in hybrid electric vehicles powered by both an internal combustion and battery-electric powertrain that are capable of operating like as a zero-emission vehicle for some distances. NZEVs are considered a bridge technology which will help the development of the full ZEV market by electrifying sectors not well suited to full electrification and supporting the ZEV supply chain.

The definition of “near-zero-emission vehicle” used in the ACT regulation is designed to apply to 2024 and later when all new engines sold are expected to have significantly lower emissions as required by the Low NOx Omnibus rulemaking. At that point, it is not meaningful to include solely combustion-powered vehicles in the definition of “near-zero-emission vehicles” as all new vehicles will meet or be close to the commenters’ “near-zero” definition. Staff’s definition is appropriate for the timeframe that the rule will be implemented in.

Manufacturer ZEV Sales – Credit for Conventional Hybrids

Comment: Commenter states that all hybrid technologies should be placed on an equal regulatory footing and should eliminate the negative crediting of hybrids. Also, commenter suggests CARB should allow hybrids to earn credits based on their relative reduction of GHGs. [OP-84]

Comment: Commenter recommends CARB to allow hybrid electric vehicles as defined in the Phase 2 GHG regulation to earn partial credits for a portion of ZEV compliance. [B1-04, T1-08]

Agency Response: No changes were made to the regulation in response to these comments. Conventional hybrid technologies have been commercially available in the heavy-duty sector for over a decade at this point, and other regulations including the California and Phase 2 GHG regulations already incentivize their purchase and use. Because the objective of the ACT regulation is to foster the deployment of zero-emission technologies, hybrid vehicles without zero-emission capability are not sufficient to meet the regulation’s goals. Plug-in hybrid vehicles meeting a minimum all-electric range requirement are a bridging technology that can offer zero-emission capability in applications that are not currently suitable for ZEVs; as a result, staff is giving partial credit for these near-zero-emission plug-in hybrids.

Manufacturer ZEV Sales – Add Credit for Electrified Power Take Off

Comment: Comment: Commenter states CARB should encourage creative solutions that could have near-term impact on existing emissions including technologies that reduce idling emissions from work trucks, such as electric power take-off. [T1-79]

Agency Response: No changes were made to the regulation in response to this comment. The regulation is designed to enable a large-scale transition to zero-emission technologies in the medium- and heavy-duty truck market. Vehicles that cannot operate part-time as a pure ZEV are not considered to be “near-zero” in the approved ACT regulation. Hybridization and ePTO technologies are already commercially viable without incentives and awarding credit for them would decrease the number of ZEVs produced.

Manufacturer ZEV Sales – Support Credit for Plug-in Hybrids

Comment: Commenter states general support for the PHEV credits currently allowed the proposed ACT regulation, and strongly supports the proposed sliding scale for NZEV crediting. [OP-50, T1-20]

Comment: Commenter supports regulation goals and sales requirements, and the inclusion of PHEVs as credit generators. [OP-61]

Comment: Commenter recommends that PHEV technology should be equated to BEV technology for 2024-30MYs as a bridge to full electrification and remain in place until battery technology (including charging) enables BEVs to be viable in the marketplace.

Commenter provided supporting documentation, articles, and references to support their comment. [B1-11]

Comment: Commenter states that many applications can be done much better with plug-in electric vehicles, especially in the fleet truck market, and that zero-emission miles accumulated are more important. [T1-09]

Comment: Commenter states CARB should encourage creative solutions that could have near-term impact on existing emissions, such as credits for plug-in hybrids. [T1-79]

Agency Response: No changes were made to the regulation in response to these comments. The objective of the ACT regulation is to foster the deployment of zero-emission technologies. Plug-in hybrid vehicles meeting a minimum all-electric range requirement are a bridging technology that can offer zero-emission capability in applications that are not suitable for ZEVs; as a result, staff is giving partial credit for these near-zero-emission plug-in hybrids. Staff views hybrid technology as a bridge technology, and will need full ZEVs everywhere feasible to meet CA air quality goals. Parallel hybrids cannot guarantee zero-emission miles and were not included.

Manufacturer ZEV Sales – Extend Sunset Date for Plug-in Hybrids

Comment: Commenter states that PHEV credits should sunset in 2040 instead of 2030, due to the following factors: the urgency of climate and AQ needs; the need for flexibility and a technology neutral approach to reducing emissions; the need for near-zero-emission vehicles for cases where full ZEVs are not yet suitable; better economical choices for low-income truck owners; reduced infrastructure burden. [OP-50]

Comment: Commenter states CARB should remove the restriction in § 1963.2(b) that eliminated the generation of NZEV credits after 2030. [OP-87]

Comment: Commenter states there are many applications that can be done better with long range plug-in hybrid trucks or strong PHEVs that annually get 90% to nearly 100% of their miles from electric energy. However, strong PHEV's need to be encouraged through this regulation with better incentives and no sunset date on eligibility. [B1-03]

Agency Response: Changes to the regulation were made in response to these comments. The Board approved changes to extend the timeframe that NZEVs can earn credits from 2030 to 2035. Plug-in hybrid or NZEVs may perform a key role as a bridging technology in allowing vehicles which cannot be fully electrified to transition to zero-emission in some capacity. This provides a partial zero-emission option for use cases that have highly variable uses or are not as suitable for electrification in the early market. At the same time, minimum all range was extended from the 2030 MY to the 2035 MY and the minimum all-electric range was changed to begin at 10 miles in 2021 but was increased to 75 miles in the 2030 model year to increase zero-emission mile operation. NZEV credits would end after the 2035 MY.

Manufacturer ZEV Sales – Extra Credit for ZEVs Deployed Before 2024 Model Year

Comment: Commenter states that ZEVs should generate additional credits if deployed sooner than the proposed ACT regulation. [OP-60]

Agency Response: No changes were made to the regulation in response to this comment. The ACT regulation already allows manufacturers to earn credit for ZEVs sold starting in the 2021 MY and grants these credits a longer life. Adding a multiplier to these credits would decrease the number of ZEVs a manufacturer would be required to produce and may decrease the total number of ZEVs deployed into California. In addition, manufacturers at this point have most likely locked in their production plan for the 2021-2023 model years so adding a multiplier would not spur additional action.

Manufacturer ZEV Sales – Avoid Multipliers for ZEVs Based on Range

Comment: Commenter states CARB should maintain the proposed one credit for each ZEV to avoid multipliers for longer range vehicles. [OP-33]

Agency Response: Staff thanks the commenter for the supporting comment.

Manufacturer ZEV Sales – Extra Credit for ZEVs Based on Range

Comment: Commenter recommends adding a range modifier or range multiplier for class 7 and 8 trucks that rewards the sale of long range zero-emission trucks. [OP-63, T1-66]

Agency Response: No changes were made to the regulation in response to this comment. Because of a number of issues associated with crediting ZEVs based on range, staff's proposal awards the same amount of credits regardless of the vehicle's all-electric range capability. First, manufacturers are already announcing single-unit trucks with over 200 miles of range and tractors with ranges of 500 miles. This indicates that range is not a technological issue; rather, it is a question of tradeoffs between cost, payload, and other factors as well as the availability of infrastructure. In this setting, fleets can analyze their operational needs and purchase the ZEV with enough range capability to meet those needs. If the regulation were to award more credit for longer range vehicles, this may lead to marketplace distortions as manufacturers are incentivized to build longer range vehicles than is necessary. This may lead to potential scenarios where fleets are forced to pay more for capabilities they do not need. For example, fleets that plan to rely more on opportunity charging (e.g., transit buses charging at each bus stop) may not need as much range from a vehicle compared to fleets that plan on depot charging their vehicles (e.g., vehicles return to a home base and charge overnight). Lastly, there is no test procedure in place for measuring the zero-emission range of zero-emission heavy-duty vehicles. A ZEV test procedure would require testing a fully manufactured ZEV on a dynamometer or modelling the vehicle's performance using simulation software. These solutions raise issues as a full chassis dynamometer test is costly and there are limited facilities to perform these tests for heavy-duty vehicles, and the data does not exist currently to model range with the resolution needed.

Manufacturer ZEV Sales – Clarify Deficit Generation Language

Comment: Commenter states CARB should modify § 1963.1(a)(1)(B) to clarify how deficits are calculated, specifically whether they are calculated per vehicle or across all sales. [OP-87]

Agency Response: Staff has modified the language to clarify how deficits are calculated. Each vehicle produced and delivered for sale in California generates deficits based on the ZEV sales percentage requirement and the appropriate Weight Class Modifier. The annual deficit is the sum of all deficits generated in a given model year.

Manufacturer ZEV Sales – Clarify All-Electric Range Definition

Comment: Commenter states CARB should modify § 1963.2(b)(1) by adding language to clarify that manufacturers may determine "all-electric range" in the same manner as GHG certification, including the test procedure. [OP-87]

Comment: Commenter states that the NZEV Factor formula changed from a battery capacity-based formula (in prior ACT regulatory workshops) to an all-electric range (AER) based formula. Commenter requests that CARB clearly indicate the exact AER test procedures to be used for chassis and engine dyno certified NZEV applications. [B1-11]

Agency Response: Staff has modified the definition of "all-electric range" and added a subsection describing "minimum all-electric range" requirements in response to these comments. These requirements are consistent with the California Phase 2 GHG requirements for measuring all-electric range and defining a minimum all-electric range until 2030.

Manufacturer ZEV Sales – Extend Credit Lifetime

Comment: Commenter states CARB should extend the credit lifetime in § 1963.2(g)(2) to allow ZEV credits to be used for five model years after the year in which they are generated, like the GHG rule at 40 C.F.R. § 1036.740(d). [OP-87]

Agency Response: Staff has modified the credit life provisions in response to this comment. In staff's original proposal, the credit lifetime was five years from the start of the model year while the Phase 2 GHG rules set the credit lifetime as being five years starting from the end of the model year. To harmonize with the Phase 2 Greenhouse Gas rules, staff has modified the ACT regulation's credit lifetimes so they are calculated from the end of the model year they are generated, not the beginning. This modification effectively extends the credit lifetime by one year. Staff does not anticipate this change will have adverse impacts as the stringent ZEV sales requirements will necessitate manufacturers use their credits rather than bank them excessively.

Manufacturer ZEV Sales – Extend Deficit Makeup Period to Three Years

Comment: Commenter states CARB should extend the requirement in § 1963.3(b) so a manufacturer must make up a deficit within three model years, like the GHG rule at 40 C.F.R. § 1037.745(e). [OP-87]

Agency Response: No changes were made to the regulation in response to this comment. The ACT regulation uses the same one-year deficit makeup period as the light-duty ZEV regulation. By requiring deficits be made up in a timely manner, the regulation ensures that manufacturers are building sufficient ZEVs to meet the state's goals. Extending the deficit makeup period to three years incentivizes delaying ZEV deployments and potentially damaging the overall zero-emission market. This modification would create unnecessary uncertainty for minimal benefit and therefore has not been incorporated.

Manufacturer ZEV Sales – Modify Credit Retirement Order

Comment: Commenter states CARB should modify § 1963.3(c) to allow manufacturers more flexibility in using credits before they retire. [OP-87]

Agency Response: Staff has modified the credit retirement order specified in section 1963.3(c) during the 30-Day Modifications in response to this comment. The modified credit retirement order states that the earliest expiring credit will be used first. This ensures that manufacturers will have assurance that their credits generated will not be wasted due to the order that credits are retired.

Manufacturer ZEV Sales – Allow Credit Transfer into Class 7-8 Tractor Group

Comment: Commenter requests that Class 8 straight truck credits be allowed free movement into the Class 7-8 tractor category, and requests credits from lower classes be restricted, capped, or otherwise limited (beyond weight class modifiers) in their ability to meet deficits in the class 8 vocational and class 7-8 tractor category. [OP-74]

Comment: Commenter states CARB should remove the restriction in § 1963.3(e) and allow a manufacturer to use straight truck credits to make up tractor deficits. [OP-87]

Agency Response: Staff made changes to the regulation to allow a limited amount of credits to be used towards meeting tractor deficit requirements. This directionally aligns with the commenter's request. The purpose of limiting the transfer of credits into the tractor group is to ensure that ZE Class 7 and 8 tractors are produced. Ensuring ZE tractors are deployed is critical to the regulation's goals as these vehicles are the largest emitters and are the most common vehicle for drayage operation. Allowing manufacturers to use non-tractor credits to meet their tractor requirement will increase the flexibility offered to them but would simultaneously reduce the amount of ZE tractors deployed. By allowing a limited number of credits to transfer from non-tractors to meet tractor-deficits, the proposal allows some flexibility to adjust to the market while ensuring ZE tractors are produced.

Manufacturer ZEV Sales – Move Reporting Date

Comment: Commenter states CARB should modify § 1963.4(a) to clarify that manufacturers must report by March 31 following the end of each model year. [OP-87]

Comment: Commenter suggests rewording section 1963.4(a) Sales Reporting. Beginning with the 2021 Model Year, a manufacturer must report by March 31 of the calendar year after each model year, the following information to CARB for each type of vehicle certified to California standards and sold in California for each model year. [B1-11]

Agency Response: Staff has modified the regulation in response to these comments so information is due by March 31 following the end of each model year rather than 90 days after the end of each model year. This effectively moves the reporting deadline back one day. This modification improves consistency between the ACT regulation and the Phase 2 Greenhouse Gas regulation.

Manufacturer ZEV Sales – Remove Zero-Emission Powertrain (ZEP) Certification Requirements

Comment: Commenter states that mandating ZEP certification combined with the broader sales mandates will unnecessarily inhibit technology development and result in hybrid vehicles generating negative credits. Commenter also states CARB is contradicting a major part of ZEP certification rationale and is concerned with it becoming a "mandatory certification process" for manufacturers subject to the new sales mandate, and states that ZEP certification should not be mandatory as part of the proposed regulation. Instead CARB should retain ZEP certification as an alternative certification method. [OP-84]

Agency Response: No changes were made to the regulation in response to this comment. The ZEP certification procedures are critical in ensuring manufacturers are developing quality products for consumers through its provisions. Specifically, the ZEP certification establishes an alternative certification pathway for HDEVs and HDFCVs that would help reduce the variability in the quality and reliability of such vehicles, ensure information regarding such vehicles and their powertrains are effectively and consistently communicated to purchasers, and accelerate progress towards greater vehicle reparability. ZEP certification requirements include: compliance with applicable emission standards, durability for the useful life of the engine, applicable labeling requirements, emissions warranty to the vehicle purchaser, and compliance with on-board diagnostic requirements. By incorporating ZEP certification into the ACT regulation, staff can ensure that fleets can expect a basic level of manufacturer support. Because the regulation does not require ZEP certification until 2024 MY, it gives manufacturers time to deploy vehicles in the early market but ensures full certification once the regulation begins requiring production at scale.

Manufacturer ZEV Sales – Wait for Results of Demonstrations

Comment: Commenter urges CARB to postpone the final development and Board approval of the regulation (not the date of its implementation), or at least build some flexibility into the rule until more can be learned from the state's current Zero- and Near-Zero-Emission Freight Facilities (ZANZEFF) investments. [OP-74]

Agency Response: No changes were made to the regulation in response to this comment. Meeting the goals laid out in the Staff Report – accelerating the first wave of ZE trucks, providing environmental benefits specifically to disadvantaged communities, fostering a large-scale transition to ZEV technologies, among others –requires immediate action. Waiting on the results of the ZANZEFF programs is inconsistent with these goals and not necessary given that the rule's requirements do not begin until 2024. Manufacturers and fleets have time to implement the ZANZEFF programs and incorporate findings from the programs into their future deployments. The ACT regulation is not dependent on the ZANZEFF and the Board gave clear direction to staff not to delay this rulemaking. Staff will be using information gathered through ZANZEFF and other demonstrations or pilot projects as we consider fleet mandates to deploy ZEVs in applications most suitable for their use.

Manufacturer ZEV Sales – Proposal Not Backed by Data or Analysis

Comment: Commenter states the timing for ZEV technology will vary considerably among different vehicle types and more analysis could provide additional insight into the ability of various market segments to transition to EV technology. Additionally, CARB's analysis doesn't have enough data to make such assessments on vehicle truck segments. Commenter requests CARB gather more data and analysis on suitability of ZEVs for different market sectors rather than finalizing the sales mandate and new reporting obligations concurrently. Commenter also requests CARB to, immediately at beginning of the rule, ensure the market signal delivered is based on thorough consideration of the technical, economic and operational challenges that remain for ZE vocational vehicle fleets. [OP-84]

Comment: Commenter states the proposed ACT regulation lacks a sufficient basis in data or robust market analysis and projections, and states assumptions used to assess TCO of battery-electric medium-duty and heavy-duty vehicles fails to fully recognize the importance of battery capacity for work trucks and overestimates the benefits of available government incentives. [OP-87]

Comment: Commenter states that the rule's timeline and feasibility studies appear to be based upon assumptions that may not reflect the realities of implementation. Commenter states that it seems unreasonable to mandate ZEV vehicles that MD and HD trucking fleets may not be able to use for their particular application. For example, remote or rural trucking operations may not be able to access charging infrastructure, and the batteries used in those trucks to support a feasibility determination may not support the payload and daily activities for which those trucks are typically purchased. [B1-07]

Agency Response: No changes were made to the regulation in response to these comments. The approved regulation does not require any individual fleet to purchase ZEVs. The approved regulation will ensure that manufacturers develop competitive ZEV products at a price point that will meet fleet needs in the market segments they chose.

Staff disagrees that the regulation does not adequately support its assumptions on technology, timing, and cost. As part of CARB's rulemaking process, staff held multiple workshops and workgroup meetings for the Proposed ACT Regulation. Staff held multiple workgroups on ZEV suitability, cost assumptions and methodology, and other key inputs to refine the assumptions and ensure we were using the most up-to-date information possible. To assess the feasibility of ZEV technology, CARB developed Appendix F to the Staff Report which assesses the feasibility of 87 different market segments in the medium- and heavy-duty market and grades their suitability. The methodology for the cost analysis is detailed in Chapter IX of the Staff Report and evaluates the cost to manufacturers to sell the required number of ZEVs, as well as the costs and savings to California businesses to support and operate ZEVs. An analysis of costs to a typical fleet can be found in Appendix H to the Staff Report.

Because the ACT regulation is a manufacturer rule, manufacturers need to identify market segments they can compete in and offer competitive products that fleets will want to purchase. Broadly, vehicles used for local delivery appear better suited while work trucks present more challenges. Manufacturers most likely will not target market segments poorly suited for electrification and will instead focus on the ones that electrification is best suited for.

As more information becomes available, staff will incorporate these new findings into new rulemakings. Staff did not assume any grants or rebates in the statewide cost analysis.

Manufacturer ZEV Sales – Feasibility of Zero-Emission Refuse Trucks

Comment: Commenter is concerned with electric-powered refuse equipment and the current market hasn't demonstrated they can meet certain duty cycle requirements for waste management. Commenter additionally states that staff suitability factors did not properly reflect the suitability weighting of Class 8 integrated solid waste management vehicles and that suitability scores of 1 or 2 for refuse or solid waste vehicles, to be dramatically overstated. [OP-81]

Comment: Commenter states they aren't convinced by the HD readiness now or in future due to duty cycle of collection vehicles and the weight penalty associated with collection systems. Commenter additionally states CARB should not be able to push ZEV technology onto refuse fleets if the ZEV technology is not reasonable, achievable, and cost-effective. Commenter recommends CARB could report back to the Board every 5 years to allow time for the refuse fleets transition off of NGVs. [OP-101]

Agency Response: No changes were made to the regulation in response to these comments. The approved regulation does not require any individual fleet to purchase ZEVs. The approved regulation will ensure that manufacturers develop competitive ZEV products at a price point that will meet fleet needs in the market segments they chose.

Broadly, the market segment analysis was used to inform decisions on the approved ZEV percentages. The market segment analysis in the Staff Report evaluated the suitability of refuse trucks in Appendix F: Market Segment Analysis. Staff found that refuse trucks are generally well suited for electrification and the assessment was informed by early ZE truck demonstrations and announcements by major truck manufacturers including Mack, Peterbilt, Lion Electric, and BYD and the City of Los Angeles commitment to make a full transition to a zero-emission refuse fleet by 2035 after conducting its own demonstration.

Manufacturer ZEV Sales – Infrastructure Concerns

Comment: Commenter states that infrastructure remains a challenge to deploy ZEVs. [OP-07]

Comment: Commenter recommends that a formal structure and process are created wherein CARB, CEC, CPUC and other relevant agencies are accountable to coordinate and plan charging infrastructure. Commenter states that permitting and other local government entitlement delays given the complexity of organizations involved and their unfamiliarity with the technologies can threaten timeline availability for heavy-duty EV's. [OP-74]

Comment: Commenter recommends CARB to continue and expand work with CPUC, CEC, and utilities on holistic long-range planning needs for infrastructure and workforce deployment. [OP-99]

Comment: Commenter states that ZEV sales requirement should include more charging stations to help develop a network before the regulation is adopted. [OP-121-Form-277]

Comment: Commenter states that infrastructure needs to be built out before the current proposal can be successful. [OP-123-Form-1161]

Comment: Commenter states that current proposal should increase the number of fast chargers and put them in strategic locations to help increase access to ZE charging. [OP-123-Form-42]

Comment: Commenter states that the high costs of infrastructure is an important barrier, particularly for zero-emission technologies, and the cost of providing hydrogen and electricity. Fleets face uncertainty on electric charging connection standards, which complicates deployment timing and future fleet expansion. [B1-07]

Comment: Commenter states that CARB could also provide credit for low power, bi-directional and wireless charging for these trucks and other electrified vehicles because of the benefits to the electric grid. [B1-03]

Comment: Commenter states there is a lack of dedicated funding for and access to heavy-duty ZEV infrastructure which are essential for vehicle operation and rollout. Some related items include accurate measurement and sale of fuel as well as policies facilitating rollout of infrastructure and vehicles. [T1-05]

Comment: Commenter states that extensive and costly infrastructure is needed for ZEVs, and that without incentives to offset those differentials, customers either will keep their old products longer or, given the choice, which the proposed regulation allows, will buy new diesel-fueled vehicles. Commenter also states that focusing the funding and infrastructure development in markets most amenable from their operating characteristics to being able to operate on ZEVs will seed the market and will allow us to better focus our efforts to further expand that market beyond 2026. [T1-19]

Comment: Commenter states CARB should, as a part of this rulemaking, assess the adequacy of infrastructure particularly for electric grid improvements vs hydrogen non-grid alternatives to ensure the ZEVs that are deployed as a result of the regulation do not become stranded assets. [T1-86]

Agency Response: Staff recognizes that a streamlined infrastructure rollout is critical for the success of an expanding ZEV market but no changes were made to the regulation in response to these comments. The ZEV sales percentage targets were based on the assumptions of return-to-base operations where infrastructure would be installed by the fleet. The market can expand faster with a broader network of public charging beyond what the regulation requires.

CARB and its sister agencies are coordinating policies to ensure a smooth transition to zero-emission vehicles. The California Public Utilities Commission and California Energy Commission are developing policy frameworks and assessments to support long-term infrastructure development plans. The California Public Utilities Commission has begun work on its draft Transportation Electrification Framework which is a policy framework intended to streamline upcoming investor-owned utility programs while providing metrics and guidance. The framework is designed to offer a holistic strategy for addressing how the state's IOUs will support California's clean transportation and climate goals.

Additionally, pursuant to Senate Bill 350, following approval by the California Public Utilities Commission, the state's three major investor-owned utilities have invested nearly $700 million over the next five years to support medium-duty, heavy-duty, and off-road transportation electrification. These investments are meant to cover all customer-side costs up to the charger and may offer a rebate for the charger itself.

The California Energy Commission, pursuant to AB2127, is developing a biannual infrastructure and energy demand assessment for electric vehicles in all categories including medium- and heavy-duty. This assessment will identify infrastructure needs as well as gaps which will help inform utilities on the investments needed in their service territories. The needs for depot charging and charging along freight corridors will be evaluated as part of these assessments. The information gathered through the Large Entity Reporting can assist our sister agencies in developing these documents and future efforts. These agency actions are part of a holistic effort by the state to streamline and support electric vehicle infrastructure for heavy-duty vehicles. The CEC is also evaluating resiliency and ZEVs which is discussed further in chapter "Written Comments Received during the 30-Day Comment Period", section "Economic Analysis – Fleet Infrastructure Resilience".

The CEC has also recently held a workshop discussing energy resilience and ZEVs. This July 2020 workshop invited several speakers to present on their view on resilience. Some speakers including Envision Solar, FreeWire, and Toyota highlighted different technology solutions including mobile chargers, chargers with battery storage and solar capability, and mobile hydrogen refuelers. Others highlighted the opportunities that vehicle grid integration and bidirectional charging can offer, with the California Transit Association stating that an integrated solution of solar, energy storage, and electric buses can provide resiliency while significantly reducing energy costs. A different presenter from the Blue Lake Rancheria showed how they were able to use ZEVs to support their microgrid during the recent power shutoff events through bidirectional charging, indicating that potential challenges resilience planning is causing, but others pointed out that ZEVs can be more resilient than other vehicles, and in some situations with vehicle grid integration, can support the grid during potential power shutoff events. The presenter Next-Dimension highlighted that ZEVs can be a solution to the state's challenges, but doing so will require coordination from state agencies, vehicle manufacturers, emergency responders, and utilities. The information gathered through the ACT Regulation's Large Entity Reporting requirements will also assist our sister agencies in developing these documents and future efforts. These agency actions are part of a holistic effort by the state to streamline and support electric vehicle infrastructure for heavy-duty vehicles.

The Governor's Office of Business and Economic Development, or GO-Biz, is working with municipalities to implement AB 1236 which requires local governments to streamline permitting processes for all types of charging stations. While streamlining permitting will require changes at the local level, action is begin taken today and many issues are expected to be resolved by the time the regulation's requirements begin.

Numerous commenters have suggested awarding credits within the ACT regulation for deploying chargers or infrastructure. Making this modification would allow vehicles to generate a smaller portion of the required credits and effectively decrease the amount of credits needed from vehicles and decrease the number of ZEVs deployed by the regulation. For this reason, staff has not modified the regulation to allow credits for infrastructure as this can be done more effectively through collaboration with our sister agencies and industry than through the ACT regulation.

Manufacturer ZEV Sales – Grid Resiliency

Comment: Commenter states electricity is not a reliable energy source. [OP-18, OP-21]

Comment: Commenter states the proposed regulation would require electrical energy supply and/or on-site battery backup charging infrastructure to meet the mandated public health and environmental protection services such as homeless encampments, fires, and disaster readiness. [OP-81]

Comment: Commenter states concern about the State's existing electrical infrastructure with blackouts and its ability to address a broader deployment of ZEVs. [OP-101]

Comment: Commenter states that the recent performance of California's electricity infrastructure in the wake of natural or climate driven disasters is not impressive. [B1-07]

Agency Response: No changes were made to the regulation in response to these comments. The California Public Utilities Commission's draft Transportation Electrification Framework, noted in the preceding agency response, explicitly identifies resiliency as a focus for the utilities and discusses vehicle to grid integration, micro grids, backup generation by diesel or fuel cell generators, and other solutions. The CPUC is currently soliciting stakeholder input and intends to finalize the Transportation Electrification Framework after incorporating this feedback. The CPUC has also started a rulemaking process regarding microgrids and resilience as directed by SB 1339. The CPUC has released its Track 1 decision as of June 2020 and has issued the scoping memo for Track 2 of this rulemaking. This work on microgrids will bolster resiliency and help support vehicle applications which rely on the grid. Lastly, as part of San Diego Gas & Electric's SB350 program, the CPUC approved a V2G pilot using buses to evaluate how these vehicles can provide energy to the grid and potentially boost resilience.

See discussion on the work California is undertaking to bolster resilience and the role of ZEVs in chapter “Written Comments Received during the 30-Day Comment Period”, section “Economic Analysis – Fleet Infrastructure Resilience”.

Manufacturer ZEV Sales - Credit for Off-Road Yard Tractors

Comment: Commenter states that small manufacturers should generate credits through sale of off-road yard tractors. [B1-02]

Agency Response: No changes were made to the regulation in response to this comment. The main difference between on-road and off-road yard tractors is whether it is equipped with safety equipment to legally operate on-road e.g., turn signals and whether it is powered by a cleaner on-road engine or dirtier off-road engine. For zero-emission vehicles, there is no emissions difference between an on-road and off-road yard tractor and the only difference is the safety equipment installed. Staff anticipates manufacturers will choose to make all zero-emission yard tractors on-road capable to earn credit in the proposal.

Manufacturer ZEV Sales - Credit for Small Manufacturers

Comment: Commenter suggests that small manufacturers should be allowed to opt-in early and generate credits. [B1-02]

Agency Response: Staff’s proposal allows small manufacturers who are otherwise exempt from the proposal’s requirements to voluntarily generate credits, therefore no changes were made to the regulation in response to this comment. This approach maintains necessary exemptions for small manufacturers while allowing these manufacturers to capitalize on their ZEV investments.

Manufacturer ZEV Sales – Small Manufacturer Considerations

Comment: Commenter states that Autocar qualifies as a small business under the Small Business Administration size criteria that set the standard for GHG, and consistent with California's Government Code. In drafting the ACT, CARB was required to determine whether the adoption of the regulation affected a small business. Commenter states that they were not contacted by CARB staff, and staff confirmed that they did not expect Autocar sales would exceed 500 on-road vehicles annually based on data they had. Thus, with respect to Autocar, CARB has not met its requirement to determine whether the ACT affects small business.

Commenter states that the ACT's ZEV production requirements and time line will impose disproportionately high burdens on a small business like Autocar, which produces small volumes of a select few product lines. The lack of product mix denies

Autocar the benefit of averaging and aggregating credits. The low overall volume denies Autocar the benefit of banking credits and prevents it from spreading development and compliance costs across many vehicles. In contrast, competitors will spread such costs across tens of thousands of vehicles and multiple product lines, and with vertical integration and robust purchasing power, the competition will gain a competitive advantage over its "small town" competitor.

Commenter states that a small business cannot utilize the credit/deficit flexibilities built into the ACT regulation. Commenter states that in the Staff Report, CARB staff describes the weight class modifiers that "provide flexibility for manufacturers to produce more ZEVs in one group to avoid making a small number of ZEV sales in other groups." This construct acknowledges that certain ZEV applications will take longer than others to bring to market (or even that electrifying some vehicles will be "avoided" altogether), and assumes that all manufacturers have products in multiple classes. Commenter states that the flexibility afforded Autocar's competitors is unavailable to Autocar and other (typically smaller) manufactures that do not have large, diverse product lines. [B1-02]

<u>Comment:</u> Commenter states the threshold for the small manufacturer exemption should be raised to a level that captures small businesses. Commenter recommends revising Section 1963(e) as follows: “Manufacturers that never exceed 1,500 annual average sales of Class 2b and greater vehicles in California for the three prior model years are exempt from the requirements of sections 1963 through 1963.5” with other conforming changes. Commenter states that the revision will provide sufficient time for small manufacturers to invest the necessary resources and time to develop ZEV versions. Commenter states that without this exemption they may be forced to stop selling vehicles in California as they see many product lines remaining as diesel or gas sales. [B1-02, T1-07]

<u>Agency Response:</u> No changes were made in response to these comments. Staff’s recommendation of a cutoff of 500 annual sales is based off of data received from EMA and DMV and is designed to ensure all major OEMs are included in the manufacturer ZEV sales requirements. Staff is meeting original intent to have all major OEMs included in the manufacturer ZEV sales requirements based on sales data received from EMA and cross referenced with DMV. The low volume exemption was created for niche and nascent businesses. This ensures an even playing field across the industry. It is not reasonable to exempt specific vehicle types, as this provides manufacturers maximum flexibility to determine how to comply. Multiple vehicle types can be built on the same chassis.

Staff notes that AB 1033 (2016) defines a small business for the purpose of regulatory analyses as one that meets three criteria: is independently owned and operated, is not dominant in its field, and consists of 100 or fewer employees. Autocar is a subsidiary of GVW Group LLC and is not an independently owned and operated company, nor have they demonstrated that they have 100 or fewer employees. Based on this, Autocar does not meet the definition of a small business for purposes of this rulemaking.

Manufacturer ZEV Sales - Require Small Manufacturers to Provide Updates

Comment: Commenter suggests that any manufacturer subject to the small manufacturer exemption should be required to provide semi-annual reports on their progress towards ZEV development, including information such as time lines and stage development by product line, number of ZEVs produced, status of pilots and demos, engine manufacturer interaction, body company involvement, and customer outreach efforts. [B1-02]

Agency Response: No changes were made to the regulation in response to this comment. All manufacturers must report their ZEV sales to earn credits. Small manufacturers are already required to report annual information under the California Phase 2 GHG regulation, and CARB will be able to track their vehicle sales and the number of ZEVs sold into California each year. There is no need to increase the reporting frequency or breadth.

Manufacturer ZEV Sales – Set Performance-based Metrics for ZEVs

Comment: Commenter states CARB should establish standards for ZEVs in this rule to drive continual improvement and innovation in clean mobility. These can include battery performance standards, such as lifecycle emission reduction goals, range requirements, and short and long-term deterioration limits. [T1-08]

Agency Response: No changes were made to the regulation in response to this comment. The regulation makes the Zero-Emission Powertrain Certification program requirements mandatory for manufacturers to earn credits. This program does not have performance standards, but does have performance disclosure and warranty requirements. There is no need to set minimum performance standards in this regulation nor the certification program, because the market will favor product offerings that meet customer needs.

Manufacturer ZEV Sales – Gradual Electrification Ramp Rates

Comment: Commenter recommends gradual electrification ramp rates. Commenter states that the typical product development cycle is four years, consumer awareness and acceptance require months if not years of sustained effort, and that the necessary charging infrastructure requires time to install. This market hesitation points to the need for gradual sales ramp rates to accommodate market adjustment. Commenter states that by specifying a 9% starting requirement for Class 2b/3 pickups in 2027 MY, the ACT regulation does not address the need for gradual transition in the segment. Commenter recommends that when electrified pickups are introduced, the initial ramp rates follow the phase-in pattern of the other Class 2b/3 and Class 8 vehicles. [B1-11]

Agency Response: No changes were made in response to this comment. As a result of the 30-Day Changes, the requirements for Class 2b-3 pickups has been modified to match those of all other Class 2b-3 vehicles. These requirements start at 5 percent in 2024 and ramp up to 30 percent in 2030. These requirements ramp up over time to give manufacturers time to develop and validate new products as well as give fleets time to test new products as well as make necessary infrastructure and workforce preparations. For staff's justification for removing the delayed timeline for pickup trucks, see section Comments Received During Original Proposal's 45-Day Comment Period, section Manufacturer ZEV Sales – Strengthen the ACT Proposal by Including Pickups Earlier and/or Increasing Sales Percentage Requirements.

The regulation's structure gives manufacturers flexibility to bank credits, shift sales between weight classes, and trade credits with other manufacturers. This means that a manufacturer who sells pickups, vans, and trucks can meet their compliance obligation by producing ZE vans and trucks without producing any ZE pickups for a number of years if there are better markets to serve or can purchase credits from other manufacturers regardless of the truck types they sold to earn their credits.

Manufacturer ZEV Sales – Inclusion of Motor Coaches

Comment: Commenter asks why motor coaches are excluded from the ACT regulation. [T1-85]

Agency Response: No changes were made to the regulation in response to this comment. Staff excluded motor coaches because motor coach manufacturers have already begun zero-emission motor coach development in response to the Innovative Clean Transit (ICT) regulation and Zero-Emission Airport Shuttle Bus regulation. Their sales in California are low such that they would be exempt as small manufacturers, and giving credit for motor coaches and other transit bus categories would not provide additional benefit as these manufacturers are separate from typical bus manufacturers and already producing ZEVs. In addition, they would dilute the total number of ZEVs deployed in the ACT regulation because they are already required by the ICT regulation.

Manufacturer ZEV Sales – Health Impacts Not Fully Quantified

Comment: Commenter states that ACT SRIA didn't fully quantify the health impacts of air pollution. Commenter submitted studies supporting their comments. [OP-73]

Agency Response: No changes were made to the regulation in response to this comment. The health analysis for the ACT regulation was performed by calculating the emission reductions per air basin based off of the number of ZEVs anticipated to be deployed in each air basin. The regulation does not require manufacturer to deploy ZEVs in locations or areas which limits the ability to estimate the emission impacts in greater detail. CARB recognizes this limitation and will reassess emissions methodology in future rulemakings and as newer research allows more thorough methodologies.

Manufacturer ZEV Sales – General Support

Comment: Commenter states they strongly support the proposed regulation. [OP-17, OP-22, T1-31]

Comment: Commenter generally supports, urging the Board to be bold to get diesel trucks off the road. [OP-35]

Comment: Commenter states support in CARB leading California to a future free of the influence of the oil industry. [OP-38]

Comment: Commenter states support for CARB to adopt the regulation and requests CARB work with trucking industry cooperatively to achieve new targets which may be difficult to attain. [OP-95]

Comment: Commenter supports the proposed regulation and reference senate bill 498 (SB 498) and SB 44 showing the Legislature's support in maximizing the adoption of ZEVs in California. [OP-100]

Comment: Commenter states they are supportive of the overall goal of the proposed regulation and are ready to help facilitate transformation of the transportation sector across all medium- and heavy-duty segments. [OP-104]

Comment: Commenter states support for the proposed ACT regulation to address climate change, air pollution, and the impacts to disadvantaged communities. [B1-09]

Comment: Commenter states that ZEVs are good and trucks have the ability to become ZEVs. [T1-35]

Comment: Commenter states they support the ACT regulation and immediate transition to cleanest available technologies. [T1-67, T1-68]

Agency Response: Staff thanks the commenters for these supporting comments. Additional issues raised by commenters, if any, are addressed in the applicable sections.

Manufacturer ZEV Sales – Support for Following Through on SIP Measure

Comment: Commenter states CARB should adopt this rulemaking to follow through on the inclusion of and commitment to the "Last Mile Delivery Standard" in the State Implementation Plan and Scoping Plan. [OP-15]

Agency Response: Staff thanks the commenter for the supporting comment.

Large Entity Reporting – General Support

Comment: Commenter commends CARB staff for making changes to original language and supports the current reporting requirements. [OP-63]

Agency Response: Staff appreciates stakeholder support for collecting this critical information. Any other comments or issues made by the same commenters are addressed in the applicable sections.

Large Entity Reporting – Unclear Language, Unclear Requirements, Unnecessary Information

Comment: Commenter states the regulation language is unclear, asking for judgements, guesses and approximations resulting in unusable data. Additionally, commenter states the goals of the reporting requirement are unclear. Commenters state CARB is asking for information about unrelated vehicles or not asking for more pertinent information regarding existing electric or low-emission vehicles. [OP-04, OP-05, OP-06, OP-09, OP-10, OP-12, OP-14, OP-32, OP-37, OP-39, OP-44, OP-51, OP-52, OP-54, OP-108, T1-26].

Comment: Commenter states that data provided would likely be inaccurate estimates because vendors, not the commenter, would have most of the data being requested. [OP-54]

Comment: Commenter states there are ambiguities in the section language that will lead to misleading or erroneous conclusions that could skew and/or double-count large entity reporting information. [OP-81]

Comment: Commenter states CARB's purpose for collecting facility level and contracting data needs to be clarified in rulemaking documents to refine the best data and collection methods to meet the intended purpose. Additionally, commenter states CARB should directly address whether indirect sources will be a point of future regulation. Commenter states that it is not clear why information on light duty vehicles is needed, or that light duty vehicle information is superfluous. [OP-106]

Comment: Commenter states that light duty vehicles were not evaluated by CARB in the economic analysis, are inconsistent with the medium- and heavy-duty focus of the regulation otherwise, and should be deleted. [OP-108]

Comment: Commenter states the regulation does not provide enough specificity in describing the type and measure of data requested, stating that many of the facility types could be interpreted broadly to apply to the commenter's facilities, but may overlap in interpretation, so the commenter would not know which facility type to group the facilities under. Additionally, commenter has concerns about how to interpret "predictable usage pattern" for the vehicle portion. [OP-110]

Comment: Commenter agrees with the comments submitted by the California Chamber of Commerce expressing concern on excessive reporting, vague enforcement, and unclear goals. [B1-08]

Comment: Commenter states the regulation language is unclear, asking for judgements, guesses and approximations resulting in unusable data. Additionally, commenter states the goals of the reporting requirement are unclear. Commenters state CARB is asking for information about unrelated vehicles or not asking for more pertinent information regarding existing electric or low-emission vehicles. [T1-70, T1-99]

Comment: Commenter states that it is important for staff to clarify and narrow the reporting requirements. [T1-42]

Comment: Commenter states that it is not clear why information on light duty vehicles is needed, or that light duty vehicle information is superfluous. [T1-99]

Agency Response: Staff made changes to the regulation to streamline the reporting process and clarify any confusing language in response to these comments. As part of these changes, staff removed the facility reporting information, truck trip count information, all light-duty vehicle information, as well as streamlined the language and added guidance on how to complete the reporting. This is consistent with the comments received as well as Board direction to streamline the reporting. Staff deliberately designed the reporting to use best estimates in order to allow respondents flexibility and leeway in responding. Staff has worked with stakeholders to streamline, simplify, and clarify expected responses to these questions. The information in the approved regulation is primarily limited to vehicle usage information and about the vehicle home base which will help staff develop effective and fair ZE fleet rules.

Large Entity Reporting – Cost Burden

Comment: Commenter states that staff underestimated the cost of the reporting requirement. [OP-03, OP-04, OP-05, OP-06, OP-09, OP-10, OP-12, OP-14, OP-32, OP-37, OP-39, OP-44, OP-51, OP-52, OP-54, OP-63]

Comment: Commenter states that mandatory reporting and purchasing requirement benefits are outweighed by the cost of regulation. Current investments by commenter's members undermine the need for mandates and ambitious timelines, and would only increase the cost of equipment. The majority of entities do not have tracking in place for the data requested, and would be required to develop and implement such systems, resulting in more cost and time burden than CARB estimated. CARB's compliance cost estimate for the reporting requirements are significantly underestimated. [OP-39, OP-108]

Comment: Commenter states entities would need to develop and implement tracking systems and record retention policies that do not exist, which are complex and expensive. [OP-54]

Comment: Commenter states that economic analysis of the reporting requirement proposal concerns them. [OP-65]

Comment: Commenter states that most waste industry providers are rate-regulated and are not free to unilaterally pass on to their customers the cost associated with a change in law or regulation. [OP-81]

Comment: Commenter states that SRIA estimates for reporting cost is unclear and underlying assumption that companies would already have data management systems to gather information is incorrect, as commenter does not have data at the level requested. Additionally, extensive facility coordination labor costs and time requirements are underestimated by CARB, as individual data points must be gathered to provide correct ranges. [OP-103]

Comment: Commenter states that SRIA severely underestimates time and cost of reporting and CARB should update economic assessment and/or refine the rule requirements to minimize the burden. [OP-106]

Comment: Commenter has concerns on the unforeseen impact to district budgets and operations, as well as the potential for needed inventory to become limited due to potential reduction in manufacturing offerings as a result of the requirements as currently proposed. Commenter is concerned potential impacts of the ACT to district budgets could directly lead to a reduction in critical services provided by districts to their community. [B1-01]

Comment: Commenter is concerned the large entity reporting requirements will imposes new costly and burdensome reporting requirements and should be addressed prior to adoption. [B1-09]

Comment: Commenter states the cost and time requirement of complying is not in line with what staff estimates. [T1-03]

Comment: Commenter states that 4 hours in the SRIA underestimates the time and thus cost burden of reporting. [T1-06]

Comment: Commenter states concern over the cost that future mandates will have to farmers, such as prices of pick-up trucks increasing. [T1-47]

Agency Response: Changes were made to the regulation in response to these comments. Staff removed all questions related to facility contracting, truck trips, and light-duty vehicles. These changes should decrease the time and expense associated with the reporting requirements. In the Staff Report, staff updated the time estimate for the large entity reporting from 4 hours as described in the SRIA to 25 hours. This is an estimate as the time needed to report will vary widely as businesses with few trucks will be able to complete their reporting quickly while large fleets will need more time. The anticipated costs of the reporting requirement are anticipated to be minimal and not result in rate increases to pass on to customers. Staff has added guidance to the regulation that will help fleets who do not have robust data management software complete the reporting requirement.

Large Entity Reporting – Regulation Requires Hard-to-Collect Information

Comment: Commenter states their members do not dictate contracted transport means and have no control over how services are provided, nor information on vehicles used to provide the services, and could likely not identify types of commodities being shipped. Paper correspondence are sent via carriers or postal system and may at some point be on 3rd party trucks over 8,500 GVWR, but validating that or the volume would be impossible. [OP-54]

Comment: Commenter states that questions asked in the large entity reporting requirement are too extensive and states that company revenues should have no place in future regulations. This creates an undue burden on fleets that do not already collect or maintain these types of records. [OP-58]

Comment: Commenter points out the record retention portion of the proposed large entity reporting requirement implies that records must be collected for every facility to support the aggregated and representative responses, which would negate any time or resource savings resulting from aggregate responses. They have hundreds of facilities which could possibly be respondent to the vehicle usage data section, and requests CARB to use vehicle usage data from a representative facility of each type. [OP-102]

Comment: Commenter states concern that vehicle usage section would require commenter to report information for each of its facilities that has a single truck stationed at the facility, and that this results in 7000 vehicles being tracked daily to collect responsive data. The reporting requirements will require unnecessarily extensive data collection and is burdensome. [OP-103]

Comment: Commenter states CARB underestimates administrative burden, costs, and compliance challenges to fleet and facility reporting. The rule implies entities would need to gather data on every facility and vehicle over the 2020, requiring collection of data prior to finalizing the rule, and the recordkeeping requirements would necessitate specificity that staff are trying to avoid with streamlining efforts. [OP-106]

Comment: Commenter states that due to lack of control businesses have over dictating transportation methods or means for services contracted, data requested may be unknown resulting in a lack of usable data. Regulated entities have no control over records of subcontractors or subhaulers that contractors hire to perform services, and will not be able to keep these records. [OP-108]

Comment: Commenter states the Board should recognize various ancillary challenges associated with the ACT fleet reporting proposal and should make efforts to overcome or minimize them. [OP-116]

Comment: Commenter states the information being asked for is intrusive. Some of their small family owned business members do not keep the data CARB will be requesting. [T1-03]

Comment: Commenter states they are being asked to report data about vehicles they do not control. [T1-06]

Comment: Commenter states that the fleet reporting puts an undue burden on entities, many of which have never been regulated by CARB prior to this rule and are not direct sources of GHG emissions. [T1-22]

Comment: Commenter states CARB underestimated the time and cost burden to comply, as members do not have systems in place to track the information CARB is seeking since they are not in the trucking business. [T1-26]

Comment: Commenter mentions the fleet reporting requirement offers challenges. [T1-46]

Comment: Commenter states that staff underestimates reporting time requirement, and states that members need at least 6 months together required data. [T1-77]

Comment: Commenter states that the fleet reporting should be streamlined to be less onerous. [T1-99]

Agency Response: Staff recognizes the potential unintended burden that the initially proposed regulation may impose on businesses, as a result, changes were made to the regulation in response to these comments. Consistent with Board direction to streamline the reporting, staff has made several key changes to the proposal. First, regulated entities were limited to only those that own or direct the operation of medium- or heavy-duty vehicles. Second, all of the facility-based data and truck trip counting questions were removed. Staff will seek to gather this data through other means such as a contract. Third, after the initial hearing, staff worked with stakeholders to further simplify report, and added additional language in the regulation to clarify expected responses and to provide more flexibility in determine which time period to use in analyzing vehicle usage data. Last, language was added to make it clear that CARB staff would seek clarification of apparent anomalies in the reported data. These changes are consistent with commenters' requests and meet the Board's direction.

Large Entity Reporting – Bifurcate the Large Entity Reporting from the ACT Regulation

Comment: Commenter requests CARB bifurcate the large entity reporting requirement from the manufacturer sales requirement into a separate rulemaking and hold additional public workshops to solicit affected businesses. [OP-03, OP-04, OP-05, OP-06, OP-09, OP-10, OP-12, OP-14, OP-32, OP-37, OP-44, OP-51, OP-54, OP-58, OP-102]

Comment: Commenter states that staff should bifurcate this rule and hold a series of workshops to create a workable streamlined data gathering process. At minimum, the current draft has many issues that must be addressed. To that end, appreciates staff's commitment and recommendations to narrow the dates upon which businesses will be required to count vehicles, clarify how businesses will choose representative weeks and facilities, and to work to revise unclear definitions. [OP-39, OP-108, T1-22]

Comment: Commenter requests CARB bifurcate the large entity reporting requirement from the manufacturer sales requirement into its own rulemaking. [T1-03, T1-23, T1-27]

Comment: Commenter asks to delay implementation of the regulation to allow time for a more thoughtful rule to be developed. [T1-99]

Agency Response: No changes were made to the regulation in response to these comments. The Board directed staff to accelerate the rulemaking process for fleet rules when they approved the Resolution. It would not be possible to have enough time to finish the manufacturer rule, craft a separate reporting regulation, have time for fleets to collect and submit data, and then use that data to craft a future ZEV fleet rule by the end of 2021. Staff held multiple workshops and workgroup meetings through a four-year public process with eight public workshops, five public workgroups, two focus group meetings, and well over one hundred meetings with stakeholders, thus providing significant opportunity through the process to obtain and respond to their concerns.

Large Entity Reporting – Specific Changes to the Facility Reporting

Comment: Commenter states the requirement for vendor or subcontractor vehicle trips should be removed, as quantifying "non-refrigerated" vs "refrigerated" trips requires visual inspection, and would be burdensome and infeasible, and the data is duplicative because those vendors would likely be subject to the reporting requirements already. [OP-61]

Comment: Commenter states CARB should recognize businesses don't have vehicle trips based on "typical week" and should work with entities to determine appropriate assumptions to avoid noncompliance. [OP-63]

Comment: Commenter recommends CARB include definitions for "goods", "non-food delivery", and "food delivery" to the representative facility survey, to help provide clarity on what is include and where to report it. Commenter questions how the term "trip" is defined in the vehicle trips section. Does trip refer to an arrival or departure of one vehicle trip or two separate vehicle trips? For example, is arriving on Monday and departing on Tuesday one trip or two trips? Commenter has questions about applicability of vehicle trips and supplier counts and wants to know if these terms include company and or non-company third-party vehicle trips and suppliers. [OP-104]

Comment: Commenter states CARB should clarify rule language if facility reporting for a "typical week" snapshot in time is intended, and provide guidance on how to determine the appropriate tracking period and documentation. [OP-106]

Comment: Commenter states that 2012.3(b)(4) should be deleted, as entities will not have data for vehicles acquired prior to 2020 reporting year. The regulation should be revised to clarify that entities should only report facilities and vehicles operated inside California. [OP-108]

Comment: Commenter states that "typical facility" and "typical week" need to be clarified with guidance. [OP-110]

Agency Response: Staff has removed the entire facility reporting section of the rule in response to these and other comments from stakeholders, and will seek to gather the information through non-regulatory means. For further information on other streamlining modifications, see response in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Large Entity Reporting – Unclear Language, Unclear Requirements, Unnecessary Information”.

Large Entity Reporting – Increase Amount of Information Reported

Comment: Commenter states the reporting requirements should ask whether current vehicle is used to help society recover after a catastrophe, whether their current vehicle is used in daily emergencies, the amount of daily average and annual miles per category of vehicle and monthly hours of operation per category of vehicle, the percentage of short trips vs long trips by category of vehicle, how many vehicles in single, double, or triple shift operations, and an estimate of the percentage of daily or annual miles driven within disadvantaged communities. [OP-50]

Comment: Commenter states CARB should require total number of hauls made by the company and the number of hauls made by direct employees to understand the extent to which a business relies on contracting. [OP-76]

Comment: Commenter states that vehicle data requested does not provide useful information, including missing the distribution of miles travelled in a year. [OP-110]

Comment: Commenter states the reporting requirements need to be strengthened and capture key data on industry adoption barriers. [T1-87, T1-91, T1-94, T1-96, T1-97]

Comment: Commenter states CARB should collect data on total hauls and hauls performed by direct employees versus contractors. [T1-88]

Comment: Commenter suggests including the weight class category for vehicles in questions 2012.1(a)(17) and (a)(18). [OP-104]

Agency Response: No changes were made to the regulation in response to these comments. The approved ACT Regulation balances the need to collect as much information as possible with Board direction to streamline the reporting and reduce burden on affected entities. Staff have determined the required information to be sufficient to broadly characterize industry sectors and to identify business models that may be able to electrify their fleets sooner, which will factor into future fleet regulations. Staff intends to allow fleets to submit voluntary information as part of their reporting. Additionally, staff intends to request and accept additional information from fleets as part of a future zero-emission fleet rule.

Large Entity Reporting – Require Annual Reporting

Comment: Commenter states CARB should require reporting on an annual basis to capture continuous updates as trucking industry grows and transforms. [OP-76]

Comment: Commenter states CARB should require annual reporting to help develop a comprehensive picture of the changing industry. [T1-88]

Agency Response: No changes were made to the regulation in response to these comments. The information required by the large entity reporting is sufficient to support further development of ZE fleet rules and gathering information annually afterwards would be unnecessary as staff would not have time to incorporated information received in April 2022 into the ZE fleet rule that staff intends to present to the Board in late 2021. Furthermore, increasing the reporting requirements will be inconsistent with Board direction to streamline the reporting. If additional reporting is necessary, staff can reintroduce requirements at a separate date in the future. Staff intends to allow fleets to submit voluntary information as part of their reporting. Additionally, staff intends to request and accept additional information from fleets as part of a future zero-emission fleet rule.

Large Entity Reporting – Lower Size Threshold

Comment: Commenter states that reporting requirement threshold should be lowered to 15 vehicles dispatched in 2019 for drayage, parcel, construction, and long-haul entities to collect data on the smaller firms that are the primary operators in these industries. Commenter states that reporting requirements should be strengthened, as data captured would be too limited to inform future policies. Commenter provides an example that reporting requirements written would only capture data on 26 trucking firms representing less than 2% of active trucks at the San Pedro Bay ports, which would be insufficient to adequately characterize port operations. Commenter provided supporting documentation, articles, and references to support their comment. [OP-76]

Agency Response: In response to this comment, staff has lowered the threshold for respondent fleets from 100 to 50 vehicles. Based on available information, staff believes that lowering the threshold to 50 would result in significantly more fleet reporting information on their vehicles. This is necessary since as a result of the strengthened manufacturer ZEV sales requirements; more fleets will need to electrify. Gathering information on these smaller fleets will give a more complete picture of the overall truck marketplace. This more granular data provides increased resolution on drayage and delivery operations that tend to attract smaller fleets than other applications. For these reasons, decreasing the fleet size threshold meets the regulation's objectives. Additionally, staff intends to request and accept additional information from fleets as part of a future zero-emission fleet rule.

Large Entity Reporting – Timing of Data Collection

Comment: Commenter states that recordkeeping is required for the year 2020, but will not be in effect until mid-2020, creating an undue burden on fleets that do not already collect or maintain these types of records. [OP-03, OP-04, OP-05, OP-06, OP-09, OP-10, OP-12, OP-14, OP-32, OP-37, OP-39, OP-51, OP-52]

Comment: Commenter states the reporting requirements of reporting and recordkeeping timing will result in a retroactive rule, which does not allow due process, so should be revised to allow facilities at least 1 year after the rule is final to prepare for implementation. The data gathering period and timeline presents challenges, including limited implementation time. Commenter also states that to take end of year odometer readings, beginning of year readings must be taken as well, which would be prior to the rule finalization period. The rule's timeline and feasibility studies are based on situations that may not work in the real world and are aggressive considering the current state of technology. [OP-39, OP-108]

Comment: Commenter states CARB has underestimated the time needed to complete reporting. [OP-110]

Comment: Commenter states the reporting requirement does not provide enough notice for entities to develop and implement tracking systems to collect requested data. [OP-61]

Comment: Commenters states the reporting time frame needs to have further expression for collection and the representative period of data collection. [OP-81]

Comment: Commenter states that recordkeeping is required for the year 2020, but will not be in effect until mid-2020, creating uncertainty on whether the regulation will be final and the amount of time entities will have to gather the data. Commenter states the time needed to gather the information is also underestimated and could take weeks, and is not already collected or easily accessed. [OP-102]

Comment: Commenter states the timing of finalizing the regulation will not leave enough time for entities to comply with the reporting requirements, as CARB requires information from data year 2020 but the entities would not be able to begin data collection until the rule is finalized, as the requirements may change. Some commenters request reporting later or data collection timelines, such as using data collected in 2021 with a reporting deadline of April 1, 2022. [OP-103, OP-116]

Comment: Commenter states the regulation does not provide sufficient time to collect data by requiring reporting in April 2021 for the 2020 calendar year. Commenter requests a July 1, 2021 deadline to avoid conflicts with other federal and state GHG emissions reporting which would unduly burden the staff whose responsibility it is to comply with reporting mandates. [OP-110]

Comment: Commenter request during busy seasons they can use a "time period" to report answers about typical daily operations. [OP-116]

Comment: Commenter states they support comments by CTA recognizing the need to further extend the reporting deadline and busy season reporting leads to overcapacity. [T1-27, T1-70]

Comment: Commenter states they need more time to review the proposed requirement to figure out how to comply. [T1-27]

Comment: Commenter states the timing of finalizing the regulation will not leave enough time for entities to comply with the reporting requirements, as CARB requires information from data year 2020 but the entities would not be able to begin data collection until the rule is finalized, as the requirements may change. Some commenters request reporting later reporting or data collection timelines, such as using data collected in 2021 with a reporting deadline of April 1, 2022. [T1-30, T1-70]

Agency Response: As a part of staff's modifications, more flexibility has been added to how fleets can collect data for the large entity reporting and what time period could be used in response to these comments. These changes were intended to make it easier for fleets to use information that is already available. The regulation describes various methods a regulated entity can use to complete their reporting. The regulation uses binned responses to provide guidance on the level of detail needed to complete the reporting. Additionally, changes were made to give flexibility allowing subsidiaries, joint ventures, and parent companies to report individually. Staff has added an option to allow regulated entities to report information about their fleet data as it consisted any time after January 1, 2019 to allow more flexibility in selecting an appropriate snapshot of their fleet operations using existing records. Beyond this, most of the information required is already expected to be kept by fleets to minimize additional information that would need to be collected. To the extent that it is simpler for fleets to collect new information, changes to the regulation provide additional guidance on how to collect representative information when needed. This representative information can be collected in any time period the fleet owner chooses before the information must be reported. These modifications allow fleets to comply with the reporting requirement regardless of whether they currently collect this information or not. These modifications also ensure that fleets are not required to provide non-existent information to complete their reporting as all information is either already available or can be quickly collected.

Large Entity Reporting – Enforcement Concerns

Comment: Commenter states that potential enforcement penalties are too high for a data gathering exercise, and does not understand how the rule will be enforced or whether reported information will meet an acceptable standard. [OP-03, OP-04, OP-05, OP-06, OP-09, OP-10, OP-12, OP-14, OP-32, OP-37, OP-39, OP-44, OP-51, OP-52, OP-54, OP-108]

Comment: Commenter states CARB cannot impose requirements on entities before a rule is finalized. Commenter states that businesses will not know whether their answers are "enough", with lack of guidance on how CARB will evaluate subjective terms such as "good faith effort" or "best judgement". [OP-39, OP-108]

Comment: Commenter states concern that rule does not provide information about how compliance will be measured or enforced, preventing effective data collection protocols from being developed. [OP-61]

Comment: Commenter states that enforcement procedure for the large entity reporting is unclear and needs to be clarified. [OP-98]

Comment: Commenter supports need for additional streamlining and clarity surrounding enforcement made by California Chamber of Commerce. [OP-116]

Comment: Commenter states that violation penalties of $37,500 is very significant to their members and should result in additional workshops. [T1-23]

Comment: Commenter states that we should ensure enforcement burden is not too great to avoid excess paperwork. [T1-77]

Comment: Commenter is concerned that failing to comply could result in huge fines as the result of a "best estimate". CARB intended to include language that would soften the enforcement of the regulation for those acting in good faith but were off in estimates, but does not see any such language in the regulation draft. [T1-99]

Agency Response: Staff added language stating that regulated entities have 14 days to respond to a request for clarification. This helps ensure that if staff has questions about reported data, there is a pathway for remediation without enforcement action. CARB's Enforcement Division has discretion when determining penalties for non-compliance, and must take into consideration statutory mitigation areas including magnitude of non-compliance, whether emissions were increased as a result of the violation, etc. Staff's intent is to collect useful data with the reporting requirement and will work with regulated entities if questions arise.

Large Entity Reporting – Confidentiality, Proprietary Info, Security, and Public Record Act Requests

Comment: Commenter states that online reporting that asks for specific company identification numbers is a concern about security preservation in light of recent data breaches. [OP-58]

Comment: Commenter states CARB should clarify whether it intends to publish, report on, or otherwise disclose fleet reporting data. [OP-116]

Comment: Commenter raises questions about the regulation’s confidentially provisions and responses to Public Record Act requests. [OP-116, OP-44]

Comment: Commenter states that some businesses will not comply with the reporting requirement because they view the data being requested as proprietary to the business. Commenter states that data collected by CARB could be transferred to other agencies that will sell the data. [T1-03]

Comment: Commenter states concern over the reporting requirements releasing personal home addresses of farm workers. [T1-47]

Comment: Commenter states they support the comments by CTA recognizing the need to further extend handling of confidential reporting data. [T1-70]

Comment: Commenter states they have concerns about potential release of confidential data. [T1-77]

Agency Response: No changes were made to the regulation in response to these comments. CARB follows standard procedures to secure confidential and personally identifiable information. Sensitive data collected in other regulations has maintained the necessary level of data security. CARB staff intend to publicly release aggregated data to meet stakeholder requests for data. Staff will maintain confidential information pursuant to California Code of Regulations title 17, sections 91000 to 91022 and the California Public Records Act.

Large Entity Reporting – Use TRUCRS System for Reporting

Comment: Commenter states CARB collect real-world data from fleets, possibly through telematics, and could potentially tie voluntary fleet submission of such data to the future fleet rule. Commenter believes real-world data is more important than the survey data. [OP-50]

Comment: Commenter states that CNG/LNG fleets already in Truck Regulation, Upload, and Compliance Reporting System (TRUCRS) should be restored. Additionally, commenter states CARB should seek outside software development firms to receive reporting information that is user friendly and meets data privacy concerns. [OP-69]

Agency Response: No changes were made to the regulation in response to these comments. Staff intends to allow respondents to download fleet information out of TRUCRS to minimize duplicate reporting; however, only a subset of vehicles report into the TRUCRS database and only a portion of those vehicles are required to report vehicle usage information. Therefore, staff will be developing a new system for collecting the information. Staff believes that developing the data collection and analysis methods internally is sufficient, and will not seek outside contractors for this specific purpose.

Large Entity Reporting – Gather Information on Existing Infrastructure Costs and Low-Emission Vehicles

Comment: Commenter states that companies responding to the large entity reporting requirement should be able to voluntarily submit the value or cost of CNG, LNG, or EV infrastructure already installed at facilities. Commenter also states CARB should allow voluntary submission of fuel consumption data. [OP-69]

Comment: Commenter states that the rule fails to request data on use of low-emission vehicles, the adoption of which has historically been incentivized by the legislature and by CARB. Failing to account for the environmental benefits these vehicles achieve, and failing to provide credit to those who followed directions and upgraded their vehicles early wastes millions of taxpayer dollars, as well as the millions invested by companies who were doing their best to upgrade their vehicles and lower emissions. For example, § 2012.3 asks for information on refueling infrastructure for fleets, but not for other facilities subject to the rule. CARB should amend the rule to take care not to disturb the investments these companies have already made in non-battery electric vehicles, such a hydrogen, biodiesel, and low NOx vehicles, all of which are contributing to the downward trajectory in transportation emissions. [OP-108]

Comment: Commenter states that reporting fails to ask about existing fueling infrastructure, use of low or near-zero vehicles, or other carbon reduction measures implemented. The reporting requirements should ask for data on low-emission vehicles to recognize existing investments. [OP-108]

Comment: Commenter states CARB should collect data on existing and near-term investments in infrastructure and cleaner vehicles/fuels, including near-zero and other advanced technologies, to help characterize fleet and facility investment plans and to inform future rules. [OP-106]

Comment: Commenter states that reporting should also consider the availability of infrastructure and that it should take into account how previously incentivized adoption of alternative fuel vehicles have been implemented. [T1-22]

Agency Response: No changes were made to the regulation in response to these comments. Staff directionally agrees that capturing the cost of existing infrastructure investments can provide valuable context, but also must comply with Board direction to streamline reporting. To accomplish this, the reporting requirement requires fleets to identify what infrastructure has been installed within the last ten years without providing additional information. This allows staff to identify which fleets have made those investments and who to contact to obtain additional information. Similarly, the fuel type of the fleet's vehicles must be reported and will allow staff to contact fleets who have invested in low-emission vehicles.

Staff intends to allow fleets to submit voluntary information as part of their reporting. Additionally, staff intends to request and accept additional information from fleets as part of a future zero-emission fleet rule.

Large Entity Reporting – Allow Entities to Provide Comments with Reporting

Comment: Commenter suggests adding a "comments" response column so entities can provide clarifications on data anomalies to better characterize their particular use case. [OP-61]

Agency Response: No changes were made to the regulation in response to this comment. Staff intends to allow fleets to submit voluntary information as part of their reporting.

Large Entity Reporting – Insufficient Outreach

Comment: Commenter states the large entity reporting requirement has been fast tracked, and CARB had only released the first concepts of the reporting requirement at the final public workshop which did not allow adequate time to address concerns from affected entities. [OP-03, OP-04, OP-05, OP-06, OP-09, OP-10, OP-12, OP-14, OP-32, OP-39, OP-37, OP-51, OP-52, OP-54, OP-58]

Comment: Commenter states the large entity reporting requirement has had limited public outreach, insufficient workshops, and lack of engagement from regulated businesses. [OP-03, OP-04, OP-05, OP-06, OP-09, OP-10, OP-12, OP-14, OP-32, OP-37, OP-39, OP-51, OP-52, OP-54, T1-26]

Comment: Commenter states CARB had only released the first concepts of the reporting requirement just 3 months before the board hearing. [OP-39]

Comment: Commenter states the large entity reporting requirement has had limited public outreach, insufficient workshops, and lack of engagement from impacted businesses, especially in the light of recent public safety power shutoffs and how those might interact with mandated electric vehicles. [OP-58]

Comment: Commenter states regulated entities were not notified of this rulemaking, and those that were notified were primarily targeted at fleet owners through existing listserves focused on the manufacturer sales requirement. Commenter states that more needs to be done to outreach to businesses to engage on this effort and other CARB efforts. Rulemaking was accelerated, stating concepts for reporting requirements were only released August 21, 2019, and states staff has not responded to public comment from August workshop nor made effort to explore alternatives proposed by stakeholders. Commenter states staff should adjust the data gathering period or the reporting deadline so it is practical for entities to comply. [OP-106, T1-30]

Comment: Commenter states that CARB did not solicit input or feedback from the businesses affected by the ACT regulation reporting requirement. Commenter states that a common criticism of regulatory agencies is that few, if any, understand how business is done and the challenges faced in compliance to such ill-prepared regulations. Commenter urges CARB to reach out and ask for input and suggestions prior to simply developing regulations in an agency vacuum. [B1-08]

Comment: Commenter states there has not been enough outreach to affected entities, and there are thousands that do not know they will be required to report. [T1-03]

Comment: Comment state CARB should interact more with affected stakeholders for the reporting requirement as they will be the end users of ZEVs. [T1-24]

Agency Response: No changes were made to the regulation in response to these comments. CARB's public planning and review process has been robust from the beginning of the ACT regulation development. Since 2016, CARB staff has held eight workshops, five workgroup meetings, and numerous individual meetings with stakeholders to provide information to the public and to solicit feedback. Staff has held several public workshops to propose and refine the large entity reporting concept. CARB staff posted information regarding these events and any associated materials on the ACT website and distributed notice of these meetings through two public list serves; "actruck" and "zevfleet" that include 3,092 and 1,356 recipients, respectively. The majority of the meetings were available by in-person attendance, webcast, and teleconference. Staff proposed this concept first in December 2018, and continued to refine the concept through public workgroups and workshops afterwards. Additionally, staff sent a mail out in mid-2018 to approximately 11,000 entities with corporate revenues at or over $50 million notifying them that staff was considering this concept. The Initial Statement of Reasons (ISOR), which was released to the public on October 22, 2019, identifies the data, reports, and information relied upon for the proposed regulation. The Draft and Final Environmental Analysis (EA) provided an analysis of the potential environmental impacts associated with the ACT Regulation, including the large entity reporting requirements. The Board held a public hearing on December 12, 2019 to consider the proposed ACT Regulation and Draft EA. Then, in February 2020, CARB hosted a workshop to discuss modifications to the ACT Regulation. The Board held another public hearing on June 25, 2020, during which CARB adopted Resolution 20-19 and approved the ACT Regulation. For these reasons, staff believes that the potentially regulated public were sufficiently noticed well in advance of the initially proposed regulation being released and well in advance of the Board's adoption of the proposed regulation.

Large Entity Reporting – Data Can Be Gathered Through Other Sources

Comment: Commenter states CARB can gather the required data through other means. [OP-03, OP-04, OP-05, OP-06, OP-09, OP-10, OP-12, OP-14, OP-32, OP-37, OP-39, OP-51, OP-52, OP-54]

Comment: Commenter recommends data collection be done through a non-regulatory "request for information" process. [OP-61]

Comment: Commenter states that vendor data is best provided by vendor owners. [OP-110]

Comment: Commenter states that some information being requested is already being gathered in other areas, and would like to combine these to avoid duplicative effort. [T1-06]

Agency Response: No changes were made to the regulation in response to these comments. Throughout the rulemaking process, staff has gathered data and information from a variety of sources such as industry reports, Department of Motor Vehicles information, and other publicly available sources. The information that currently exists is insufficient to properly assess the ZEV potential of medium- and heavy-duty as most data sources do not have information about key characteristics for truck electrification, e.g. typical daily mileage, ability to install infrastructure, whether vehicles return to a central base, and so on.

Staff attempted to collect vehicle usage data through a voluntary survey that was sent out early 2018. The response rate was roughly 1 percent and the information received was not representative of the trucking industry or any individual sector. Fleets and organizations who were actively engaged in the ACT rulemaking process did not participate in this voluntary survey. Based on these events, staff determined the best way to gather sufficient data from across the breadth of the trucking sector is through a mandatory reporting requirement.

Large Entity Reporting – Standardized Template

Comment: Commenter requests a standardized response template for the reporting requirement be provided for entities. [OP-61]

Agency Response: Staff intends to use a standardized spreadsheet for regulated entities to complete their responses.

Large Entity Reporting – Only Report Own Vehicles

Comment: Commenter states that reporting requirements should be limited to their own fleet operations under their direct control as opposed to third party vendor fleets. [OP-61]

Agency Response: Changes were made to the regulation in response to this comment. Staff modified the regulation to require vehicle operational characteristics only be reported for vehicles the entity has under their control. Entities will still have to report general information on the number of subcontractors, subhaulers and subhauler vehicles, but will not be required to report operational characteristics of those vehicles.

Large Entity Reporting – Focus on Delivery Vehicles

Comment: Commenter states that only seeking information from light and medium-duty pickup and delivery fleets would be a simpler approach. [OP-58]

Agency Response: No changes were made to the regulation in response to this comment. Because the scope of future ZE fleet rules is anticipated to include more vehicles than just delivery vehicles, it would be inconsistent to only include light- and medium-duty delivery vehicles.

Large Entity Reporting – Allow Fleets to Use a Representative Facility

Comment: Commenter states that each regulated entity should only be required to provide a general inventory of total number of facilities and the number of vehicles stationed at each facility for each group/class of facility, and to have a detailed report of data CARB is requesting submitted for only one representative facility in each group of facilities including vehicle usage information. [OP-102, OP-103]

Agency Response: Staff has clarified the regulation text in response to this comment. The proposal in the Staff Report allowed entities to use the operational data collected from one facility for vehicles at other facilities if the entity determines they have similar operational characteristics. Staff has clarified the language to ensure entities are aware they have this option. This meets the commenter's request and is consistent with Board direction to streamline the reporting.

Large Entity Reporting – Require Future ZEV and Infrastructure Plans

Comment: Commenter suggest CARB should consider adding a question that ask for future acquisition plans for electric vehicles procurements by type, duty cycle, and number of acquisitions by year (over a ten-year period). In addition, CARB should also request the same information for potential future charging infrastructure. [OP-104]

Agency Response: No changes were made to the regulation in response to this comment. Staff is not proposing to collect this information as it would be of minimal value and be inconsistent with Board Direction. At this point, relatively few fleets have concrete plans in place for incorporating ZEVs as most ZEVs are still in the demonstration phase. Likewise, most fleets do not consider infrastructure until they have committed to adding ZEVs to their fleet. Adding this question to a reporting requirement due in April 2021 would have little value as the majority of fleets would not be able to answer anything of value. In addition, including more questions would not be consistent with Board direction to streamline reporting.

Large Entity Reporting – Exempt Emergency Vehicles

Comment: Commenter asks for an exemption from the reporting requirement for emergency vehicles designed to respond during power outages. [OP-108]

Agency Response: No changes were made to the regulation in response to these comments. Emergency vehicles as defined in the California Vehicle Code 165 are exempt from the Large Entity Reporting requirements. The reporting requirements do apply to non-emergency vehicles that are used for emergency response. Understanding these vehicles will be critical in ensuring that future fleet rules do not impede these vehicles from their critical operations.

Large Entity Reporting – Exempt Rental, Leasing, Construction, and Construction Repair Companies

Comment: Commenter states rental and leasing companies and construction and equipment repair vehicles should be exempt from the large entity reporting requirements. [OP-58]

Agency Response: No changes were made to the regulation in response to this comment. The purpose of the Large Entity Reporting is to gather information that can be used to develop future fleet rules. It is premature to exempt any fleet category from the reporting requirement as determining which vehicles may need additional time or cannot be electrified is as critical as determining which vehicles can be easily electrified. The fleets mentioned in the comment letters sum up to be a significant portion of the California fleet, and major rental and leasing companies are already making significant investments in ZEVs. Staff will evaluate the potential for electrifying these vehicles in the ZE fleet rule but removing the reporting requirements will hobble staff’s future efforts.

Large Entity Reporting – Exempt Class 8 Vehicles Registered under the International Registration Plan

Comment: Commenter states the large reporting requirements need to be streamlined and should exclude interstate trucks and Class 8 trucks registered with the International Registration Plan (IRP). [OP-98, T1-70]

Comment: Commenter supports the American Trucking Associations’ Request to Exclude Class 8 trucks registered with the International Registration Plan from Large Fleet Reporting. [OP-116]

Agency Response: No changes were made to the regulation in response to these comments. The purpose of the Large Entity Reporting is to gather information that can be used to develop future fleet rules. It is premature to exempt any fleet category from the reporting requirement as determining which vehicles may need additional time or cannot be electrified is as critical as determining which vehicles can be easily electrified. IRP vehicles represent a significant portion of vehicles miles travelled in California. In addition, many fleets register their entire fleets under IRP for a variety of reasons despite the vehicles not leaving their home base in California. The regulation only applies to those vehicles that travel through or are based in California, so the requirements are only applicable to vehicles that do business in California.

Large Entity Reporting – Exempt Companies Without Vehicles

Comment: Commenter states that their members do not haul or sub haul insurance products, but use national mail carriers or only receive paper and office supplies. Commenter also states that port and rail location usage is rare for their members, and though some companies may have heavier vehicles, a small percentage are used in California. Due to this, commenter requests CARB modify applicability to exclusively apply to haulers or carriers, or carve out exemptions or minimize data requirements for their members (non-hauler/carriers). [OP-54]

Agency Response: Changes were made to the regulation in response to this comment. Staff removed all requirements on businesses that do not own or broker vehicles. This is consistent with the commenter’s request and Board direction to streamline reporting requirements. In addition, staff removed requirements to report about facilities, truck trips, or light-duty information. Staff retained requirements for large businesses with greater than $50 million in annual revenue and at least one vehicle as staff foresees that the future ZE fleet rule may have requirements on large businesses regardless of how many vehicles that business owns.

Large Entity Reporting – Clarification on Off-Road Yard Tractors

Comment: Commenter request CARB clarify whether “yard goats” with off-road engines are included in the large entity reporting. [OP-116]

Agency Response: In response to this comment staff modified the requirements to explicitly include off-road yard tractors or yard goats. This meets the commenter’s request and is consistent with Board direction to clarify the requirement.

Large Entity Reporting – Modify Definition of “Fleet” and “Fleet Owner”

Comment: Commenter suggests removing the definitions of “federal fleet” and “rental or leased fleet” and the last sentence of the first paragraph, as the language suggests there are only two subclassifications of fleets - "federal" and "rental or leased". The California Uniform Commercial Code cited only defines "lease". Commenter suggests separately defining "rental and leased vehicles" as: Rental and Leased Vehicle means a vehicle under a contract or agreement for a term or period of one year or more that may include an option to renew the contract or agreement. Commenter suggests redefining “fleet owner” definition to exclude rental or leasing companies.(This comment incorporates a comment letter that was submitted in response to a draft of the Large Entity Reporting requirement prior to the release of the Staff Report) [OP-58]

Agency Response:

Some changes were made to the regulation in response to this comment. Staff removed the definitions of “federal fleet” and “rented or leased fleet”. However, staff has not defined “rented or leased vehicles” as these terms are generally understood and specific details on the usage of these terms are provided in the definitions of “common ownership and control” and “fleet owner” elsewhere in the regulation text.

Staff has not made modifications to the “fleet owner” definition in response to these comments. The regulation specifies that vehicles that are in a renting or leasing arrangement of one year or more must be reported by the renter or leasee, and arrangements of less than one year must be reported by the renting or leasing company. Removing requirements on renting and leasing companies will prevent necessary data collection on a significant portion of California’s fleet.

Large Entity Reporting – Modify “Subcontractor” and “Subhauler” Definitions”

Comment: Commenter states that current subhauler and subcontractor language in the large entity reporting section is confusing and should be reworded to capture all contracted businesses. [OP-76]

Comment: Commenter recommends changing references of “subcontractor” to “contractor.” and that reporting be limited to identifying the contractors who have a direct relationship with the reporting company and not associates. [OP-104]

Comment: Commenter states that subcontractor counts need to be removed or redefined. [OP-106]

Comment: Commenter states that "subcontractor" definition makes no sense, and revisions should be made. Commenter states that "work" under the subcontractor definition needs to be explained, and related to the vehicle usage. [OP-108]

Agency Response: In response to these comments, staff made changes to the usage of “subcontractor” and “subhauler” within the regulation. Staff removed the definition of “subcontractor” from the list of definitions because the term was only used once within the regulation and the description was incorporated into the body regulatory text. Staff then clarified and elaborated on its usage within the one location it is used in the regulation.

Staff modified the subhauler definition to state that it applies to brokers as well as motor carriers, and removed the phrase “to serve its customers” to make it clear that the definition does not apply to companies who serve customers on the regulated entity’s behalf. These changes improve readability and meet the commenter’s requests.

Large Entity Reporting – Clarification of Confusing Terms

Comment: Commenter requests the term "dispatched" is clarified, and suggests: "provided direction or instruction for routing a vehicle(s) to specified destinations for specific purposes of…" [OP-61]

Comment: Commenter states that facility categories, contracting practices, fleet mix, fueling infrastructure, and service delivery are internally inconsistent and do not match cross-agency policies and mandates. [OP-81]

Comment: Commenter states it is unclear if the potential groupings (vehicle body type, weight class bin, fuel type) are three possible options for respondents to choose one or if all three are required in the reporting in the description of grouping in 2012.3(b). [OP-104]

Comment: Commenter suggests clarifying whether “under your authority” refers to a reporting entity’s motor carrier number in questions 2012.1(a)(14)(B) and (a)(14)(C). [OP-104]

Comment: Commenter suggests defining terms "electric vehicle supply" and electric vehicle" for questions 2012.2(a)(1)(D) and (a)(1)(E) in the grouped facility information sections, and asks whether CARB is asking for all charging equipment to be responded for, including Level 1, portable, Level 2, etc. [OP-104]

Comment: Commenter states the information regarding the infrastructure in question (a)(6)(D) is vague and needs clarity. [OP-104]

Comment: Commenter suggest clarifying general entity information for question (a)(13) "contractors", as it is unclear if CARB is seeking information on activities by contractors that are directly serving a customer need or if a more expansive definition of contractor work is intended. [OP-104]

Comment: Commenter asks if question 2012.3(b)(2)(H), for reporting on the percentage of vehicles that “Returns to this facility daily”, should be interpreted as “always returns” or “typically returns”. [OP-104]

Comment: Commenter suggests changing Section (b)(2)(J) and (K) to “Stays within 50 miles of this facility on a typical day” and “Usually tows a trailer more than 100 miles a day”. [OP-104]

Comment: Commenter asks if, in section 2012.3(b)(3), the average annual mileage for a typical vehicle by vehicle group is an average across the fleet for a particular vehicle type or an average for the vehicle group at the specific facility being reported on. [OP-104]

Comment: Commenter asks that "typical" and "representative" in relation to the facility information be clearly defined. [OP-106, OP-108]

Comment: Commenter states CARB must define "typically", otherwise will get widely varied and unusable data. [OP-108]

Comment: Commenter states that "broker" can be read to include anyone that orders delivery, and should be modified to reflect the intended target. [OP-108]

Comment: Commenter states that "responsible person" needs to be defined or deleted. [OP-108]

Comment: Commenter asks that "operated" in relation to the facility information be clearly defined. [OP-108]

Comment: Commenter asks that partnership and sole proprietorship definitions be updated to "A general partner or the proprietor, respectively, or their delegate or designee." [OP-108]

Comment: Commenter asks that "managed" be more clearly defined for the facility portion of "managed at the facility". [OP-108]

Comment: Commenter asks CARB define "written sustainability plan". [OP-108]

Agency Response: In response to these comments, staff has modified multiple portions or the regulation text to more clearly state what regulated entities are required to do and what specific terms mean.

The definition of “broker” has been narrowed to only entities with brokerage authority. This change clarifies staff’s original intent to only include those with brokerage authority.

The term “electric vehicle supply” has been clarified to refer only to Level 2 or higher powered chargers. This removes ambiguity around what chargers are and aren’t included. The other infrastructure information requested in section 2012.2(a)(6)(d) has not been cited as vague or difficult to understand and as a result has not been modified.

The term “managed” was primarily used in the facility and truck trip reporting sections which have been deleted from the original proposal in the Staff Report.

The term “partnership or sole proprietorship” has been updated to include their delegate or designee as the commenter requested.

The term “operated” was primarily used in the facility and truck trip reporting sections which have been deleted from the original proposal in the Staff Report. The commenter is not referring to the other parts of the regulation which may have used the term “operated”.

The definition of “responsible official” has been clarified to only apply to records retention requirements and not the other portions of the regulation.

The regulation was modified to make more clear by adding language to expand sections 2012.2(b)(2)(H) to give an example that a vehicle returns to its home base daily if it returns to its base 9 out of 10 times.

Section 2012.2(b)(2)(J) was modified to be a “yes or no” question instead of requiring fleets to count the number of trucks. This change simplifies reporting by asking whether a majority of the vehicles do or do not stay within 50 miles of the vehicle home base on a given day. The section was also changed to give fleet managers more flexibility in how to complete the reporting.

Section 2012.2(b)(2)(K) was not modified as section 2012.2(b)(2) allows fleets to estimate their responses to sections 2012(b)(2)(A-Q) and staff expects this particular question to be primarily to answered based on a fleet manager’s knowledge and experience of their fleet operation.

The term “sustainability plan” was not necessary to define because staff’s intent was for the respondent to identify any written plan to support sustainability goals. This question seeks to understand whether sustainability is considered in decisions made at the organization. Creating a specific definition would add complexity and unnecessary burden that is inconsistent with the intent of the question.

Staff has not formally defined the terms “typically” or “representative”. These terms were used most often in the facility and truck trip section which was deleted. Staff has inserted additional language to better describe what “typical” and “representative” means in the context of the individual questions being asked where the terms are still used. Staff specifically used these terms to give respondents flexibility in how to answer these questions and to minimize the amount of information that would need to be collected. These changes will improve the overall quality of the responses and simplify reporting for respondents.

Large Entity Reporting – Some Vehicles Do Not Have Odometers

Comment: Commenter states they have some responsive vehicles that do not measure usage by miles and do not have odometers and have hour meters instead. [OP-110]

Agency Response: No changes were made to the regulation in response to this comment. Vehicles without odometers tend to have low daily mileage. Fleets can use information such as dispatch records or hour readings estimate their mileage, or alternatively capture the mileage for a representative period to estimate the typical mileage. Because the reporting requirement has wide response categories for entities to fill, entities can place their vehicles whichever response category they deem the most appropriate. Staff anticipates that fleets will place these vehicles without odometers into the lowest mileage response category, but will work with regulated entities through the implementation process to provide guidance.

Large Entity Reporting – Remove Language Potentially Requesting Home Addresses

Comment: Commenter asks the rule be revised to not require disclosure of home addresses of employees where a vehicle may be assigned. [OP-108]

Agency Response: Staff has clarified the language to explicitly prevent entities from reporting addresses that may be employee’s home addresses.

Large Entity Reporting – Expand Subcontractor Contract Length

Comment: Commenter states the reporting requirements should be changed to cover all contract lengths, as drayage contracts are often 90 days or less, and the current year or more threshold would miss these fleets. [OP-76]

Agency Response: In response to this comment staff has removed the limitation to contract lengths of only one year or longer to ensure data are gathered about all entities that are contracted to deliver items or perform work for a regulated entity. This change will help ensure sufficient data are collected to craft effective fleet rules.

Large Entity Reporting – Explain Thresholds Used for Large Businesses and Large Fleets

Comment: Commenter asks CARB to explain the $50M US-wide revenue regulatory basis, stating that this will capture entities with very little California presence. Commenter also asks the basis for the use of 100 vehicles in the fleet size requirement. [OP-108]

Agency Response: As stated in the Staff Report, the thresholds were selected to include a wide range of entities because nearly all rely on services that use trucks and buses, and all are likely to be directly or indirectly affected by a future ZEV requirement because a general goal established in the mobile source strategy and the SIP is to accelerate the use of ZEVs everywhere feasible. The revenue threshold was selected as a way to exclude small businesses from the reporting requirement, to reduce the number of entities that report, and provide a representative data set of the wide range of business models and vehicle operations in California. Large entities have adequate resources to respond to questions about their existing operations and are more likely to keep information electronically than smaller entities which means their reporting burden would be less significant. Information from large entities is expected to provide a robust data sample to help answer questions about sector-by-sector variations in vehicle usage and contracting for transportation services. The 2019 tax year was selected as a baseline year so that regulated parties would know whether they are subject to the regulation when the regulation was considered by the Board.

Large Entity Reporting - Vehicle Definition Consistency

Comment: Commenter suggests the definitions under the manufacturer requirement sections (1963 through 1963.5) also be applicable to the large entity reporting sections (2012 through 2012.3). [OP-104]

Comment: Commenter states that the vehicle definition n section 2012 should be the same definition as in section 1963. [OP-106]

Agency Response: No changes were made to the regulation in response to these comments. First, the Large Entity Reporting refers to “on-road vehicles with a GVWR greater than 8,500 lb.” This is a specific and understood phrase that does not need additional description. Second, the definition used in 1963 is a technical definition that may confuse or mislead stakeholders subject to the Large Entity Reporting. For these reasons, staff has not added a definition of “vehicle” to the Large Entity Reporting requirement.

Large Entity Reporting – Apply Same Fleet and Revenue Size Threshold

Comment: Commenter states CARB should apply the same fleet and revenue size thresholds to public agencies as are applied to private companies. [OP-110]

Agency Response: No changes were made to the regulation in response to this comment. Public fleets have been identified as a beachhead target well-suited for electrification and information is needed to determine how quickly these fleets can electrify. The Board reaffirmed this direction and strengthened it by directing staff to return with fleet rules that will transition public fleets to fully zero-emission capable by 2035. Because this goal will apply to all public fleets, information is needed from all public fleets in order to develop effective fleet rules.

Large Entity Reporting – Level Playing Field Analysis

Comment: Commenter states the regulation does not explain how in-state companies will not experience a competitive disadvantage vs out-of-state companies doing business in California. [OP-58]

Agency Response: No changes were made to the regulation in response to this comment. As part of the Original Proposal, staff performed an analysis on the "Significant Statewide Adverse Economic Impact Directly Affecting Business, Including Ability to Compete". Staff determined that the ACT regulation would not have a significant statewide adverse economic impact on businesses or private persons. The manufacturer ZEV sales requirement is anticipated to have a net positive effect on the state. The large entity reporting affects both in-state and out-of-state businesses that do business in California equally so as a result, it is not anticipated to adversely California businesses.

The ACT regulation only applies to manufacturers and does not impose costs on fleets, other than minimal reporting costs for large entities. The regulation is aimed at larger companies and ensures that employee-based companies as well as companies using a contractor model are on a level playing field.

Large Entity Reporting – Lower Size Threshold

Comment: Commenter states that CARB should lower the reporting threshold for firms in trucking segments with high concentrations of contractors like port trucking, and package delivery. [T1-87]

Comment: Commenter states that lowering the firm size threshold to 15 or more dispatched vehicles; clarifying the distinction between subhaulers and subcontractors to ensure that all businesses operating under all length contracts are covered. [T1-88]

Agency Response: The approved regulation was modified from the original proposal to lower the fleet size threshold from 100 to 50 vehicles. Based on available information, staff believes that lowering this number even further would result in exponentially more fleet respondents with diminishing returns on the value added by the additional data.

Large Entity Reporting – Limit Scope Based on Future Fleet Rules

Comment: Commenter states that staff should outline the likely paths of the Fleet Rule prior to finalizing the data request rule, identify the specific data gaps to be filled by the rule, and narrow the scope of the data requests to those issues relevant to the subsequent end-user rule [T1-22]

Agency Response: No changes were made to the regulation in response to this comment. Staff are attempting to broadly capture information from a variety of businesses to understand which fleets have vehicles that are suitable for electrification, and to better understand where and how infrastructure is needed to expand the market beyond depot charging as part of determining the path for the Fleet Rule. See discussion on the timing and content constraints of the large entity reporting requirement as it relates to future fleet strategies in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Large Entity Reporting – Bifurcate the Large Entity Reporting from the ACT Regulation”. Also, see discussion related to staffs attempts at narrowing the scope and burden of the large entity reporting requirement, including completely removing the facility reporting section and implementing numerous clarifications and guidance language in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Large Entity Reporting – Regulation Requires Hard-to-Collect Information”.

Large Entity Reporting – General Support

Comment: Comment states SCE supports the ACT regulation and stands ready to facilitate the transformation of the transportation sector across all medium- and heavy-duty segments. [T1-04]

Comment: Commenter states they support the effort to collect more and better information to inform future regulation, [T1-06]

Comment: Commenter states they support CARB's proposed reporting requirement. [T1-31]

Comment: Commenter state as they support fleet reporting standards. [T1-52]

Comment: Commenter supports efforts to streamline reporting requirements, stating more needs to be done. [T1-77]

Comment: Commenter supports the reporting requirements and approve of the options presented by staff. The current proposal would lead to quicker collection of the data, which would allow for expediting the fleet requirements. [T1-85]

Agency Response: Staff appreciates stakeholder support in collecting this critical information.

Future ZEV Policy – Adopt Zero-Emission Fleet Rule in 2021

Comment: Commenter states CARB should adopt corresponding fleet purchase requirements in 2021. [OP-02, OP-41, OP-46, OP-48, OP-117, OP-122, T1-13]

Comment: Commenter states CARB should adopt a fleet rule by July 1, 2021, effective January 1, 2024. [OP-13]

Comment: Commenter states CARB should accelerate development of a ZEV fleet rule. Commenter states the fleet rule should be brought forward in time to make sure that a stronger rule is matched with the fleet requirement at the same time. [OP-15, T1-40]

Comment: Commenter states CARB should expedite the "fleet rule" to encourage conversion of large fleet operations to ZEVs. [OP-64]

Comment: Commenter states CARB should expedite the fleet rule by using existing data and augmenting it to finalize, rather than waiting for the ACT regulation reporting requirements to be submitted. CARB should adopt fleet purchase requirements by 2021 to make simultaneous with the ACT regulation. [OP-72]

Comment: Commenter states CARB should adopt fleet purchase requirements earlier than staff's proposal, with implementation in 2021. [OP-83]

Comment: Commenter urges CARB to continue to move forward with development of the fleet regulation with a goal simultaneously broaden infrastructure and financing options. Commenter states CARB should also consider light-duty ZEV rule targeting 100 percent adoption by 2035 to achieve 80 percent GHG reduction by 2050. [OP-94, T1-43]

Comment: Commenter states CARB should adopt fleet purchase requirements earlier than staff's proposal, specifically in 2021 with implementation in 2024. [OP-96, T1-17, T1-48]

Comment: Commenter urges CARB to include flexibilities that allow fleet purchases to access incentive funding even as they are mandated to purchase ZE trucks. CARB needs to adopt fleet mandates that mirror the sales targets of the proposed regulation. [OP-99]

Comment: Commenter states CARB should adopt fleet purchase requirements earlier than staff's proposal, with implementation in 2024. [OP-119, OP-121-Form, OP-123-Form, OP-124-Form]

Comment: Commenter states they support a fleet purchase standard. [T1-52]

Comment: Commenter believes that a multiple fleet rule approach would be more effective than one blanket fleet rule to be implemented in 2024. The Commenter thinks this strategy will help provide certainty to manufacturers that demand further products to exist on a complementary timeline. [T1-79]

Comment: Commenter appreciates the commitment from the Board to develop a suite of fleet programs with the same timeline. Commenter encourages the Board to accelerate the development of fleet rules for those segments that are identified by staff to best positioned for electrification. [T1-79]

Comment: Commenter states the fleet mandate should happen quicker. [T1-81]

Agency Response: No changes were made to the regulation in response to these comments. The Board set a goal of bringing a fleet rule for consideration by the end of 2021, which is earlier than initially proposed, when they approved the Resolution. Staff held a kickoff workshop in February 2020 to begin that rule development process. Staff presented and solicited feedback on a number of ideas ranging from purchase requirements to fleet standards and contracting requirements. Further discussion on the ZE fleet rule is premature as the proposal is still under development and is a separate rulemaking from the ACT regulation.

Future ZEV Policy – Set Clear 100 Percent ZEV Targets

Comment: Commenter states CARB should set aggressive goals to achieve ZE vehicles in targeted categories and explain how the goals would tie into state and federal emissions reduction goals. [OP-01, OP-59, OP-72, OP-83, OP-96, OP-119, OP-121-Form, OP-123-Form, OP-124-Form, T1-48]

Comment: Commenter recommends that staff develop an analysis for ZEV truck sales similar to the one CARB staff presented to the Board for passenger vehicles. Commenter states that the presentation, titled "Critical Need for Actions to Accelerate the Transition to a Zero-Emission Future" clearly showed the need to increase the rate of passenger vehicle sales of ZEVs to near 100 percent by 2035, in order to achieve an 80 percent reduction in GHG emissions by 2050. A similar plan will be necessary to guide the vision for trucks. [B1-10]

Comment: Commenter states CARB should outline long-term objectives to achieve 100 percent zero-emission trucks in various categories while explaining how the manufacturer requirement proposed fits with those objectives and Federal/State air quality and climate goals. [OP-02, OP-41, OP-46, OP-48, T1-13]

Comment: Commenter states CARB should set a goal for all trucks to be zero-emission by 2040. [OP-13]

Comment: Commenter states CARB should specify target dates for 100 percent ZEV by truck sectors, similar to CARB's stated 100 percent delivery trucks by 2040 goal. [OP-15]

Comment: Commenter states CARB should identify long-term ZEV goals for medium- and heavy-duty vehicles consistent with state GHG goals. [OP-33]

Comment: Commenter states CARB should set aggressive goals for ZEV adoption beyond 2030. [OP-40, OP-64, OP-78, OP-126-Form]

Comment: Commenter states the Board should direct staff to develop and share with the Board its analysis for increasing sales of ZEV trucks beyond 2030 that is consistent with the states air quality goals. [OP-94]

Comment: Commenter states CARB should outline long-term objectives to achieve 100 percent zero-emission trucks in all categories. [OP-117]

Comment: Commenter states CARB should inform when all truck sales must be 100 percent zero-emission, which would set goals to inform planning and adaptation for infrastructure. [OP-122]

Comment: Commenter states CARB should set a goal for one hundred percent ZEVs and expedite the timeline for a fleet rule. [T1-18]

Comment: Commenter states CARB should aim for one hundred percent ZEVs in the foreseeable future. [T1-39]

Comment: Commenter recommends an increase of the yearly and final percentage goals from 24 to 30, and urge setting overarching and weight vehicle class specific timelines for 100 percent ZEVs. [T1-98]

Agency Response: The approved regulation includes a number of modifications to the original proposal to significantly increase the number of ZEVs sold in California across all vehicle groups from 2024 to 2030 and to increase the percentage requirements from 2030 to 2035 rather than keeping them constant during that period. The timeframe has also been extended until 2035 with continued increases in annual sales. In addition, the Board directed staff to work towards an ultimate goal of 100 percent zero-emission where feasible by 2045 when they approved the Resolution. In addition, the Board directed staff, through the approved Resolution, to set earlier targets for key beachhead markets including:

- Drayage trucks, last mile delivery, and government fleets: 100 percent zero-emission vehicle fleets by 2035
- Refuse trucks, and local buses: 100 percent zero-emission vehicle fleets by 2040
- Utility fleets: 100 percent zero-emission capable vehicles by 2040

Strong policy targets have guided the development of the ACT regulation and will guide the development of the Advanced Clean Fleets regulation with the goals of achieving carbon-neutrality in California by 2045, achieving a 100 percent zero-emission drayage fleet by 2035 and a 100 percent zero-emission fleet where feasible by 2045 as outlined in Executive Orders B-48-18 and N-79-20.

Future ZEV Policy – Additional Credit for Strong Plug-in Hybrids

Comment: Commenter states that PHEVs that get between 75 and 100 percent of annual VMT from off-board power sources such as grid electricity should generate additional credit in a future fleet rule if a crediting system is developed, if fleets can prove through telematics, etc., that the VMT is within that range after a period in-use. [OP-50]

Agency Response: No changes were made to the regulation in response to this comment. The approved ACT Regulation does not require fleets to make vehicle purchases, so the comment is not applicable to this regulation. As staff works on future ZE fleet rules, staff can consider at that time how to credit plug-in hybrid vehicles and whether to use in-use, real world data.

Future ZEV Policy – Considerations to Include in Future ZE Fleet Rule

Comment: Commenter states that waste company investments in alternative fuel vehicles and infrastructure should influence future fleet purchase requirements. [OP-69]

Comment: Commenter states that transition to electric power away from natural gas has the waste industry in a quandary about capital investments and the air quality trade-offs that might occur as a result of the proposed regulation. [OP-81]

Comment: Commenter states they need assurance from CARB that NGV investments will not be stranded. Commenter states that CARB is leapfrogging the local air districts and Short-Lived Climate Pollution Strategies to pursue an ACT regulation that will not achieve the same near-term NOx and carbon intensity reductions compared to the existing emission inventory. [OP-101]

Agency Response: No changes were made in response to these comments. Staff does not agree the ACT regulation is inconsistent with other air quality programs such as the Short Lived Climate Pollutant strategies. The ACT regulation requires manufacturers to sell ZEVs but does not require fleets to purchase ZEVs. Because the ACT regulation is a manufacturer rule, manufacturers need to identify market segments they can compete in and offer competitive products that fleets will want to purchase. Fleets do not face a requirement to purchase ZEVs in the ACT regulation, therefore the comment is not relevant to the manufacturer ZEV sales requirement. Rather, the comment appears to be directed at a future fleet rule. The information being collected in the mandatory fleet reporting in the ACT regulation will provide staff with information needed to evaluate concern in a future zero-emission fleet rule.

The impacts of a ZE fleet rule will be evaluated at the time of that rulemaking and is premature for this discussion. The impacts of related programs such as the Short Lived Climate Pollutant strategies should be addressed during development of these future zero-emission fleet rule. Staff invites interest parties to participate in these upcoming rulemaking and provide relevant information to staff.

<u>Future ZEV Policy – Employee Misclassification Impact on Trucking Emissions</u>

<u>Comment:</u> Commenter states CARB should support fair trucking practices as a part of the rulemaking language to address misclassification related issues, as misclassified companies are less able to comply with clean trucking rules. [OP-76]

<u>Comment:</u> Commenter states CARB needs to address the issue of misclassification of drivers as dependent contractors. Many of the misclassified drivers earn minimum wage and can't afford the cost of purchasing or maintaining electric trucks. [T1-88, T1-94, T1-95]

<u>Comment:</u> Commenter states that in order to achieve compliance with the new rules, CARB needs to ensure the companies that are employing these drivers are taking responsibility for the transition to clean trucks. [T1-88]

<u>Comment:</u> Commenter states California needs to do its part to make sure these regulations spread the burden between companies and workers. [T1-89]

<u>Comment:</u> Commenter states that misclassified independent contractors are important to address to ensure compliance with air quality regulations, and requests more stringent reporting requirements. [T1-90]

<u>Comment:</u> Commenter states when drivers are misclassified, they are being deprived of their minimum wages, benefits, and workers' compensation. Commenter states CARB needs to address the issue of misclassification of drivers as independent contractors that ties them into economic stresses. [T1-91, T1-92]

<u>Comment:</u> Commenter states many of the drivers have a financial burden due to low minimum wages and the cost of maintenance on clean trucks. [T1-92]

<u>Comment:</u> Commenter urges CARB to come up with a policy or act to help the issue of misclassification of drivers and to provide them with more benefits and insurance. As CARB has noticed, drivers can't afford the cost of purchasing or maintaining electric trucks [T1-93]

<u>Agency Response:</u> To better capture information on this market segment, staff has reduced the fleet size threshold from 100 to 50 to ensure smaller fleets, which would be more likely to have owner/operators contracting for work, are included in the data gathered. Additionally, brokers are required to provide additional information and detail

about contracted trucking practices, require respondent entities to keep and provide records on request about dispatched trucks, and have changed the requirement for reporting contracted entities from a 1-year contract threshold to contracts of any length. These changes are anticipated to enable staff to better assess how fleets that use contracted trucks operate, especially from the drayage and delivery sectors. No further changes have been made in response to these comments as the issues raised are beyond the specified scope of the rulemaking.

Future ZEV Policy – Authority to Regulate Businesses Who Do Not Own Vehicles

Comment: Commenter states they are uncertain whether CARB's statutory authority includes the ability to regulate purchases of businesses that are indirect sources as they do not own vehicles themselves. [OP-108]

Comment: Commenter states that it is not clear that the legislature's grant of statutory authority to CARB would include the ability to impose a regulatory purchase requirement on businesses that are indirect sources of emissions -- i.e., those business that rely on trucking to supply their needs on deliver their products, yet do not own or control the vehicles used. Commenter states that such an extension of regulatory power, if the state deems it appropriate, should be granted by the legislature, and not imposed through the regulatory process. [B1-07]

Agency Response: The comments are outside the scope of the ACT regulation. The comments are specific to a fleet purchase concept and, therefore, are not applicable to the approved ACT manufacturer requirements.

Future ZEV Policy – Five Percent Turnover Requirement for Delivery Vehicles

Comment: Commenter states taking 5% of the polluting delivery trucks and vans off the road, starting with the older or more polluting vehicles would be economically feasible. In 10 years, half of delivery vehicles should be emissions free if new purchases are required. [OP-34]

Agency Response: No changes were made in response to this comment. The commenter is advocating for two distinct policies, a requirement for fleets to turnover their vehicles and a requirement that a portion of new purchases be zero-emission. Because the ACT Regulation does not regulate fleet’s vehicles, the commenter’s proposal to turnover vehicles would be outside the scope of the regulation. Staff will evaluate strategies to turnover requirements and potential accelerated replacement as part of the upcoming ZE fleet rule. The ACT regulation requires manufacturers to sell zero-emission medium- and heavy-duty vehicles across all vocations and is anticipated to result in significant electrification of delivery trucks and vans. By regulating all Class 2b-8 vehicles, the ACT regulation achieves greater ZEV penetration than a regulation focused narrowly on delivery vehicles could achieve.

Future ZEV Policy – Support Workforce Development

Comment: Commenter states CARB needs to invest in workforce development that supports the transition to ZE transportation and benefits economically challenged communities. [OP-99]

Agency Response: No changes were made to the regulation in response to this comment. The Board directed staff through the Resolution to identify and commit additional future resources to addressing indirect costs associated with the ACT regulation, including, but not limited to, workforce development and training, when they approved the Resolution. Staff recognizes that state investment that supports California workers can expand the benefits of the regulation, and deliver much-needed jobs training and employment opportunities to communities across the state. Staff's efforts in this area will seek to leverage, to the maximum extent possible, existing and scalable curriculums already utilized by early adopters of zero-emission heavy-duty vehicles.

Out of Scope – Incentive and Funding Policies

Comment: Commenter states more emphasis should be put on an incentive-based program that focuses on those fleets where the current ZEV technology is economically viable. Commenter states that the current Public Safety Power Shutoff events are very real, and regulations that mandate electric vehicles on businesses must be well thought out and thoroughly discussed with the impacted businesses. [OP-58]

Comment: Commenter states CARB should create combined funding for ZEV and NZEVs and infrastructure rather than have separate funding opportunities with different requirements and timelines. Incentives should be structured to support large scale near-zero deployments until 2027, and additional funds for electric and hydrogen infrastructure. [OP-60]

Comment: Commenter states concern that failure to better coordinate funding and planning among the many state, regional and local agencies could jeopardize the entire transition and adoption of EV's. Commenter is concerned with the inability to purchase vehicles using HVIP for state mandated vehicles. Insufficient funding for the grid upgrades and equipment installation can threaten timeline availability for heavy-duty EV's, and continued availability of purchase incentives for fleet owners is crucial and that available funds are multi-year rather than annual funding. Commenter urges CARB that financial incentives be developed to minimize obstacles to ZEV adoption by consolidating vehicle and infrastructure funding programs into a single program. [OP-74, T1-11]

Comment: Commenter states significant incentive funds should be identified and deployed to construct the necessary ZEV infrastructure and reimburse fleets for increased marginal costs of purchasing and operating ZEV trucks. [OP-87]

Comment: Commenter states that challenges identified in the Investment Plan such as purchase cost, ZEV infrastructure, service and support, secondary market undeveloped for ZEVs, and technology concerns need to be addressed to further advance the electric truck market. [OP-98]

Comment: Commenter states CARB needs to make adequate and reliable funding through 2030 such as HVIP and LCFS. [OP-99]

Comment: Commenter states CARB should recognize the need to preserve the HVIP funding for CNG fleet and create a demand for instate RNG from SB 1383. [OP-101]

Comment: Commenter states that hydrogen fuel cell infrastructure can be available for fuel cell trucks if LCFS credits and HVIP are made available to help pay for fuel cell electric trucks and hydrogen fueling infrastructure. Commenter provided supporting documentation, articles, and references to support their comment. [OP-107]

Comment: Commenter states there should be guaranteed incentives that will help with costs of operations and capital purchase reach cost disparity as their current fleets. [OP-123-Form-905]

Comment: Commenter states there should be guaranteed ZEVs on-road by either "carrot on a stick" incentives or enforced regulations. [OP-123-Form-1241]

Comment: Commenter stats that government-driven investment and incentives are critical for the success of the infrastructure build out. [OP-123-Form-1161]

Comment: Commenter states there are insufficient incentives for heavy-duty trucks and vehicles. [T1-05]

Comment: Commenter states CARB should align with other state agencies regarding implementation and funding and provide resources to advance the ZEV industry across the state. [T1-15]

Comment: Commenter states that CTA supports further incentives to bridge the gap between outdated and cleaner engine technologies. [T1-46]

Comment: Commenter states they would like to see ZEV vehicles be pushed through incentives and not mandates. [T1-47]

Comment: Commenter states CARB should take leadership in spurring the development and investment in long-range zero-emission trucks with hydrogen or even long-range battery-electric trucks. [T1-66]

Comment: Commenter suggest CARB introduce a truck buyback program to convert polluting trucks into truck-homes to create low-income housing near resources that minimize vehicle miles travelled. [OP-70]

Comment: Commenter states CARB should focus on how to incentivize pickups; specifically given they're driven by small businesses and they may not be able to earn LCFS credits. They don't think truck market can transform without commitments by the state and hope CARB continues to provide incentives in those regulated categories beyond 2024 or 2027 timeline. Commenter states that current timeline as structured in regulation are dependent on the state providing sufficient and consistent funding for HVIP, CORE, pilots and demonstration projects. [T1-79]

Comment: Commenter states that successful electrification of the HD sector requires a holistic approach addressing not just vehicle availability, but also infrastructure, costs, and potential fleet requirements. Commenter states that purchase incentives, fueling incentives, and infrastructure programs are programs that are generally not designed with HD pickups in mind. Commenter also states that a fleet purchase rule cannot support the sale of HD pickups. [B1-16]

Agency Response: No changes were made to the regulation in response to these comments. The comments relating to funding policies and incentives are outside the scope of this regulation. Staff recognizes that incentives can play an important role in the early adoption of new technologies. However, the cost analysis for this regulation did not include any grants or rebates and the regulation is not predicated on the availability of incentives. The existing LCFS regulation has been in place for a decade and fleets can take advantage of it directly when dispensing low carbon fuels.

CARB offers a portfolio of incentive programs currently which are designed to incentivize technology from early demonstrations to full scale commercial deployment. The demonstrations and pilot projects funded through our incentive programs help reduce costs, increase experience with the new technologies, and expand the overall ZEV marketplace. The ACT regulation is needed to drive manufacturers to develop new ZEV products and generate SIP-creditable emissions reductions beyond what is feasible through incentive programs. By achieving larger economies of scale, the ACT Regulation will help make ZEV technology more viable across sectors and fleets.

Out of Scope - Scale Back the Low NOx Omnibus

Comment: Commenter states the Low NOx Omnibus Rule should be scaled back substantially to allow for a cost-effective and growing transition to medium- and heavy-duty ZEV technologies. [OP-87]

Agency Response: No changes were made to the regulation in response to this comment. This comment is outside the scope of ACT regulation and pertains to a separate regulation, the Low NOx Omnibus regulation.

<u>Out of Scope – Existing In-Use Regulations</u>

<u>Comment:</u> Commenter states CARB should allow older truck models to operate longer in California. [OP-25]

<u>Comment:</u> Commenter talks about his experience with the Truck and Bus rule and grant programs for cleaner trucks. Commenter states that he received a notice in April 2019 stating that his truck will not be allowed on the road after January 1, 2019, and states that this was the first notice that he received. Commenter states that he cannot afford another truck and that there is no financial assistance or grants available for the purchase of another truck. [OP-53]

<u>Agency Response:</u> No changes were made to the regulation in response to these comments. The regulation does not affect in-use vehicles and applies to a portion of new vehicle sales. Comments referring to existing in-use requirements such as the Truck and Bus Regulation are outside the scope of this regulation.

<u>Out of Scope – Carbon Tax</u>

<u>Comment:</u> Commenter opposes the ACT regulation and states that electric cars are not a public benefit. Commenter states polluting vehicles should be taxed or regulated to reduce emissions, including getting older noncompliant vehicles off the road. Commenter states that inflexible mandates are costly and ignore possible solutions such as natural gas trucks. [OP-36]

<u>Agency Response:</u> No changes were made to the regulation in response to this comment. The comment is outside the scope of the regulation, as the regulation only establishes requirements for introducing new heavy-duty vehicles and engines. However, CARB notes that it has promulgated several regulations, including the Truck and Bus regulation (13 CCR section 2025) that require on-road truck and bus fleets to ensure that in-use, older, heavy-duty vehicles meet performance standards that are equivalent to new 2010 emission standards.

<u>Out of Scope – Road Use Charges</u>

<u>Comment:</u> Commenter states a "Road Use Charge" system is needed, and to push for legislation requiring it, stating SB1077 provides feasibility. [OP-49]

<u>Agency Response:</u> No changes were made to the regulation in response to this comment as it is outside the scope of the regulation, however, staff appreciates the input. Staff will monitor such efforts as staff begins work on ZE fleet rules and other related policies.

Out of Scope – Effects of Climate Change are Already Here

Comment: Commenter shares an anecdote on the impacts of wildfires and poses an open question as to whether the regulation is too late or not. [OP-47]

Agency Response: No changes were made to the regulation in response to this comment. The past few years have clearly shown the impact that climate change is causing on the state's forests and exasperating wildfires across the state. As wildfires clearly have a significant impact on California's air quality, more needs to be done to mitigate the effects of climate change. CARB will continue to take bold action to reduce pollution and protect the health of Californians. This rulemaking is a key component of CARB's long-term strategy to reach carbon neutrality and protect the health of Californians.

Other – Other Waste Industry Requirements

Comment: Commenter states the rule should take into account and support efforts made to date along alternative fuel pathways. The waste industry is mandated by SB1383 to recycle and recover 75% of organic waste by 2025, which they suggest should be achieved by digesting into low carbon fuels to use in conventional vehicles. [OP-32, OP-44]

Agency Response: No changes were made to the regulation in response to this comment as it proposes a change that is beyond the scope of this rulemaking action.

Other – General Opposition

Comment: Commenter opposes the regulation, stating the voters of California should have a say in it. [OP-16]

Comment: Commenter states they are opposed to rule implementation, as requiring all trucks to be electric is not sustainable and rules must be voted on by taxpayers. [OP-18]

Comment: Commenter states this rule is not the solution, as California consumers cannot afford increases in the cost of living, and states that this rule will cause the cost of living to increase. [OP-19]

Comment: Commenter opposes this action. [OP-20, OP-23, OP-26, OP-31]

Comment: Commenter states opposition, as the regulation is too burdensome. [OP-24]

Comment: Commenter opposes rules that affect small businesses or truckers. [OP-30]

Comment: Commenter states opposition to rule as electric vehicles are neutral in benefit and mandates are inflexible, costly, and ignore other solutions such as natural gas trucks. [OP-36]

Comment: Commenter suggest a sales mandate is no longer warranted because vehicle penetration will grow organically. Commenter states a sales mandate could cause manufacturers to deploy the technology into customer operations for which it is not well suited, thus having the effect of impeding market acceptance. [OP-74]

Comment: Commenter states opposition as the proposal will increase the price of everything exponentially and CARB should be concerned about pollution (including that created by electricity generation). Commenter also asks if the rule will apply to illegal aliens. [OP-21]

Comment: Commenter opposes due to negative impact to California economy that is not justified by the proposed results. [OP-27]

Comment: Commenter opposes as forcing manufacturers and companies outside of California to go to zero-emissions "upends" small businesses and does not achieve anything. [OP-29]

Comment: Commenter states strong opposition due to the impact on the health and finances of California. [OP-42]

Comment: Commenter opposed to rule because of the economic damage to California and the insignificance of GHG benefit globally compared to other countries' GHG emissions. [OP-57]

Comment: Commenter has concerns about maintenance cost when drivers switch from conventional trucks to zero-emission trucks. They believe it would cost drivers 70% more than making this change. [T1-91]

Comment: Commenter opposes rule as a waste of taxpayer funds, and states there is no such thing as a "zero-emission truck" as electricity generation causes emissions. [OP-71]

Agency Response: No changes were made in response to these comments. Staff recognizes that all regulations can result in positive and negative changes. The ACT regulation has undergone a four-year public process with eight public workshops, five public workgroups, two focus group meetings, and well over one hundred meetings with stakeholders. Through this process, staff has developed a proposal that maximizes public benefits while minimizing negative impacts and adverse effects.

Staff acknowledges that vehicles with zero tailpipe emissions may generate upstream emissions as a part of fuel production. The well-to-wheel emissions of zero-emission trucks was already analyzed in Chapter VI of the Staff Report. Due to the lower upstream and downstream emissions of electricity and hydrogen versus gasoline and diesel, zero-emission trucks are anticipated to upstream and downstream emission benefits and produce lower emissions than all other technology options. CARB is simultaneously working to reduce emissions of other combustion-powered vehicles through regulations such as the Low NOx Omnibus and Low Carbon Fuel Standard.

Staff evaluated costs to the state as a whole and the total cost of ownership for a vehicle. Through these analyses, staff found that while zero-emission vehicles will cost more upfront due to higher vehicle costs and additional infrastructure costs, they will cost less over their lifetime due to lower fuel costs, LCFS revenue, and reduced maintenance expenses. ZEVs placed into well-suited applications will see a positive TCO versus their diesel counterparts, and more applications will show a payback over time as ZEV costs decline.

A number of studies from groups including ICF International, the North American Council on Fuel Efficiency, Union of Concerned Scientists, and University of California, Los Angeles have found that ZEVs are both cleaner on a well-to-wheel basis as well as superior economically versus gasoline, diesel, and natural gas options.

Impacts to local government and state government revenues are estimated in Attachment C to the 30-Day Changes. The ACT regulation is projected to have a slightly positive fiscal impact on local government due to increase in sales taxes and utility user taxes, and a significant decrease in revenue to the state government largely due to a decrease in gasoline and diesel fuel taxes.

As part of the Staff Report and 30-Day Changes, staff performed a macroeconomic analysis on the ACT regulation. The analysis found that the regulation is anticipated to have minimal effects on the state's economy and is projected to result in a slight increase in economic indicators. Because zero-emission trucks are anticipated to have a positive total cost of ownership, the regulation results in cost savings in the trucking industry which spreads through the California economy. Because the proposal only affects major manufacturers and large entities, the rule is not anticipated to have major impacts on small businesses and may create new opportunities.

The ACT regulation requires manufacturers to sell ZEVs but does not require fleets to purchase ZEVs. Because the ACT regulation is a manufacturer rule, manufacturers need to identify market segments they can compete in and offer competitive products that fleets will want to purchase. Broadly, vehicles used for local delivery appear better suited while work trucks present more challenges. Manufacturers most likely will not target market segments poorly suited for electrification and will instead focus on the ones that electrification is best suited for. The ACT Regulation applies to medium- and heavy-duty manufacturers, large businesses, large fleets and brokers, and government agencies. It does not directly affect small businesses, although some small businesses such as infrastructure installers and electric vehicle service providers may benefit from the effects of the regulation. The regulation does not apply to individuals.

Staff's TCO analysis and research show that ZEVs have lower maintenance costs per mile than conventional counterparts due to fewer moving parts, technologies such as regenerative braking systems, and other efficiency improvements. Staff has not been made aware of any research or industry models that indicate contrary information.

Other – Comments Addressed in The Environmental Response

Comment: Commenter states the proposed ACT regulation may actually trigger a number of compliance responses producing environmental impacts. Waste recycling and composting activities are either overlooked or completely disregarded and they should better align and harmonize all of our environmental policies at the federal, state and local levels. Commenter is concerned that the Draft EA does not fully factor all the impacts and current initiatives on the state's solid waste management system, and states that the Draft EA should take into consideration the environmental and fiscal impacts from increased costs for construction and operation of new waste management facilities to support recycling replacement of off-road and on-road vehicles. [OP-81]

Agency Response: These comments are addressed in the "Environmental Response to Comments" document. See Response to Comments on Final Environmental Analysis prepared for the ACT Regulation (Response to Comments link) presented and approved by the Board at the June 25, 2020 hearing.

WRITTEN COMMENTS RECEIVED DURING THE 30-DAY COMMENT PERIOD

Manufacturer ZEV Sales – General Support

Comment: Commenter states general support for the proposed changes to the regulation. [RP1-01, RP1-02, RP1-03, RP1-04, RP1-06, RP1-08, RP1-09, RP1-11, RP1-13-Form, RP1-14, RP1-19, RP1-20, RP1-21, RP1-22, RP1-23, RP1-24, RP1-25, RP1-26, RP1-29, RP1-30, RP1-31, RP1-33, RP1-35, RP1-37, RP1-39, RP1-40, RP1-41, RP1-42, RP1-43, RP1-45, RP1-48, RP1-49, RP1-51, RP1-53, RP1-55, RP1-56, RP1-61, RP1-65, RP1-67, RP1-68, RP1-69, RP1-70, RP1-71, RP1-72, RP1-74, RP1-75, RP1-76, RP1-78, RP1-79, RP1-81, RP1-82, RP1-83, RP1-84, RP1-87, RP1-89, RP1-90, RP1-91, RP1-92, RP1-94, RP1-95, RP1-96, RP1-97, RP1-98, RP1-99, RP1-100, RP1-101, RP1-102, RP1-103, RP1-104, RP1-105, RP1-107, RP1-108, RP1-109, RP1-110, RP1-111, RP1-112, RP1-113, RP1-114, RP1-115, RP1-116, RP1-117, 118, RP1-119, RP1-120, RP1-121, RP1-122, RP1-123, RP1-124, RP1-125, RP1-126, RP1-127, RP1-128, RP1-129, RP1-130, RP1-131, RP1-132, RP1-133, RP1-134, RP1-136, RP1-138, RP1-139, RP1-140, RP1-142, RP1-143, RP1-144, RP1-146, RP1-147, RP1-149, RP1-150, RP1-151, RP1- 152, RP1-153, RP1-155, RP1-156, RP1-157, RP1-158, RP1-159, RP1-160, RP1-161, RP1-162, RP1-163, RP1-164, RP1-165, RP1-166, RP1-167, RP1-168, RP1-170, RP1-171, RP1-173, RP1-174, RP1-175, RP1-176, RP1-177, RP1-178, RP1-179, RP1-180, RP1-182, RP1-183, RP1-184, RP1-185, RP1-186, RP1-187, RP1-188, RP1-189, RP1-190, RP1-192, RP1-198, RP1-199, RP1-200, RP1-201, RP1-204, RP1-207, RP1-208, RP1-209, RP1-211, RP1-217, RP1-220, RP1-221, RP1-

222, RP1-224, RP1-225, RP1-226, RP1-229, RP1-230, RP1-231, RP1-235, RP1-241, RP1-242, RP1-243, RP1-244, RP1-245, RP1-246, RP1-248, RP1-249, RP1-250, RP1-251, RP1-252, RP1-253, RP1-256, RP1-257, RP1-260-Form, RP1-261, RP1-262, RP1-264, RP1-267, RP1-268, RP1-270, RP1-271, RP1-273, RP1-276, RP1-282, RP1-286, RP1-290, RP1-291, RP1-292, RP1-293, RP1-295, RP1-300, RP1-301, RP1-309, RP1-311, RP1-319, RP1-323, RP1-325, RP1-331, RP1-336, RP1-339, RP1-341]

Comment: Commenter states his support on hydrogen vehicles. [RP1-13-Form-1746]

Comment: Commenter states his support on hydrogen vehicles and its fuel supply infrastructure. [RP1-13-Form-3346, RP1-191]

Comment: Commenter on behalf of several organizations supports the proposed modifications and updated reporting requirements. Commenter states the reporting requirement will collect sufficient data for development of fleet rules. [RP1-57]

Comment: Commenter applauds improvement of the proposed changes to the regulation and attaches a total cost of ownership for electric class 2b/3 pickup trucks and a press release from General Motors about their Ultrium Battery for the electrification of work trucks. [RP1-58]

Comment: Commenter suggests that there is confidence in battery electric truck infrastructure and CARB can confidently adopt a robust ACT regulation, knowing that agencies, industry, and other stakeholders are engaged in a comprehensive set of programs to meet the needs of battery electric ZEVs. Commenter provided supporting documentation, articles, and references to support their comment. [RP1-188]

Comment: Commenter states that short-haul vehicles should be manufactured as ZEVs, and have incentives like tax breaks to comply. [RP1-213-Form-31]

Comment: Commenter states battery powered vehicles are an economical solution to combustion engine. [RP1-213-Form-557]

Comment: Commenter on behalf of Southern California Edison (SCE) state they support the ACT regulation and are ready to facilitate the transformation of medium- and heavy-duty vehicles to zero-emissions. [RP1-259]

Comment: Commenter on behalf of NRDC submitted form letters from 5,503 signatories providing general support for the propose changes to the regulation. [RP1-260]

Comment: Commenter states general support for the proposed changes to the regulation, and states that the rule will incentivize and accelerate battery development that will boost EV adoption nation- and world-wide. [RP1-278]

Comment: Commenter states general support for the proposed changes to the regulation, and highlights economic benefits: driving down ZEV battery costs for LD and HD, reducing need for expensive and often extremely dirty Peaker power plants, facilitating renewable energy integration into the grid, spurring new technologies and businesses using new inexpensive energy storage in CA. [RP1-279]

Comment: Commenter states general support for the proposed changes to the regulation, and states that the rule will help the 122 CA hospitals and 58 major U.S. businesses that are a part of their coalitions achieve economic growth in a clean, resilient sector, and will generate almost 2 million new jobs for Californians, and save hundreds of millions if not billions of dollars in avoided costs from reduced emissions. [RP1-280]

Comment: Commenter recognizes need for infrastructure needs that will result from the ACT regulation, and stands ready with experience to provide what's needed. Commenter states general support for the proposed changes to the regulation, and states that the rule will help the state meet its climate action goals. [RP1-281]

Comment: Commenter states ACT is needed to bring ZE trucks into wide scale production, and complements other State electrification policies like LCFS that will bring both environmental and economic benefits. [RP1-294]

Comment: Commenter has 3,637 signatures of Californians that believe in the new proposal and urges CARB to reject any delays that might rollback the regulation. [RP1-306]

Comment: Commenter has 36 public comments addressed CARB that were submitted to the Union of Concerned Scientists by California scientists, engineers, doctors, and public health experts urging for a strong ACT Rule. [RP1-308]

Comment: Commenter provides general support for the ACT regulation on grounds of GHG emissions reduction, air quality, public health, and increasing battery development and resulting spread of EVs around the nation and the world. [RP1-318]

Comment: Commenter and the 563 signatories support the proposed changes to the regulation. [RP1-324]

Comment: Commenter on behalf of the Peninsula Interfaith Climate Action Organization supports the proposed changes to the regulation. [RP1-337]

Agency Response: Staff appreciates the supportive comments. Additional issues raised by commenters, if any, will be addressed in the following applicable sections.

Manufacturer ZEV Sales – Strengthen the ACT Proposal Increasing Sales Percentage Requirements

Comment: Commenter suggests earlier ZEV sales requirement beginning in 2022. [RP1-03]

Comment: Commenter states regulation should increase ZEV sales requirements for all classes and years, especially in early years. [RP1-08]

Comment: Commenter states that 100% of vehicles and machinery sold/imported into CA should be zero-emission by 2030. [RP1-27]

Comment: Commenter is in support of a 30% minimum sales requirement of zero-emission trucks by 2030 but suggests a higher manufacturer sales percentage is preferable. [RP1-47, RP1-50, RP1-52, RP1-54, RP1-59, RP1-60, RP1-62, RP1-63, RP1-126, RP1-135, RP1-137, RP1-258, RP1-262, RP1-263, RP1-268, RP1-269, RP1-274, RP1-275, RP1-279, RP1-304, RP1-321, RP1-322, RP1-327, RP1-328, RP1-329, RP1-332, RP1-333, RP1-334, RP1-335, RP1-338, RP1-340, RP1-342]

Comment: Commenter recommends a sales increase of 30% per year. [RP1-93]

Comment: Commenter states that they don't believe the transition should take 13 years. [RP1-160]

Comment: Commenter would like us to consider a different implementation of ZEV sales percentage requirements: 1% by 2025, 2% by 2026, 4% by 2027, 8% by 2028, 16% by 2029, 32% by 2030, and 64% by 2032. [RP1-212]

Comment: Commenter states we should adopt an even stronger ACT regulation. [RP1-219, RP1-260-Form-1556, RP1-261]

Comment: Commenter states that the 50% requirement by 2030 should also apply to the Class 2b-3 group, not just classes 4-8. [RP1-223]

Comment: Commenter states the ACT regulation should require 40% by 2030. [RP1-227]

Comment: Commenter urges CARB to adjust the zero-emission vehicle sales percentage for Class7-8 trucks to start with 12% in 2024 and 80% by 2035. [RP1-236, RP1-289, RP1-297, RP1-299, RP1-310, RP1-314]

Comment: Commenter states all commercial trucks should follow the ACT regulation. [RP1-260-Form-1148]

Comment: Commenter states ACT should apply to all motor vehicles. [RP1-260-Form-1512]

Comment: Commenter states all trucks need to be switched to electric. [RP1-260-Form-2000]

Comment: Commenter states that the ACT regulation needs to include 100% zero-emission trucks by 2023. [RP1-260-Form-2024]

Comment: Commenter urges strengthening the ACT regulation to respond as quickly as the climate and air pollution crises demand. Commenter states that the ACT regulation should call for stronger ZEV sales requirements across vehicle classes and years. Commenter provided supporting documentation, articles, and references to support their comment. [RP1-287]

Comment: Commenter states we should electrify all modes of transportation. [RP1-296]

Comment: Commenter states the ACT regulation should begin in 2025 with 30% ZEVs. [RP1-296]

Comment: Commenter states that Class 7-8 trucks should start with 12% in 2024 and 80% by 2034. [RP1-298]

Comment: Commenter states need for a stronger ACT regulation, comparing Norway's 50% requirement by 2030 to ACT's 30% requirement, and cites falling battery prices as one reason for why stronger ACT requirements are possible. Commenter provided supporting documentation, articles, and references to support their comment. [RP1-305]

Agency Response: No changes were made to the regulation in response to these comments. See further discussion on staff's rationale for the regulation's requirements in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Strengthen the ACT Proposal by Including Pickups Earlier and/or Increasing Sales Percentage Requirements".

Manufacturer ZEV Sales – Pair Manufacturer and Fleet Requirements and Focus on Beachhead Markets

Comment: Commenter states that the proposed amendments maintain a fundamentally flawed regulatory structure and does not meet Board direction to revise and restructure the ACT regulation to pair manufacturer and fleet requirements. Commenter provides quotes from Board members from the December 12, 2019, Board hearing supporting commenter's statements. [RP1-218]

Comment: Commenter supports accelerating the transition to zero-emission technologies through a thoughtful policy approach that prioritizes promising sectors and use cases, often referred to as a beachhead or segmented approach. CARB staff's proposed amendments did the opposite by making the rule less segmented. OEMs are segmented in the medium- and heavy-duty market, a broad unsegmented approach may harm certain OEMs who only manufacture in less mature markets and benefit OEMs who happen to manufacture in the more easily electrified segments of the market. [RP1-241]

Comment: Commenter urges CARB staff to consider the value of additional segmentation to add clarity to the goals of this regulation and to strongly inform an effective fleet rule structure. Commenter suggests incorporation of beachhead strategies to quickly get to scale and reduce costs. [RP1-265]

Agency Response: No changes were made to the regulation in response to these comments. Please see the discussion about transitioning key beachhead markets to zero-emission in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Pair Manufacturer and Fleet Requirements". In addition, the Board has directed staff through the Resolution to return to the Board with a ZE fleet rule by the end of 2021 and to ensure the upcoming zero-emission fleet rules compliment the ACT Regulation. These commitments show CARB's overall direction to have both manufacturer and fleet rules, but do not mean that staff must present both simultaneously.

Manufacturer ZEV Sales – Manufacturer Requirements Are Too Stringent

Comment: Commenter states that ACT sets impossible goals for the deployment of currently non-existent heavy-duty vehicles. Commenter states that the 5% sales requirement by 2024 for Class 7 & 8 trucks is not realistic because ZEVs are not currently produced in the category, and would not be produced in enough quantity required to meet the requirement. [RP1-106]

Comment: Commenter recommends more realistic sales targets and suggests CARB maintain the original sales percentage requirements for MYs 2024-2030, rather than the revised sales requirements. [RP1-205]

Comment: Commenter states that CARB should revert to its original strategy that sales percentages would serve as a "floor" to bring large HD manufacturers into the zero-emission truck market and corresponding fleet rules would be used to meet the ZEV goals of maximizing deployments. [RP1-214]

Comment: Commenter states rule targets are too aggressive, as at-scale commercial production of Class 5/6 and Class 8 ZEVs is not expected by commenter until 2023-2024 timeframe, and not one that has been announced that the commenter can purchase in quantity that will meet their duty-cycle and dispatch business models. [RP1-232]

Comment: Commenter states the proposal to remove the exemption for Class 2b-3 pickup trucks until 2027 as originally proposed is not analytically supported and removes the more segmented original proposal. Commenter recommends reinstating the exemption for Class 2b-3 pickups until 2027 and returning to the sales percentages in the original ACT regulation for Class 7-8 tractors. Commenter supports the increased percentages for Class 2b-3 vans and suggests separating vans from pickups in Class 2b-3. [RP1-241]

Comment: Commenter states the increased sales mandate was not accompanied by any analysis of technical feasibility. [RP1-247]

Comment: Commenter expects small numbers of available tractors in 2021 and expects them to be used for regional haul and not long haul. Commenter predicts that rapid electrification of regional tractors may not lead to achieving the sales percentages and timelines in the 30-Day Changes for years 2024 and 2027. [RP1-265]

Comment: Commenter states targets are too aggressive. [RP1-284]

Agency Response: No changes were made to the regulation in response to these comments. Staff recognizes that the ACT regulation's requirements are aggressive but are technologically and economically feasible. These requirements are necessary in order to enable large-scale electrification at the scale necessary to meet the states air quality and climate goals. Without transitioning as much of the medium- and heavy-duty sector to zero-emission where feasible, California will not be able to meet air quality goals, climate change targets, nor its carbon neutrality goals. By setting stringent requirements on manufacturers, CARB is ensuring there will be sufficient vehicles available for fleets to purchase. CARB intends to develop future ZE fleet rules to ensure ZEV deployments in fleets. To supplement this effort, other California policies can provide incentives, ensure access to infrastructure, and achieve other goals that are needed for widespread transportation electrification.

Staff performed analyses in Appendix F to the Staff Report as well as Attachment B to the 30-Day Changes. These show that the manufacturer ZEV sales requirements are feasible for zero-emission technology. Because of the need for electrification and the feasibility of the requirements, staff is maintaining the current ZEV percentage requirements.

Manufacturer ZEV Sales – Rationale for Increasing Class 2b-3 and Pickup Requirements

Comment: Commenter states that they would like to understand the basis for sales targets increasing by 100%. In addition, commenter would like to understand the inclusion of Class 2b-3 pickups. [RP1-215]

Comment: Commenter states adding pickup trucks to the rule only adds complexity and potentially little value. [RP1-216]

Agency Response: No changes were made to the regulation in response to these comments. As detailed in Attachment B to the “Notice of Public Availability of Modified text and Availability of Additional Documents and Information” for the ACT regulation, released in April 28, 2020, for public comment, staff moved the requirements for Class 2b-3 vehicles forward one year without changing the start date and removed the pickup truck exemption. The inclusion of Class 2b-3 pickup trucks in 2024 is supported by new information in recent market announcements showing that a number of zero-emission pickup and additional van models will be commercially available from several manufacturers well before the 2024 model year. See further discussion of staff’s rationale for increasing manufacturer’s sales requirements for Class 2b-3 vehicles in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Manufacturer ZEV Sales – Strengthen the ACT Proposal by Including Pickups Earlier and/or Increasing Sales Percentage Requirements”.

Manufacturer ZEV Sales – Increase Weight Class Modifier for Class 2b-3 Vehicles

Comment: Commenter recommends increasing the weight class modifier for Class 2b-3 to 1.0. [RP1-241]

Agency Response: In response to this comment and new information, the weight class modifier for Class 2b-3 vehicles was increased from 0.6 to 0.8. This change was necessary as there is a higher risk to manufacturers that produce vehicles in this category due to relatively high proportion of personal-use and small fleet purchasers of pickups and vans. The Weight Class Modifiers are designed to allow manufacturers flexibility in producing their products while maintaining overall emissions benefits. Heavier vehicles produce more emissions, and electrifying heavier vehicles provides more benefits. Increasing the weight class modifier to 1.0 for Class 2b-3 vehicles would put them on par with a Class 4-5 vehicle. This would overestimate the emissions of a Class 2b-3 vehicle and overstate the benefit of electrifying a Class 2b-3 vehicle. Keeping the 0.8 value correctly states the emissions of a Class 2b-3 vehicle.

Manufacturer ZEV Sales – Allow More Technologies and/or Fuel Options

Comment: Commenter suggests that the ACT regulation consider the “cyclone” engine, which uses renewable fuels, as an alternative option to meet zero-emissions standards. Commenter provided supporting documentation, articles, and references to support their comment. [RP1-16]

Comment: Commenter states that there are a number of renewable low carbon fuels in the marketplace that are reducing emissions. Commenter suggests that we should let the market figure out the most appropriate technology; and asks why should CARB dictate a winner at this point? Commenter suggests allowing alternative fuels/technologies participate in the rule. [RP1-106]

Comment: Commenter states that air quality improvements could be better accomplished by including other fuel types in the rule. [RP1-260-Form-300]

Comment: Commenter recommends CARB develop a manufacturer rule that is technology neutral. Commenter believes this rule, and any future fleet rule, should set emissions targets and allow any technology to meet it instead of specifying that only electric and hydrogen vehicles can be used for compliance. [RP1-272]

Agency Response: No changes were made to the regulation in response to these comments. The ACT regulation requires manufacturers sell ZEVs as a percentage of annual truck and bus sales in California. A ZEV is defined in the regulation as, “an on-road vehicle with a drivetrain that produces zero exhaust emission of any criteria pollutant (or precursor pollutant) or greenhouse gas under any possible operational modes or conditions”. See staff discussion on how the ACT regulation has the primary purpose of expanding electrification in California, but is one of a suite of CARB efforts to reduce emissions from vehicles and fuels, in chapter “Comments Received During Original Proposal’s 45-Day Comment Period” section “Manufacturer ZEV Sales – Credit for Low NOx Engines and Renewable Fuels”.

Manufacturer ZEV Sales – Give Credit for Low NOx Engines

Comment: Commenter in reference to Section 1963(a), states that the ACT regulation should provide an incentive to build Low NOx RNG medium- and heavy-duty trucks. [RP1-106]

Comment: Commenter recommends that the rule include NZEV credits for vehicles with engines certified to the optional low NOx standard of 0.02g/hp-hr and that use renewable fuel. [RP1-206]

Comment: Commenter states the ACT regulation should include a partial credit for low NOx trucks (0.02 grams of nitrogen oxides per brake horsepower hour (g/bhp-hr)) and a range multiplier for long range trucks (Class 7 and 8 - minimum range of 300 to 400 miles) to incentivize the sale of long range near-zero and zero-emission trucks. [RP1-216]

Comment: Commenter recommends that the rule include NZEV credits for vehicles with engines certified to the optional low NOx standard of 0.02g/hp-hr and that use renewable fuel. Additionally, the commenter is concerned that the, "definition of NZEV in the proposed rule focuses on certain technologies instead of actual emissions performance or capability." [RP1-218]

Comment: Commenter recommends amending the regulation to incentivize the deployment of low NOx trucks powered by RNG to provide immediate air quality benefits. [RP1-254]

Comment: Commenter recommends developing a credit system, much like the one proposed by CARB staff for hybrid-electric platforms, for heavy-duty trucks that meet a 0.02 g/bhp-hr NOx certification standard or better. Additionally, the commenter states the ACT regulation needs to focus on existing technologies such as Low NOx engines now and push later for new technologies in order to reduce air pollution sooner than 8 years. Commenter states staff's current proposal ignores the long-term benefits of using Low NOx trucks powered by renewable natural gas. [RP1-228]

Comment: Commenter states CARB should consider a backup strategy in the event of missing ZEV targets. The Low NOx, RNG powered trucks are able to hit the market soon while manufacturers work on producing ZEVs. [RP1-232]

Comment: Commenter states there should be a credit system for Low NOx trucks powered by RNG. [RP1-233]

Comment: Commenter states that it is unclear from CARB's analysis whether the shorter-term air quality goals could be met utilizing currently existing low and ultra-low NOx technologies in a much more cost-effective manner than the approach currently proposed by CARB. [RP1-272]

Comment: Commenter recommends allowing electric hybrids, including non-plug-in hybrid-electrics that meet or exceed MY2027 Phase 2 GHG standards, to receive partial credit in truck sectors facing challenges to fully electrify. Commenter cites China's related approach in LDVs, and provides a link to an article that also supports their position. Commenter suggests adding a compliance pathway to comply with the ACT regulation that allows for low-carbon fuel use in trucks such as ultra-low NOx trucks. [RP1-284]

Comment: Commenter urges CARB to continue to allow RNG/CNG to be one of the preferred options in the ACT regulation as a bridge to future technologies. [RP1-320]

Agency Response: No changes were made to the regulation in response to these comments. To the extent commenter in RP1-218 is asserting that the NZEV definition sets a prescriptive standard, CARB disagrees. The ACT regulation establishes a compliance option that provides partial credits to manufacturers that elect to produce and sell vehicles that do not meet the full criteria for a ZEV but that can operate for a specified mileage range - a minimum all-electric range (AER)) - without generating GHG or criteria emissions. Vehicles meeting this criterion are referred to as near-zero emission vehicles (NZEVs). The ACT regulation does not require manufacturers to sell NZEVs, but instead permits manufacturers that elect to sell NZEVs to do so as an interim partial compliance option to the primary regulatory requirement to earn ZEV credits in order to offset their deficits. It is a partial compliance option because manufacturers can use NZEV sales to meet no more than half of their deficits and no NZEV credits can be earned after the 2035 model year. Thus, the NZEV credit partial compliance provision does not constitute a prescriptive standard because it is purely optional and not a requirement mandated under the regulation. See discussion about credits for Low NOx vehicles in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Manufacturer ZEV Sales – Credit for Low NOx Engines and Renewable Fuels”.

For the sake of clarity, commenter RP1-228’s claims must also be put in the correct context. The commenter essentially alleges that its own analysis suggests that the ACT rulemaking will not achieve enough near-term NOx and carbon intensity emission benefits, relative to the existing emissions inventory, for SIP purposes unless CARB allows for manufacturers to generate NZEV credits with Low NOx engines. First, the discussion of “emission benefits” or “emissions inventory” or “emissions analysis” in the ACT rulemaking context is more related to an evaluation of how well the proposed regulations achieve the objectives of the ACT regulation than it is to any consideration of environmental impacts. (See 40 C.F.R. § 1066.605 [requirements for emissions testing not related to CEQA requirements].) In other contexts, like in environmental review situations (e.g., CEQA), these terms might point to air quality impacts or greenhouse gas (GHG) impacts. But, unless specifically incorporated into the environmental analysis of an environmental review document under CEQA, discussions of these terms in the ISOR, FSOR, or other record documents should not be taken to implicate an environmental review analysis of air quality or GHG impacts. Here, the commenter is asserting that its suggested concept of including Low NOx engine to generate NZEV credits will be an emissions benefit for SIP purposes to meet the state's air quality goals under the Clean Air Act. This is not a comment about environmental impacts. Rather, the commenter disagrees with CARB's policy approach. The comment is noted.

Second, the commenter RP1-228's assertion that air quality improvements, relative to the baseline scenario, would be better accomplished through the use of Low NOx engines also deserves clarification. The use of the word "baseline" has a different meaning in the CEQA context than in discussions of non-CEQA issues. For example, ISOR's Appendix F (Emissions Inventory Methods and Results) provides analysis of the proposed ACT regulation on criteria and GHG emissions by estimating emissions under a "Baseline scenario" and a "Proposed Rule scenario." According to Appendix F, the "Baseline scenario represents the existing forecasted emissions inventory without the proposed ACT rule," and this forecasted inventory includes the same vehicle sales and population growth assumptions reflected in CARB's EMFAC (Emission Factor model) emissions inventory for weight Class 2b and greater vehicles for all fuel types. In other words, in the FSOR (Appendix F), the economic and emissions benefits of the ACT Regulation were evaluated against the business-as-usual (BAU) "baseline scenario" for each year of the analysis period from 2020 to 2040. In contrast, the baseline used for CEQA purposes in the EA is "a 2018 baseline, as that is the year in which CARB filed the notice of preparation" (NOP). Per CEQA requirements, the CEQA baseline corresponds with what is known as the existing conditions on the ground (including the regulatory setting and physical conditions in 2018) at the time of the filing of the NOP. (Title 14, California Code of Regulations, section 15125, subd. (a)(1).) Although the discussion of environmental impacts in the EA references the BAU scenario, the EA uses the existing conditions as the point for comparison when evaluating reasonably foreseeable changes that could result from deploying the required number of ZEVs required by the ACT regulation. As such, the CEQA baseline (see Attachment A to Final EA) serves a different purpose and has a different meaning from the "BAU baseline scenario" in Appendix F. For purposes of evaluating these comments, CARB interprets commenter's position as relying on existing forecasted emissions to suggest that its proposed Low NOx credit approach would achieve more emissions reductions below the forecasted emissions than the proposed ACT regulation. There is no suggestion in this comment that the proposed ACT regulation is actually causing an environmental impact, rather, it argues that the proposed ACT regulation could do more to reduce emissions below the forecasted emissions inventory if it adopted commenter's concept. CARB disagrees with commenters' argument on this point based on the reasoning already provided, above, in rejecting Alternative 3.

Manufacturer ZEV Sales – Modify Near-Zero-Emission Vehicle Definition

Comment: Commenter in reference to Section 1963(c)(16) suggests that the NZEVs definition should include the cleanest certified NOx vehicles in California. [RP1-106]

Comment: Commenter states that CARB should include heavy-duty trucks that meet a 0.02-gram NOx standard within the ACT regulation definition of near-zero. Commenter states that they support the Coalition of Natural Gas comment from May 28, 2020 of which they are also a signatory. [RP1-194]

Comment: Commenter suggests that the NZEV definition should define applicable technology in terms of quantifiable exhaust emission standards, to include engines emitting less than 0.02 g/bhp-hr NOx. [RP1-206]

Comment: Commenter states the definition of "near-zero" in the Staff Report is not consistent with many CARB, California Energy Commission, and South Coast Air Quality Management District documents. For example, the SCAQMD Air Quality Management Plan, which was approved by CARB, goes as far as explicitly defining "near-zero" as 0.02 g/bhp-hr, consistent with CARB's 90 percent reduction target. Commenter suggests that CARB set a performance-based definition for "near-zero" and continue to use the 90% reduction target and 0.02 g/bhp-hr emission rate. [RP1-216]

Comment: Commenter recommends modifying the NZEV definition to include additional technologies that can achieve the optional certification to 0.02g/hp-hr NOx standard and use renewable fuel. Commenter states that CARB should also clarify that the new definition of NZEV used in the ACT regulation does not affect the definition of "near-zero" as it is used in other CARB regulations or funding programs. [RP1-218]

Comment: Commenter states the definition of near-zero is a conflicting regulatory and statutory definition that is confusing to everyone. Commenter states PZEV is a vehicle that has the ability to operate partially in zero-emission mode. This would be a consistent definition to what is used in the light-duty vehicle sector, and should be used in the ACT regulation. Commenter states that the Low NOx 0.02 grams standard should be included in the near-zero definition. [RP1-228]

Comment: Commenter states that the near-zero term should include Low NOx trucks. [RP1-233]

Comment: Commenter states the definition of "near-zero" is conflicting with the commonly held "near-zero" definition and is confusing to stakeholders. Commenter recommends the inclusion of low NOx engines that meet the 0.02 g NOx value into the "near-zero" definition of the ACT regulation. [RP1-254]

Agency Response: No changes were made to the regulation in response to these comments. See staff's reasoning for maintaining the "near-zero-emission vehicle" definition in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Near-Zero-Emissions Vehicle Definition".

Manufacturer ZEV Sales – Add Midterm Reviews, Offramps, Market Reviews, or Appeals Process to Assess Regulation

Comment: Commenter requests that staff update their analysis of the current and future manufacturer marketplace and the medium- and heavy-duty ZEV models that will be available for purchase within the timelines of the ACT regulation. Commenter also states an update to CARB's analysis of the current and future economic conditions that will affect availability of ZEV's and sources of funding for government agencies should be completed. [RP1-44]

Comment: Commenter in reference to 1963.3 suggests that ACT does not provide alternatives to the strict requirements of the regulation e.g. an appeals process, technology determination, variance process, compliance provisions and suggests language similar to the Advanced Clean Transit regulation [sic]. Commenter provided supporting documentation, articles, and references to support their comment. [RP1-106]

Comment: Commenter suggest that CARB should reevaluate the ACT regulation prior to 2035 to ensure that progress towards a zero-emission future does not stagnate at the required percentages. [RP1-140]

Comment: Commenter states that CARB should provide a provision in the rule to exempt manufacturers from mandated sales that exceed infrastructure build-out and purchase incentive availability. [RP1-214]

Comment: Commenter states that the ACT regulation should be reconsidered again in 3 years after it becomes law to accelerate the timeline. [RP1-223]

Comment: Commenter states that the ACT regulation should include regulatory provisions for relief if the market causes failure to meet the sales percentages. [RP1-241]

Comment: Commenter requests that CARB update their analysis of the current and future manufacturer marketplace and sources available for funding for fleet agencies at critical milestone dates in the proposed regulation. [RP1-255]

Comment: Commenter suggests it is appropriate for CARB to perform check-ins over the course of the rule's implementation to ensure the rule remains on a path to success. [RP1-259]

Comment: Commenter states it would be highly prudent to build "checkpoints" into the regulation at specific milestones to assess the market, and to assess whether staff's assumptions have borne out. [RP1-265]

Comment: Commenter recommends a future check-in regarding the market's progress in meeting the regulation in 2026. [RP1-281]

Agency Response: No changes were made to the regulation in response to these comments. Staff intends to return to the Board with a recommendation in 2021 with a complementary regulatory strategy on fleet owners to further the deployment of ZEVs. As a result, staff will continue to monitor the ZEV market and will be prepared, if needed, to make any adjustments at that time. Staff does not believe mid-term reviews or checkpoints are necessary, however, staff is prepared to come back to the Board once the regulation is in effect, if market conditions change. The Board provided a pathway to meet future ZEV goals, as described in the Board's final resolution, which will require, at minimum, full compliance with the approved regulation. For additional information, see response summarizing how off-ramps fail to add regulatory certainty in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Add Off-Ramps to the Proposal".

Manufacturer ZEV Sales - Elect ACC or ACT Credits Year Round

Comment: Commenter states that in Section 1963.2(a) staff should clarify that manufacturers have the flexibility to choose the program in which to generate credits throughout the year to prevent double counting between Advanced Clean Cars rule and ACT rule. [RP1-235]

Agency Response: No changes were made to the regulation in response to this comment. Manufacturers can claim credit in either program throughout the model year and are only required to report those credits once per year for the approved ACT regulation.

Manufacturer ZEV Sales – Extra Credit for ZEVs Based on Range

Comment: Commenter states that the current credit modifier value of 0.8 for Class 2b-3 vehicles does not provide incentives for OEMs to develop and produce vehicles to address the need of personal use buyers. OEMs can earn the same amount of credits by offering 150-mile ZEV vs. offering 300-mile ZEV. Toyota recommends adding "bonus" credit to the weight-class modifier in which OEMs are provided incentives to develop and provide longer range vehicles. From light-duty ZEV market assessments, Toyota is aware that one of the important factors for consumers is longer range availability. [RP1-80]

Agency Response: No changes were made to the regulation in response to this comment. See discussion on why staff chose not to give longer ranged ZEVs more credit in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Extra Credit for ZEVs Based on Range".

Manufacturer ZEV Sales – Promote Hydrogen Fuel Cell Electric Vehicles and Associated Incentives

Comment: Commenter recommends a mechanism in the rule to incentivize production of hydrogen ZEVs starting in 2025 through 2035 in heavier GVWR ranges to help Caltrans meet its user range requirements, and/or an incentive program to develop heavy-duty electric vehicles and EV infrastructure that meets their range and needs. [RP1-273]

Agency Response: No changes were made to the regulation in response to this comment. The ACT regulation categorizes hydrogen fuel cell electric vehicles as ZEVs and sets stringent requirements on manufacturers to produce ZEVs. To meet these stringent targets, staff expects manufacturers to work closely with their customers and design ZEVs that meet their customer's operational needs. Building hydrogen fuel cell electric vehicles with longer range capabilities is one solution for meeting the ZEV mandates. Regarding financial incentives, see discussion about incentives in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Out of Scope – Incentive and Funding Policies".

Manufacturer ZEV Sales – Clarify Changes to Low Volume Manufacturer Exemption

Comment: Commenter states that by striking out "Class 2b and greater vehicles" in the "Low Volume Manufacturer Exemption", it can be interpreted that many light-duty vehicle OEMs will be regulated under the Advance Clean Truck regulation even if they would be qualified as low volume manufacturers under the original description. CARB does not offer explanation as to why the "Class 2b and greater vehicles" description was struck from the modified proposal. Toyota requests reinstatement of "Class 2b and greater vehicles" into description of low volume exemption. [RP1-80]

Agency Response: No changes were made to the regulation in response to this comment. While the text "Class 2b and greater vehicles" was removed from the Low Volume Manufacturer Exemption section, the definition of "vehicle" explicitly states that vehicles must have a GVWR greater than 8,500 lb. The modified statement does not change the applicability of the exemption and only removes duplicative text.

Manufacturer ZEV Sales – Modify NZEV Credit Generation Past 2030

Comment: Commenter recommends modifying NZEV vehicle requirements; specifically, section 1963.2(b)(2) should be eliminated and section 1963.2(b)(1) should be revised to read as follows: "NZEV Factor Value. The NZEV factor used to calculate NZEV credits shall be calculated as 0.01 multiplied by the all-electric range, and is not to exceed 0.75 until the end of the 2029 model year and 0.65 starting with the 2030 model year." [RP1-218]

Agency Response: No changes were made to the regulation in response to this comment. The suggested change would effectively decrease the amount of credit longer range NZEVs would generate past 2030 and would maintain a minimum all-electric range of 35 miles. In contrast, the approved ACT regulation increases the minimum all-electric range requirement from 35 miles to 75 miles in 2030 MY. The commenter's proposed change would encourage the production of shorter-range ZEVs since there would be no requirement to produce ZEVs with at least 75 miles of range. In addition, the commenter's proposed change would dis-incentivize the production of longer-range ZEVs since vehicles with more than 65 miles of all-electric range would no longer receive additional credits.

In order to achieve zero-emission wherever feasible by 2045, manufacturers need to be building vehicles with sufficient zero-emission capabilities to meet all fleet needs. These proposed changes recommended by the commenter would not improve the likelihood of achieving this goal.

Manufacturer ZEV Sales – Use Battery Capacity instead of All-Electric Range for NZEVs

Comment: Commenter suggests that the ACT regulation should measure clean air value of a vehicle by its battery capacity in kWh as opposed to the self-claimed all-electric mile range. [RP1-140]

Agency Response: No changes were made to the regulation in response to this comment. The ACT regulation requires the same test as the California Phase II GHG regulation that measures the all-electric range. The tested all-electric range is a useful metric that is representative of the miles travelled and vehicle efficiency. Because a range test is already required, an additional battery capacity test would place an unnecessary burden on manufacturers while providing no additional benefit.

Manufacturer ZEV Sales – Encourage Longer Range Plug-in Hybrids

Comment: Commenter states that regulations and incentives have not encouraged mid-range to long-range PHEV's and suggests that mid-range and long-range PHEV's, in combination with BEV's, is better in the near- and long-term than a scenario with only BEV's. [RP1-64]

Agency Response: No changes were made to the regulation in response to this comment. The approved regulation requires manufacturers produce ZEVs and provides credits for NZEVs that manufacturers can use to meet part of their compliance obligation.

Manufacturer ZEV Sales – Adjustments to NZEV Credits

Comment: Commenter requests the eligibility to generate credits for PHEV's (NZEV's) should be extended from 2035 to 2045 with a 75-mile AER and also extended past 2045 provided the PHEV has a 75-mile AER and is only capable of using or can be shown to use only an ultra-low carbon fuel for its secondary propulsion system [RP1-64]

Comment: Commenter requests capping the amount of credits in a class from PHEVs (NZEVs) be modified. Specifically, the proposed limit of 50% of class 2b-3 and class 4-8 straight truck credits from NZEVs should be increased to 75% especially in the years after 2030 when NZEVs must have a 75 mile AER. [RP1-64]

Comment: Commenter suggests the crediting system should encourage manufacturers to produce plug-in hybrid electric trucks that can provide more than 75% of their miles from an electric off-board power source through a new after-the-fact credit system based on proving that up to 95% of annual miles are all-electric. [RP1-64]

Comment: Commenter suggests revising the NZEV maximum allowance upward to as much as 70 percent from MYs 2024–2030 and tapered off in MYs 2031–2034 to hit 50 percent in MY 2035. [RP1-205]

Agency Response: Changes were made to the regulation to extend the NZEV credit generation sunset date from 2030 to 2035 for NZEVs that achieve more than 75 miles of all-electric range. This is directionally consistent with these comments. See discussion about staff's reasoning for this extension in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Extend Sunset Date for Plug-in Hybrids". No changes were made to the NZEV credit value nor the limitation of allowing only up to 50% of a manufacturer's annual obligation to be met with NZEV credits. Staff set the NZEV credit value at a minimum, to meet the California's GHG Phase II regulation's minimum all-electric range, and tied the increase to a utility factor based on the vehicle's all-electric range, maxing out at 75% of a full ZEV credit. This is to encourage manufacturers to produce full ZEVs while still allowing for development of NZEVs, considered to be a bridging technology, in cases where ZEVs may not fit in the 2024-2035 timeframe. ZEVs are the preferred technology option because they produce zero tailpipe emissions. The 50 percent NZEV maximum allowance is designed to allow significant production of NZEVs without deviating too significantly from the ZEV goals. Increasing the maximum NZEV allowance could potentially defer ZEVs from being deployed in California which runs counter to the regulation's goals.

Manufacturer ZEV Sales – Do Not Allow PHEVs to Generate Credits

Comment: Commenter states the ACT regulation should be technology forcing, not just call for technology that is available today. CARB should require full electric vehicles rather than relying on near electric vehicles and credits. Credits should be phased out or eliminated altogether. [RP1-287]

Agency Response: No changes were made to the regulation in response to this comment. NZEVs are considered a bridging technology because they use an electric powertrain that is capable of some level of zero-emission miles. Therefore, their sales helps support the zero-emission supply chain, workforce development and are an option to achieve zero-emission operation in situations where ZEVs may not be suitable. In addition, the regulation does not award credits for NZEVs past 2035 to ensure that it is clear that ZEVs are the end goal for all market segments.

Manufacturer ZEV Sales - Credits Retirement Order Preferences NZEV Credits

Comment: Commenter states that in Section 1963.3(c)(2) the revised credit retirement order gives preference to NZEV credits over ZEV credits for different weight class groups, and that there should be no preferential treatment for NZEVs because it will lead to market distortions. Tesla states that modifying the expiration date for NZEV credits would be a more effective approach. [RP1-235]

Agency Response: No changes were made to the regulation in response to this comment. The credit retirement order was developed to simplify implementation. The order in which credits are retired is based on expected manufacturer preferences: older credits should be used before newer credits because they expire first, and NZEV credits should be used before ZEV credits because they are less fungible. Therefore, the retirement order states that oldest credits are used first, and NZEV credits are used before ZEV credits. This order represents how a manufacturer would use their credits if they had the option to do so and is not designed to incentivize NZEV credits.

Manufacturer ZEV Sales – Plug-in Hybrids Instead of Battery-Electric

Comment: Commenter states that PHEVs are a better option than one big battery BEV used for a truck because the energy used in a BEV could be redistributed to many smaller PHEV's resulting in longer life cycles. [RP1-18]

Agency Response: No changes were made to the regulation in response to this comment. Staff considers plug-in hybrids as a bridge technology. Please see the discussion about how the regulatory structure will encourage both full ZEVs and longer ranged NZEVs in chapter "Written Comments Received during the 30-Day Comment Period", section "Manufacturer ZEV Sales – Encourage Longer Range Plug-in Hybrids".

Manufacturer ZEV Sales - Add Credit for Electrified Power Take Off

Comment: Commenter recommends that vehicles with approved ePTO systems are included in the definition of near-zero-emission vehicles and proposes a mechanism by which ePTO manufacturers could be designated as credit earners through rule language changes. [B2-24]

Comment: Commenter states that the regulation has been centered on applications which are primarily used for traveling vehicle miles and not for performing work functions. Commenter states that the rule should consider the emissions for vehicles across a range of use cases and urges CARB to evaluate the value of hybridization solutions not just for driving the vehicle, but also for electrifying the primary work function even if it is not conducted during the drive cycle using systems such as electrified power takeoff (ePTO). [RP1-32]

Agency Response: No changes were made to the regulation in response to these comments. See discussion on why awarding credit for electrified power take and similar technologies is unnecessary in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Add Credit for Electrified Power Take Off".

Manufacturer ZEV Sales – Credit for Conventional Hybrids

Comment: Commenter asks if the ACT regulation could include hybrid engines that run on NG, diesel, jet fuel, or gasoline. [RP1-16]

Comment: Commenter recommends the ACT regulation should expand compliance pathways to include conventional heavy-duty hybrids (HEV) and recommends flexibility to the proposed credit system by providing partial credits for HEVs similar to PHEVs. [RP1-205]

Agency Response: No changes were made to the regulation in response to these comments. See staff reasoning for not crediting conventional hybrids in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Credit for Conventional Hybrids". Awarding credit for conventional engines would be inconsistent with the goals of the regulation, regardless of the type of fuel used by the conventional hybrid vehicle. However, the regulation does include credit for NZEVs vehicles regardless of which combustion fuel source they use.

Manufacturer ZEV Sales – Extend Deficit Makeup Period to Three Years

Comment: Commenter recommends modifying the requirements to make up a deficit to require a manufacturer to make up a deficit within three model years, in alignment with the Heavy-Duty GHG rule. [RP1-218]

Agency Response: No changes were made to the regulation in response to this comment. See discussion on maintaining the current deficit makeup period in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Extend Deficit Makeup Period to Three Years".

Manufacturer ZEV Sales - Allow Credit Transfer Between Categories

Comment: Commenter states that the rule should allow sufficient flexibility to sell more ZEVs in one category and fewer in another. [RP1-191]

Agency Response: No changes were made to the regulation in response to this comment. The regulation already allows manufacturers to transfer credits between weight categories and to use credits from selling ZEVs in one category to meet another category's deficit obligations. The only exception is the Class 7-8 Tractor category, which has limited credit transfers from the other categories to ensure tractors are produced and sold into California. Class 7-8 ZE tractors are needed to meet the state's ZE drayage goals.

Manufacturer ZEV Sales – Class 2b-3 Targets Hindered by Lower Fleet Rule Potential

Comment: Commenter is concerned achieving aggressive Class 2b-3 targets is at risk because fleet mandates will not capture small businesses/single owner operators and therefore a big part of 2b-3 market will not fall under fleet rules. [RP1-265]

Agency Response: No changes were made to the regulation in response to this comment. Staff recognizes that there are fewer large fleets in the Class 2b-3 population; however, some fleets such as government fleets and utilities are well suited for electrification. In addition, staff anticipates manufacturers will sell vehicles to individuals and small fleets regardless of the presence of a fleet mandate. Despite this, staff will evaluate methods to accelerate fleet uptake across all vehicle classes in the upcoming ZE fleet rule.

Manufacturer ZEV Sales – Ban Internal Combustion Engines

Comment: Commenter suggests earlier ZEV sales requirement beginning in 2021, all new trucks should be electric by 2030, and to ban all non-electric trucks from entering CA by 2040. [RP1-10]

Comment: Commenter states the regulation should be strengthened by requiring the elimination of fossil fuel powered trucks before 2030. [RP1-12, RP1-36]

Comment: Commenter states that only electric trucks should be allowed to operate in CA and all other trucks can trans-ship goods at the border. [RP1-260-Form-1914]

Agency Response: No changes were made to the regulation in response to these comments. The Board directed staff, through the approved Resolution, to develop supporting policies and regulations to electrify all vehicles where feasible by 2045. However, due to the early nature of the market, some market segments appear challenging to electrify currently. For example, electrifying long-haul trucks will require an interstate infrastructure network. Other niche markets such as crane trucks, logging trucks, emergency vehicles, etc. also present unique challenges to electrification. For these reasons, staff is not proposing a combustion engine ban in this rulemaking but will assess the market as it develops. For more detailed discussion about why it would not be feasible to require more ZEVs than the approved regulation, see chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Strengthen the ACT Proposal by Including Pickups Earlier and/or Increasing Sales Percentage Requirements".

Manufacturer ZEV Sales – Cost Analysis Overestimates LCFS Adoption by Fleets

Comment: Commenter states that the proposed ACT regulation assumes significant Low Carbon Fuel Standard (LCFS) benefits to nearly all truck users, when it is completely unproven that operators will receive LCFS credits. [RP1-218]

Agency Response: No changes were made to the regulation in response to this comment. Staff disagrees with the notion that the LCFS regulation and the credit mechanism is unproven for fleet operators. The LCFS regulation has been in place for a decade and has been used by a wide range of fleets. The LCFS credit value is established by the market and is substantial.

The staff analysis is a representative of a likely scenario of ZEV deployments in California from 2020 to 2040 and intentionally does not include assumptions that are unlikely to occur. By 2035, staff estimates that about 15 percent of the trucks in operation would be ZEVs which is a relatively small fraction of the total fleet. The staff assumptions reflect that fleets are not required to purchase ZEVs, and would make their purchase decisions primarily based on the total cost of ownership. Operators that could not benefit from the LCFS credits are simply less likely to purchase ZEVs than operators that could. For this reason, the staff analysis is representative of a likely ZEV deployment scenario and is appropriate as is. In addition, credits earned by a station owner can be passed on to a vehicle operator by reflecting it in the pump or station price as is currently done for renewable diesel and renewable natural gas.

Manufacturer ZEV Sales – Reduced Government Budgets' Impact on Incentives not Analyzed

Comment: Commenter states that the ACT did not analyze the impacts of a statewide deficit in government budgets and the resulting impacts on availability of incentives. [RP1-169]

Agency Response: No changes were made to the regulation in response to this comment. First, the staff analysis did include an analysis of the impacts on state and local governments resulting from the purchase of ZEVs instead of combustion vehicles. Second, the ACT regulation is not predicated on the availability of incentives. See the discussion about incentives in chapter “Comments Received During Original Proposal's 45-Day Comment Period”, section “Out of Scope – Incentive and Funding Policies”.

Manufacturer ZEV Sales – Cost Burden to Consumers

Comment: Commenter asks how the ACT regulation will ensure that consumers are not burdened by costs from switching to zero-emission technology. [RP1-26]

Agency Response: No changes were made to the regulation in response to this comment. As part of the Standard Regulatory Impact Assessment (SRIA), appendix C of the Staff Report, staff performed an analysis on the costs to the state as a whole as well as costs to a typical fleet. The analysis reflects that ZEVs have higher upfront costs, and a lower total cost of ownership primarily from lower maintenance and fuel cost savings. ZE truck owners that own their charging or hydrogen fueling stations can further lower fuel costs by taking advantage of the Low Carbon Fuel Standard (LCFS) program. The ACT regulation is expected to result in a total cost saving of $4.9 billion to truck transportation in California compared to Business as Usual from 2020 through 2040, mostly due to fuel cost savings. This estimate includes infrastructure cost, higher cost of the vehicles, maintenance and fuel savings, and cost savings due to the Low Carbon Fuel Standard. It does not include vehicle or infrastructure incentives. Thus, incentive programs such as the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Program (HVIP), utility investments, and other funding may be used to offset some potential upfront cost to consumers.   Several hundred million dollars per year have become available recently, which would further increase savings to fleet owners.

Manufacturer ZEV Sales – CARB Does Not Have Authority to Require Zero-Emission Powertrain Certification

Comment: Commenter states that CARB does not have the authority to mandate the zero-emission powertrain certification warranty, defect reporting, and recall requirements for ZEVs. Commenter states none of the requirements contained in the ZEP Certification relate to engine or vehicle emission standards or in-use performance and are instead consumer-protection requirements which is beyond CARB's authority. Based on definitions in the Health and Safety Code, commenter states that CARB's certification authority extends to powertrain components that have no authority to discharge emissions into the air. Commenter states, similarly, CARB does not have the authority to require warranty and recall for ZEVs nor defect and recall requirements as the Health and Safety Code are specific to tailpipe emission and related emissions standards.

Commenter states CARB's response to EMA's comments in the ZEP Certification rulemaking does not consist of a response at all. As a result, commenter states the ZEP Certification requirement remains invalid and unlawful. [RP1-218]

Agency Response: No changes were made to the regulation in response to this comment. CARB adopted the Zero-Emission Powertrain Certification regulation on June 27, 2019, and parts of this comment are directed at CARB's authority to adopt certification, warranty, defect reporting and recall requirements as part of that rulemaking action. Notwithstanding that fact, CARB provides the following response to the comment.

CARB disagrees with the commenters' assertion that it does not have authority to adopt certification, warranty, defect reporting and recall requirements as part of this rulemaking action. CARB is authorized to adopt standards, rules and regulations, and to perform such acts as may be necessary for the proper execution of the powers and duties granted to and imposed upon the Board by law (California Health and Safety Code (H&SC) sections 39600 and 39601). H&SC sections 39002 and 39003 place the responsibility for controlling air pollution from motor vehicles on CARB. Additionally, H&SC section 38560 directs CARB to adopt rules and regulations to achieve the maximum technologically feasible and cost-effective GHG emission reductions from sources, including mobile sources. The growth and successful adoption of heavy-duty ZEVs, which will lead to reductions in mobile source emissions, is critical to California meeting its air quality standards and GHG reduction goals. The regulation furthers those reduction goals.

A "motor vehicle" is defined in H&SC section 39039 (referencing California Vehicle Code (CVC) section 415) as a vehicle that is self-propelled. A "new motor vehicle" means a motor vehicle, the equitable or legal title to which has never been transferred to the ultimate purchaser (H&SC 39042) and a "new motor vehicle engine" means a new engine in a motor vehicle (H&SC 49042.5). Clearly, a new heavy-duty battery-electric or fuel-cell vehicle and its engine, (which comprises a primary part of the powertrain), fall within these definitions. New motor vehicles and engines may not be imported, delivered, purchased, rented, leased, acquired, offered for sale, sold, or registered for use in California unless they have first been certified by CARB. Thus, a heavy-duty battery-electric or fuel-cell vehicle, like a heavy-duty internal combustion engine vehicle, must be certified by CARB. Certification includes setting emission standards (H&SC 43101) and test procedures (H&SC 43104) and necessary ancillary requirements such as warranty and recall (see H&SC sections 39600, 39601, 43205.5, 43214, 43106, and 43105). These provisions broadly apply to all new vehicles and engines – there are no exemptions for battery-electric or fuel-cell vehicles and their powertrains. Furthermore, EMA misconstrues the nature of this rulemaking action, as it does establish emission standards and other emission related requirements for heavy-duty battery-electric and fuel cell vehicles and their powertrains. In 2004, the U.S. Supreme Court clarified that the definition of “standard” as it applies to emissions from motor vehicles and motor vehicle engines under Title II of the federal CAA, relates to the emission characteristics of vehicles or engines and includes not only traditional emissions limits for specified pollutants (e.g., 0.4 grams of oxides of nitrogen per mile), but also requirements that vehicles and engines be equipped with certain types of pollution-control devices, or incorporate design features related to the control of emissions. Engine Mfrs. Ass'n v. S. Coast Air Quality Mgmt. Dist., 541 U.S. 246, 253, 124 S. Ct. (2004). The regulation does not primarily comprise a consumer protection regulation – rather, it establishes requirements intended to ensure the introduction of zero-emitting heavy-duty vehicles into California.

HD ZEV failure or lack of support (and resulting downtime) is expected to result in higher usage of internal combustion vehicles and greater emissions. By reducing the number of failures and/or the amount of downtime caused by failures, the regulation will provide some level of protection to HD ZEV adopters and help ensure that the emission reductions attributed to the measures it aims to support will actually be achieved.

Manufacturer ZEV Sales – Allow More Credits to Transfer into Class 7-8 Tractor Group

Comment: Commenter recommends modifying the low tractor volume flexibility language and proposes the following: "Low Tractor Volume Flexibility. A manufacturer who has tractor deficits remaining after retiring credits per the credit retirement order in sections 1963.3(c)(1) and 1963.3(c)(2) can use Class 2b-3 or Class 4-8 group ZEV credits, starting with the earliest expiring credits, to satisfy up to 50 of their Class 7-8 tractor group deficits." [RP1-218]

Comment: Commenter suggests CARB adopt a strategy to cap credit movement into the tractor category at 90% in 2024 and decrease over time such that in model year 2031 the manufacturer would be required to sell their full tractor ZEV requirement. [RP1-214]

Agency Response: See discussion regarding changes staff made to allow credit transfer into the tractor category, and why the amount of credits allowed to transfer were limited to balance the need to ensure Class 7-8 ZE tractor production while providing manufacturers flexibility in complying with the rule, found in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Manufacturer ZEV Sales – Allow Credit Transfer into Class 7-8 Tractor Group”.

Manufacturer ZEV Sales – Set Performance Metrics for Zero-Emission Technologies

Comment: Commenter states that ACT should include performance-based metrics to ensure continued progress and cost-effectiveness in zero-emission technology. Commenter supports providing performance-based metrics and goals for HD electric vehicles that encourage improving battery performance, account for emissions over the full lifecycle, and take into account range requirements and deterioration limitations that incentivize investment in the technology. [RP1-205]

Comment: Commenter supports revisiting ZEP requirements to establish performance-based metrics on electric trucks' batteries and components. Commenter states that this would drive continual improvement in electric truck component development and ensure the most cost-effective overall emission reductions and the most affordable trucks for California. Commenter states performance based metrics for electric vehicles could include battery performance and durability standards, such as lifecycle emission reduction goals, range requirements, and short- and long-term deterioration limits. [RP1-284]

Agency Response: No changes were made to the regulation in response to these comments. Using performance-based metrics in a regulation would create additional complexity and would be more challenging to develop and enforce. The approved regulation will ensure that manufacturers develop competitive ZEV products at price points that will meet fleet needs. This can be observed in the light-duty market where manufacturers are continuously releasing ZEVs with higher range, higher battery capacity, more battery density, and other improvements. For these reasons, setting performance-based targets for zero-emission vehicles is unnecessary at the current stage of the market.

Manufacturer ZEV Sales – Oppose Extending NZEV Crediting Past 2030

Comment: Commenter states that ACT should not extend the NZEV credit beyond 2030 because ZEVs will be fully accessible and commercialized by 2030. [RP1-140]

Agency Response: No changes were made to the regulation in response to this comment. See the rationale for extending the timeframe that NZEVs can earn credits in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Manufacturer ZEV Sales – Extend Sunset Date for Plug-in Hybrids”.

Manufacturer ZEV Sales – Penalty Calculation for Failure to Meet a Deficit

Comment: Commenter states that for Section 1963.5(a)(4) the penalty should be based on the manufacturers' actual outstanding deficit rather than one half of their deficit. [RP1-235]

Agency Response: No changes were made to the regulation in response to this comment. Health and Safety Code section 43212 specifies that manufacturers who do not comply with emission standards are subject to a civil penalty of $37,500 for each vehicle which does not comply with California standards. Section 1963.5(a)(5) specifies how to convert the size of a deficit into vehicle equivalents for the purpose of HSC 43212. Staff decided to divide the deficits in half for this conversion to ensure that the penalties are representative. For example, failing to produce a zero-emission Class 8 non-tractor would generate two deficits. Under staff's current proposal, this would result in a penalty of $37,500 per Class 8 ZEV not sold. Without dividing the deficits by two, this penalty would be $75,000 per vehicle, double the statutory amount. The current formula encourages compliance while meeting statutory guidance on the penalty amount per vehicle.

Manufacturer ZEV Sales – Feasibility of Zero-Emission Refuse Trucks

Comment: Commenter expresses concern over the ability of Class 8 waste collection vehicles to go EV, due to their high consumption of energy from the collection and compaction work they do, and citing significant technological hurdles to be overcome. [RP1-320]

Agency Response: No changes were made to the regulation in response to this comment. See response outlining refuse truck electrification in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Feasibility of Zero-Emission Refuse Trucks".

Manufacturer ZEV Sales – Proposal Not Backed by Data or Analysis

Comment: Commenter states CARB needs to conduct additional analysis to ensure accuracy in assumptions and appropriate goals in regulations. [RP1-320]

Agency Response: No changes were made to the regulation in response to this comment. See response detailing staff's work developing and updating the assumptions used to support the regulation in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Proposal Not Backed by Data or Analysis".

Manufacturer ZEV Sales – Clarification Regarding Medium-Duty Passenger Vehicles

Comment: Commenter states that the new ACT regulation does not define medium-duty passenger vehicles (MDPV), while the California Phase II GHG regulations do, and would like clarification on the categorization. Commenter's understanding is that the categorization of a truck for ACT purposes is independent of its categorization for GHG purposes and that a >8500 lb. GVWR MDPV could be part of a manufacturer's light duty fleet for GHG purposes, and, at the same time, be part of the manufacturer's MD/HD fleet for ZEV (ACT) purposes. [RP1-193]

Agency Response: No changes were made to the regulation in response to this comment. The scope of the ACT regulation includes vehicles above 8,500 lb. GVWR to be consistent with the scope of the Advanced Clean Cars ZEV regulation that includes vehicles with a GVWR at or below 8,500 lb. GVWR. This approach avoids any potential overlap where the same vehicle would be face requirements in both ZEV regulations. The ACT regulation uses GVWR for determining which vehicles fall into which categories and does not have a MDPV definition.

Manufacturer ZEV Sales – Use Existing Light-duty CRDTS Reporting System

Comment: Commenter states that for ACT reporting, CARB should use the existing Zero-Emission Vehicle (ZEV) Credit Reporting and Data Tracking System (CRDTS) because a central database provides a single information source that is aligned with CARB executive orders along with maintaining previous reporting and credit bank information [RP1-193]

Agency Response: No changes were made to the regulation in response to this comment. Staff intends to leverage existing CARB reporting systems where feasible to minimize the reporting burden for manufacturers, and will ensure that manufacturers have a system to report their information as required by the ACT regulation.

Manufacturer ZEV Sales – No Pay-to-Pollute Penalties

Comment: Commenter suggests that the ACT regulation restate that paying a penalty provision is just one step a manufacturer must take if ZEV credit shortfalls are not addressed in a timely manner. Commenter also suggests that the ACT regulation should further clarify the need to satisfy credit deficits even after a penalty is applied to avoid a "pay to play" assumption. Commenter provided supporting documentation, articles, and references to support their comment. [RP1-208]

Comment: Commenter states that there needs to be clarification that paying a penalty does not satisfy the compliance obligation with credits. [RP1-235]

Agency Response: No changes were made to the regulation in response to these comments. A manufacturer that does not meet their deficit requirements would be subject to a penalty as specified in section 1963.5(a)(4) and would still need to fulfill their sales obligation to make up the deficit shortfall.

Manufacturer ZEV Sales – Interactions with the Low NOx Omnibus Rulemaking

Comment: Commenter states the overlap from the ACT regulation and Low NOx rules will create a market where traditional truck manufacturers will either reduce sales or abandon the market altogether in California. [RP1-218]

Comment: Commenter recommends emissions inventories and market analyses be considered for the ACT regulation and Low NOx Omnibus rules holistically. [RP1-284]

Agency Response: No changes were made to the regulation in response to these comments. Staff recognizes that the ACT regulation and Low NOx Omnibus regulation will both affect heavy-duty manufacturers over the course of this decade. These regulations in combination will ensure that manufacturers are selling zero-emission vehicles wherever possible, and the cleanest combustion everywhere else.

In addition, because the ACT regulation was proposed and adopted before the Low NOx Omnibus, there is a limit to the amount of analysis that can be done in this rulemaking. The California Department of Finance requires that the impact of regulations be compared against a baseline scenario consisting of current conditions and enacted laws. Because the Low NOx Omnibus was not adopted at the time the regulatory documents for the ACT regulation were released, it would be inappropriate to include that proposed regulation as a part of the baseline for the ACT regulation analysis.

Manufacturer ZEV Sales – Heavy-Duty Trucks Not Suitable For Electrification

Comment: Commenter states that there are challenges with ZEV trucks in the heavy-duty group due to large capital costs, travel range, and charging times that are needed in emergency response and 24-hr operations [RP1-273]

Agency Response: No changes were made to the regulation in response to this comment. See discussion about the market analysis for vocational vehicles in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Exempt Class 8 Vocational Vehicles".

Manufacturer ZEV Sales – Hydrogen Better for Long Haul

Comment: Commenter states that electric trucks will not work for interstate movement but that hydrogen electric trucks will work. [RP1-05]

Agency Response: No changes were made to the regulation in response to this comment. See discussion about the lack of technological barriers to building longer range battery-electric vehicles and the resulting tradeoffs in chapter "Written Comments Received during the 30-Day Comment Period", section "Economic Analysis – Analysis Does Not Include Long-Haul Trucks Used For Freight Movement". Generally, hydrogen electric vehicles are better suited for long haul applications, but infrastructure, cost, and other barriers still exist that currently prevent widespread adoption.

Manufacturer ZEV Sales – Health Benefits will be Greater than Anticipated

Comment: Commenter states that the health benefits analysis is conservative because it does not factor in many pollutants and health endpoints due to limits in CARB's health evaluations and quantifications, which were discussed with the Board at the April 23 hearing. Commenter believes the health benefits from the rule will surpass the estimated $9 Billion in staff's analysis. [RP1-120]

Agency Response: No changes were made to the regulation in response to this comment. Staff recognizes that current health benefit analyses, though conservative, are based on the standard CARB accepted methodology. Efforts to keep the methodology up to date are on-going with the Research Division. CARB is committed to taking bold action to reduce pollution and protect the health of Californians, and will continue to update the health benefits associated with reducing harmful emissions.

Manufacturer ZEV Sales – Three-Legged Stool

Comment: Commenter states that the ACT regulation needs to be restructured by prioritizing the most suitable market segments, link any sales mandates to purchase requirements, focus on the needs of fleets to convert to ZEVs, and recognize the charging infrastructure needs. [RP1-218]

Agency Response: No changes were made to the regulation in response to this comment. Please see the discussion about staff's exploration into transitioning beachhead markets to zero-emission, as well as timing and other constraints preventing coupling of fleet and manufacturer requirements in this regulation, in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Pair Manufacturer and Fleet Requirements". In addition, please see the discussion about the development of policy frameworks and assessments to support long-term infrastructure development plans by the California Public Utilities Commission and California Energy Commission in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Infrastructure Concerns".

Manufacturer ZEV Sales - Allow 5 Year Credit Life Starting from Ultimate Purchaser Placement in Service

Comment: Commenter states that the "ultimate purchaser" tracking requirement will create an unintended burden for CARB and its credit reporting mechanism given the proposed five-year expiration of credits. For example, in an ideal setting, 2024MY ZEVs are all sold by December 31, 2024, and OEMs can bank these credits as 2024MY credits by March 2025. Commenter states that if OEMs are unable to place-in-service their ZEVs by Dec 31, 2024, the credit reporting mechanism must allow the flexibility for OEMs to report 2024MY ZEVs to be reported in March 2026 or March 2027. Commenter states that there needs to be modification of the five-year expiration of credits rule that allows OEMs to be given five full years from the date the ZEV was placed-in-service vs. current model year designation. [RP1-80]

Agency Response: No changes were made to the regulation in response to this comment. Staff disagrees that there will be an unintended burden for CARB associated with the tracking requirement and the five-year expiration of credits. ZEV credits are generated for each vehicle based on the manufacturer-designated model year, regardless of when the vehicle is placed in service. The reporting and recordkeeping apply to ZEVs produced and delivered for sale for each model year, beginning in 2021. If the OEM was unable to produce and deliver for sale a number of ZEVs by the end of the vehicles designated model year, the OEM would report those ZEVs at the end of the next model year. However, the five-year credit lifetime would still be based on the manufacturer-designated model year the credit was generated. The rationale for the credit lifetime is to ensure that credits earned in excess of the minimum requirements do not get banked indefinitely and undermine goals to maximize the use of ZEVs everywhere feasible if the ZEV market grows faster than the sales percentage require. The credit life period provides flexibility to manufacturers in introducing new ZEV models and in using banked credits to manage annual truck sales fluctuations.

Manufacturer ZEV Sales – Add Travel and Pooling Provisions for Section 177 States

Comment: Commenter states that the rule should provide additional compliance provisions for other states such as credit travel and pooling provisions. [RP1-218]

Comment: Commenter urges the Board to consider a modified travel provision that allows a calibrated level of credits earned in one state to be counted as earned in all ZEV states at a proportional value. Commenter recommends the ability to pool credits regionally because this will allow manufacturers to place vehicles into high demand areas with existing infrastructure without creating a compliance shortfall in other states. [RP1-326]

Agency Response: No changes were made to the regulation in response to these comments. These comments refer to two potential provisions, a travel provision and pooling provisions.

Ultimately, the Board decided not to include a travel or pooling provision in the ACT regulation but asked staff to work with other potential Section 177 states on this topic. CARB staff will work with our partner Section 177 states to determine if these, or comparable provisions, might enhance both California and Section 177 states' goals in ensuring the introduction and use of more heavy-duty ZEV vehicles in future rulemakings.

Manufacturer ZEV Sales – Clarify or Remove "Sold to Ultimate Purchaser"

Comment: Commenter states the need for clarification of the "Delivered for Sale" language because the deficit generation language, and credit language stating that credits are not earned until vehicles are delivered to the ultimate purchaser do not align with the "delivered for sale" intention or approach. This would impose burdens on OEMs to track vehicles through their final sale. Commenter requests that CARB strike text in the credits/deficits sections of the final rule, so it is clear that CARBs intent is to report ZEVs based on when they were delivered for sale. [RP1-193]

Comment: Commenter recommends modifying of the description of vehicles sold in California. EMA proposes modification of language in Section 1963.1(a) as follows: "Deficit Generation. Starting with the 2024 model year, a manufacturer shall annually incur deficits based on the manufacturer's annual sales volume of on-road vehicles produced and delivered for sale in California." [RP1-218]

Comment: Commenter states that the calculations based on "delivery to final purchaser" is problematic and is concerned that manufacturers have no means of controlling who the final recipient of the vehicle is, and are unclear on the necessity of diverging from standard industry practice to use point of final delivery into California. [RP1-265]

Agency Response: No changes were made to the regulation in response to these comments. The terms "produced and delivered for sale in California" and "sold to the ultimate purchaser in California" are used in the regulation to ensure ZEVs are placed and operated in California in order to ensure the air quality benefits occur in-state. Without this language, manufacturers that sell vehicles to entities based outside of California that are delivered out of state, but are ultimately placed in service in California, would not get credit for these vehicles. Additionally, this language helps ensure that ZEVs are not assigned credits until a vehicle is sold to a customer, rather than allowing credits to accrue by simply delivering it to a California dealer and placing it on the dealer's lot. Staff recognizes that manufacturers will likely need to develop methods to track and document final delivery to the ultimate purchaser.

Manufacturer ZEV Sales – Analysis Did Not Provide Alternatives to the Updated Proposal

Comment: Commenter states that the updated analysis for the proposed amendments only analyze the proposed changes against the original proposal, and does not present a range of options between the two and does not demonstrate why it has chosen one target over a range of others. [RP1-272]

Agency Response: No changes were made to the regulation in response to this comment. Staff developed the final requirements based on Board direction, including to align the regulation's ZEV requirements with major state goals such as 2045 carbon neutrality and 100 percent ZE drayage by 2035 and many public comments requesting more stringent requirements. Staff developed the percentage requirements based on meeting these goals and found these goals feasible based on the state of the technology and market as discussed in the ISOR and updated analyses as part of the 30 day modifications. The Staff Report also includes discussion of a number of alternative scenarios as required by the APA.

Manufacturer ZEV Sales – Non-IOU Utilities Lack Infrastructure Programs

Comment: Commenter states that many fleets will be supported with infrastructure by one of the three large investor-owned utilities, and is concerned that staff is de-emphasizing that approximately 20% of the state's load is served by municipal utilities and these fleet customers may not have access to the IOU make-ready programs. [RP1-265]

Agency Response: No changes were made to the regulation in response to this comment. The approved regulation is a ZEV sales requirement for manufacturers and does not place ZEV purchase requirements on fleets. In addition, staff did not include any rebates or grant in the cost analysis and the results still show that overall, there will be a net economic savings. To the extent that incentives are used the net costs would be lower than staff assumed.

Manufacturer ZEV Sales - Infrastructure Challenges

Comment: Commenter states more hydrogen cars and stations are needed. [RP1-13-Form-60]

Comment: Commenter states that many government fleets are dependent on publicly available refueling infrastructure because they lack capital funding to install infrastructure, available real estate (or the capital funding to purchase that real estate) to install refueling infrastructure, and staffing to operate and manage refueling infrastructure. [RP1-44]

Comment: Commenter states that California should provide certainty for refueling infrastructure for ZEVs. [RP1-191]

Comment: Commenter states that the ACT regulation should encourage hydrogen mobility infrastructure, in addition to battery charging infrastructure. [RP1-205]

Comment: Commenter states that the electric supply in California is a concern because it is not ready for large scale roll out. [RP1-232]

Comment: Commenter states that the ACT regulation needs charging stations in convenient locations to be successful. [RP1-249]

Comment: Commenter notes that the ACT regulation will create significant growth in transportation-related electricity demand and associated needs for utility infrastructure upgrades, additional system-level planning, and customer-side charging infrastructure. Preliminary analysis conducted by SCE shows that the grid impacts and incremental work are within the scope of the utility's ability to manage. To ensure well-timed alignment of work that utilities need to do, utilities will need additional granularity, resolution, and accuracy related to where, when, and how fleets will electrify. Therefore, commenter states it is critical for the state agencies, utilities, fleet owners, and manufacturers to work collectively to reduce uncertainty for customers and address necessary infrastructure upgrades, and commenter urges CARB to help convene these stakeholders during implementation. Commenter provided supporting documentation, articles, and references to support their comment. [RP1-259]

Comment: Commenter suggests close coordination with CARB's sister agencies to support implementation through significantly increased funding for charging infrastructure and enabling widespread infrastructure development. [RP1-265]

Comment: Commenter states that infrastructure is costly and their old facilities may not have space or capacity to support the electricity demand. Commenter also states Caltrans fleets are widely dispersed with 318 locations throughout CA, which hampers moving vehicles around to manage the utilization of ZEV assets. [RP1-273]

Comment: Commenter wants more collaboration among CARB, utilities, CEC, CPUC--including informing CEC and CPUC of timelines needed to meet the regulation, and of the magnitude of electrification needs; and sharing between CARB and utilities of infrastructure process and needs. [RP1-281]

Agency Response: No changes were made to the regulation in response to these comments. See the discussion about infrastructure incentive programs from utilities and the State's long-term development strategies, as well as how the large entity reporting requirement will support infrastructure development in chapter "Written Comments Submitted During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Infrastructure Concerns".

Manufacturer ZEV Sales – Extend Comment Period Due to COVID-19

Comment: Commenter request an additional review and comment period of 90 days due to unanticipated staffing and financial impacts of COVID-19. [RP1-44, RP1-181]

Comment: Commenter states the deadlines should be extended due to the financial burdens from COVID-19. [RP1-233]

Agency Response: No changes were made to the regulation in response to these comments. In response to the challenges presented by the COVID-19 pandemic, staff increased the public comment period from 15 days to 30 days to review and submit comments related to the proposed changes being made to the ACT regulation. The impacts of COVID-19 were addressed by the Board at the hearing, and concluded that adequate additional time was provided.

Manufacturer ZEV Sales – Feasibility of Zero-Emission Refuse Trucks

Comment: Commenter states current range and weight limitations of heavy-duty electrified [refuse] vehicles would significantly increase the need for more vehicles, labor costs, and traffic on municipal streets. [RP1-320]

Agency Response: No changes were made to the regulation in response to this comment. See discussion around the lack of a mandate to produce refuse vehicles, staff's suitability analysis, and current market movements indicating refuse vehicles are suitable for electrification in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Feasibility of Zero-Emission Refuse Trucks".

Manufacturer ZEV Sales - Leakage Out-of-State

Comment: Commenter asks how the ACT regulation will address manufacturers that decide to move out-of-state. [RP1-26]

Agency Response: No changes were made to the regulation in response to this comment. A manufacturer may decide not to sell vehicles into California as a result of this or other regulations, and therefore would no longer be subject per the scope and applicability of the ACT regulation. Because ACT is not a fleet requirement, there is no reason fleets would decrease their purchases as a result of this regulation. Therefore, it is reasonable to conclude that the sales of the manufacturer who departed California will shift to other manufacturers who stay within the California market. This will result in the same number of ZEVs required but split between a different pool of manufacturers.

A growing body of studies, research, and reports indicates that the future of medium- and heavy-duty transportation will be powered by zero-emission technologies. If some manufacturers decide to leave the state, they will still need to develop zero-emission technology to stay competitive in the nationwide trucking market. Regulations such as ACT and policies such as the Memorandum of Understanding between 15 states and the District of Columbia show that the market is shifting towards zero-emissions. Manufacturers who leave the California market due to this zero-emission regulation may be left behind as less of the market will be served by combustion-powered technologies.

Manufacturer ZEV Sales - Reporting Timing

Comment: Commenter recommends CARB revise 17 CCR 1963.4 to include CARB acceptance of OEM information as an explicit step between OEM sales reporting and when OEM credit transfers can occur and recommends adjusting the timing of the credit acceptance and credit transfer steps to each have an additional 90 day window (e.g. CARB credit acceptance is completed no later than 180 days following the end of each model year, and credit transfers occur no later than 270 days following the end of each model year). [RP1-193]

Agency Response: No changes were made to the regulation in response to this comment. Credit transfers must be reported annually with sales information, and staff will adjust credit accounts to ensure accurate information is reflected regardless of when the information is sent. Manufacturers that carry forward a deficit have the flexibility to make up that deficit within one year which will allow credit transfers to occur and be reported for the purposes of making up a prior year's deficit carry-over.

Economic Analysis – General Cost Concerns

Comment: Commenter states that the CARB doesn't recognize that ZEVs will cost more for fleets to purchase and operate than traditional vehicles, and fleets must invest in charging infrastructures at their facilities. [RP1-218]

Comment: Commenter states that their members are concerned that CARB's cost model is premature. Commenter states that it is critical that the state and its businesses better understand proven charging strategies that result in a positive TCO. [RP1-244]

Comment: Commenter states this will put a financial burden on truckers. [RP1-260-Form-3526]

Agency Response: No changes were made to the regulation in response to these comments.

Staff's methodology to evaluate costs was to look at both the cost to the state as a whole and to look at the total cost of ownership for a vehicle. This method illustrates the costs to both California and a typical fleet. Through these analyses, staff found that while zero-emission vehicles will cost more upfront due to higher vehicle costs and additional infrastructure costs, but cost less over their lifetime due to lower fuel costs, LCFS revenue, and reduced maintenance expenses. ZEVs placed into well-suited applications will see a positive TCO versus their gasoline, diesel, and natural gas counterparts, and more applications will show a payback over time as ZEV costs decline. This is shown in numerous studies CARB's own analysis as well as studies and reports from ICF International, Lawrence Berkeley National Laboratory, the North American Council on Fuel Efficiency, Union of Concerned Scientists, University of California, Davis, University of California, Los Angeles, and others.

Staff held numerous workgroup meetings to discuss what cost assumptions to use and what applications to evaluate. Staff used the best available in information to evaluate costs. While there are many unknowns regarding future costs, staff does not agree that is too premature to develop a cost model to inform the Board's decision.

Additionally, the regulation does not place a requirement on fleets to purchase ZEVs and does not believe it is meaningful to evaluate cost scenarios that are not likely to occur.

Lastly, while many electric vehicles appear to offer a positive total cost of ownership over the regulatory timeframe, the ACT regulation is not predicated on a positive total cost of ownership. Some of the main goals of the regulation include reducing criteria and greenhouse gas emissions and fostering the zero-emission medium- and heavy-duty market. Many of CARB's other regulations do not have a defined payback period but have been adopted as the benefits outweigh the costs.

Economic Analysis – Support for Specific Areas

Comment: Commenter's independent economic analysis aligns with CARB's in the following areas: Commenter states that their experience with Class 2b-3 and Class 4-5 EVs infrastructure, and charging costs largely align with the ACT Staff Report and the updated April analysis; Commenter projects that Class 3 electric delivery operations will be cost-neutral without incentive funding in the 2024 timelines targeted by this regulation, inclusive of vehicles, chargers with infrastructure upgrades amortized over the lifetime of multiple trucks, and a managed overnight depot charging strategy, and; Commenter states that the positive TCO model developed by CARB matches the projections of fleet members with last-mile Class 7-8 operations and last-mile Class 3 operations under specific circumstances. The fleet positive TCO scenarios are dependent on the applicability of a) overnight, lower-kW, depot fueling and b) vehicle incremental costs in line with CARB's MY 2024 projections. [RP1-244]

<u>Agency Response:</u> No changes were made to the regulation in response to this comment. Staff thanks the commenter for the supporting points.

<u>Economic Analysis – Many Applications Operate Differently Than Modelled</u>

<u>Comment:</u> Commenter states that with regional short-haul distribution of Class 7-8 tractor operations they do see potential opportunities for fleet electrification but only with clear caveats regarding vehicle cost, availability, grants, incentives, and ideal charging operations. Commenter states that the technological and operational needs of drayage, regional haul, vocational, food distribution, retail distribution, last mile, public fleet, and other types of medium- and heavy-duty truck applications vary tremendously, and as a result, present real-world challenges to zero-emission project implementation. [RP1-244]

<u>Agency Response:</u> No changes were made to the regulation in response to this comment. In the cost analysis, staff modelled the costs for a typical vehicle, not a vehicle operating in best case or worst-case conditions. Staff recognizes the trucking industry is diverse and covers many unique applications, but because the point of the regulation is on manufacturers, staff does not foresee manufacturers will be targeting their product offerings to fleets poorly suited for electrification. Adoption will likely begin in relatively well-suited fleets first, and then expand over time as costs decline and fleet experience with the technology improves.

<u>Economic Analysis – Analysis Did Not Include Gaps in Heavy-Duty Product Availability</u>

<u>Comment:</u> Commenter states concern that gaps in heavy-duty EV product availability is not reflected in CARB's cost models. As CARB continues to refine their cost models and timelines, vocational fleets need a more nuanced approach that will account for the current market status and the time required to complete the engineering, integration, and total pricing activities required by the suppliers. [RP1-244]

<u>Agency Response:</u> No changes were made to the regulation in response to this comment. In the fleet TCO analysis, three vehicles are modeled – a Class 3 passenger van, a Class 6 walk-in step van, and a Class 8 day-cab tractor used in regional operation. These three vehicles represent vehicle types that are commercially available or are in pre-commercial demonstrations. The TCO analysis was not intended to

analyze every vehicle use case but as a general analysis of these representative vehicles.

Staff anticipates due to the ACT regulation that manufacturers will begin to offer more electrified products over the course of the regulation to meet its increasingly stringent requirements. To ensure that fleets purchase these vehicles, manufacturers will need to ensure that they are offering these ZEVs at competitive prices.

In future ZE fleet rules, staff anticipates performing more granular analyses on specific use cases and body types to develop a better understanding of cost in regulated applications.

Economic Analysis – Vehicle Life Assumption is Too Long

Comment: Commenter states CARB made several inaccurate assumptions including assuming very long operating life when many fleets replace trucks after a short period of ownership. [RP1-218]

Agency Response: No changes were made to the regulation in response to this comment. Because the ACT regulation affects the state as a whole rather than any individual fleet, staff performed an analysis on a statewide level rather than looking at individual fleets. This leads to some key differences from a fleet-level analysis. No set vehicle life is used in the statewide cost analysis; instead, vehicles remain in the analysis until they leave the state fleet due to attrition or being sold out of state. If a fleet sells a truck to another fleet within California, from the statewide perspective nothing has changed.

Staff developed a separate TCO analysis to assess what the costs to a typical fleet would be if they purchased a ZEV. For this analysis, staff assumed the fleet would own the vehicle for 12 years. In reality, some fleets own their vehicles for a shorter period while others own the vehicle for its entire life. Twelve years was meant to be a representative value and has been used by other cost analyses. It is important to note that even if a vehicle is operated by one owner or multiple owners in the same period, the overall cost should remain the same over the period. However, the costs and fleets for each individual fleet will vary.

Economic Analysis – Recognizing the Importance of Service and Support Networks

Comment: Commenter states that up-front truck costs include elements of ongoing support and warranty coverage and that CARB must not underestimate the critical importance of after-sales support and service networks in the analysis. [RP1-244]

Agency Response: No changes were made to the regulation in response to this comment. Staff recognizes the importance of service and support networks to foster this emerging market. A key rationale for the rulemaking is to ensure large manufacturers are developing zero-emission products and providing service and support to ensure these vehicles stay on the road. Staff's vehicle cost analysis included an additional 10 percent adjustment to reflect the "soft costs" associated with vehicle production including setting up service and support networks.

Economic Analysis – Analysis Does Not Include Long-Haul Trucks Used For Freight Movement

Comment: Commenter states there is a significant number of trucks that travel 350-500 miles per day moving freight throughout the state. Commenter questions why the analysis does not include these vehicles or if batteries exist that can meet these range needs. [RP1-169]

Agency Response: No changes were made to the regulation in response to this comment. This comment is referring to Class 7-8 tractors that are primarily used for freight movement. While a large portion of these trucks are used for regional and long-haul trucking, this does not represent the entire segment. As stated in the Staff Report, numerous data sources such as the 2002 Vehicle Inventory and Use Survey and 2018 California Vehicle Inventory and Use Survey indicate that a large portion of tractors are used for shorter distance operations. Staff's assessment assumes that electrification in the tractor segment will start with shorter haul applications such as city delivery and drayage first, and then expand to other sectors including regional trucking. Note that ZEV tractors are expected to represent less than 15% of the tractor fleet by 2035 and is it not as likely that long-range ZEVs would be deployed unless the TCO is better than what staff assumed in the cost analysis.

There does not appear to be any technological limitations that would prevent manufacturers from building ZEVs that can meet these 350 to 500 mile range needs, but offering vehicles with such high range creates tradeoffs. Higher range will increase the needed battery capacity for a BEV which will both raise the vehicle's price and could decrease the usable payload of the vehicle. While these challenges will diminish over time as battery prices decline and battery capacity increases, they remain factors that fleets will remain aware off. Hydrogen fuel cell technologies are also a potentially viable ZEV option in these longer distance use cases.

Economic Analysis – Cost Analysis Underestimates Vehicle Cost

Comment: Commenter states concern that CARB's incremental cost of $71,000 for a Class 7-8 EV tractor in 2024 may be an inappropriate cost to apply across all manufacturers. Commenter states that quotes received by members have been 3x to 5x current diesel tractor prices (which is in the low $100K range). Commenter states there is concern about the reliability of the information underpinning the market adoption assumptions. Commenter states concern that a cost model based on preliminary estimates from emerging manufacturers will underestimate the true cost of the incremental operations needed to support the large scale EV deployments industry wide. [RP1-244]

Comment: Commenter states CARB's current assumptions significantly underestimate vehicle costs by more than 300%. [RP1-320]

Agency Response: No changes were made to the regulation in response to these comments. Staff use the best available information in the economic analysis for the regulation and discussed data sources and assumptions with stakeholders in several workshops and work group meetings. Staff recognizes that ZEVs produced today have a significantly higher upfront cost versus their combustion-powered counterpart. Per Appendix H to the Staff Report, staff estimate that in 2018, a day cab tractor capable of 180 miles per day would cost nearly four times its diesel counterpart. However, due to projected battery cost reductions for heavy-duty vehicles and increased economies of scale, CARB forecasts that the cost of ZEVs will drop over the rest of the decade. This assessment matches the findings of other reports on heavy-duty electrification. While staff does not assume a ZEV will match the cost of a combustion-powered vehicle over the regulatory timeframe, decreasing vehicle costs will narrow the gap and make ZEVs an attractive option to fleets based on the total cost of ownership. CARB's findings on vehicle cost are in line with other studies referenced in the Staff Report that indicate declining vehicle costs.

Economic Analysis – Battery-Electric Truck Assumptions Do Not Meet Fleet Needs

Comment: Commenter states that the proposed ACT regulation includes battery-electric truck mileage ranges that will be unacceptable to truck customers – ranges that will be shortened further by the heavy loads and harsh operating conditions associated with commercial vehicles. [RP1-218]

Agency Response: No changes were made to the regulation in response to this comment. Staff based the range assumptions on the average daily mileage based on the EMFAC inventory. This is meant to represent a "typical" use case, not a best-case or worst-case scenario. Because fleets have no requirement to purchase ZEVs, there is no reason for manufacturers to target applications with long ranges or heavy loads unless they can offer a compelling product in that category. So, by using the "typical" use case, staff avoids using a scenario which may be too optimistic or too pessimistic in regards to ZEV adoption.

Economic Analysis – Light-Duty Battery Price Data Cannot Be Used for Heavy-Duty Vehicles

Comment: Commenter states that the proposed ACT regulation assumes low battery prices based on battery-electric passenger cars, when truck operating conditions and duty cycles will demand different technologies. [RP1-218]

Agency Response: No changes were made to the regulation in response to this comment. Staff recognizes that heavy-duty vehicles currently have different challenges than light-duty vehicles. As a result, staff assumed heavy-duty battery prices will lag behind light-duty prices by five years. This reflects the smaller economies of scale, unique packaging requirements, enhanced durability requirements, and other factors. Other stakeholders have noted that this assumption leads to drastically higher battery prices than light-duty vehicles and the battery costs and vehicle costs used by staff are too high because in nearly all cases the battery cells used in trucks are the same as those used in cars and some trucks manufacturers are using complete battery packs from light duty cars in their battery electric trucks.

Economic Analysis – Incorrect Financing Terms

Comment: Commenter states that a typical truck loan is six years or longer with interest rates nearer seven percent, rather than the five years with 5 percent interest as staff assumed. [RP1-169]

Agency Response: No changes were made to the regulation in response to this comment. Staff recognizes that different fleets will pay different amounts for financing. Generally, larger, well-capitalized fleets will achieve more favorable financing terms than small fleets or small businesses. Staff finds the five years, five percent interest rates appropriate as during the public process in developing cost estimates, numerous stakeholders stated such terms were typical and other assessments used similar values.

Economic Analysis – Total Cost of Ownership Analysis Did Not Include Federal Excise Tax

Comment: Commenter states that the TCO calculations did not include the Federal Excise Tax, a 12 percent tax on the sale of new Class 8 vehicles, is not accounted for. [RP1-265]

Agency Response: No changes were made to the regulation in response to this comment. As described in the Staff Report, staff assumed all Class 8 vehicles are subject to a 12 percent Federal Excise Tax.

Economic Analysis – Regulation Does Not Address Infrastructure Challenges

Comment: Commenter states that the proposed ACT regulation ignores the costs and complications of installing, maintaining, and expanding a charging infrastructure at fleet facilities, which the fleet may rent. [RP1-218]

Comment: Commenter states charging infrastructure that is needed would further burden governmental entities with unfunded capital projects. Commenter notes that current electric infrastructure costs are approximately three times that of already established CNG infrastructure. [RP1-320]

Agency Response: No changes were made to the regulation in response to these comments. Staff recognizes the investments necessary for infrastructure and fully incorporated such costs into the statewide cost analysis in the Staff Report. Staff also notes that because this a manufacturer sales requirement, fleets who face cost barriers to installing infrastructure or fleets who rent vehicles have no requirement to purchase ZEVs. Manufacturers must identify which fleets can install infrastructure and develop competitive products for them to purchase.

Specifically, as part of the Staff Report's cost analysis, staff included the costs of chargers, site infrastructure upgrades, and charger maintenance in the analysis. Staff held multiple workgroup meetings to solicit feedback on the cost inputs and used the most up-to-date information wherever possible using real world experience and fleet data. Staff notes that because this is a manufacturer requirement, no fleet is required to purchase ZEVs unless they choose to do so. Fleets will purchase ZEVs if it makes financial sense for them to do so, including infrastructure costs and expenses. To the extent that some fleets rent their facilities or are unable to access capital for financing, they have no obligation to purchase ZEVs.

Economic Analysis – Regulation Will Increase Electricity Generation, Transmission, and Distribution Costs

Comment: Commenter states that California already has some of the highest electricity rates in the country and significant investments will be required in new generation, transmission, and distribution infrastructure. Commenter states that with so many parallel efforts requiring substantial investment it is hard to see how CARB's future electricity cost projections can be maintained at such low levels. CARB must carefully consider the impacts on future electric rates to end-user customers such as commercial electric truck fleet operators. [RP1-244]

Agency Response: No changes were made to the regulation in response to this comment. As stated in the Staff Report, increased electricity usage from ZEVs provides an opportunity for a number of benefits to the utilities, their customers, and the overall grid itself. In a 2017 letter to CARB, the California Electric Transportation Coalition, a non-profit whose board of directors includes the major California utilities, outlined the benefits of transportation electrification to California's power grid. Electric vehicles are capable of shifting load to off-peak periods and increasing overall demand, both of which help create a more efficient, highly utilized grid. Studies have found that light-duty ZEVs provide a benefit to all utility customers as their electricity utilization drives down rates for all other ratepayers.

Economic Analysis – Diesel Fuel Cost Estimate Is Too High

Comment: Commenter states the cost analysis overestimates fuel costs as diesel costs $3.25/gallon versus the $4/gallon assumed. [RP1-169]

Agency Response: No changes were made to the regulation in response to this comment. As described in the Staff Report, the cost analysis was based on the best information available to estimate costs over the analysis period from 2020 to 2040. Using today's diesel fuel price to represent costs out to 2040 is simplistic and is appropriate for a long-term analysis. Staff used the California Energy Commission's "Revised Transportation Energy Demand Forecast" to estimate fuel prices out to 2030, and the Energy Information Administration's "Annual Energy Outlook" to forecast prices from 2030 to 2040. These forecasts are independent projections that include the effects of regulations, legislation, and other factors that influence future prices.

Economic Analysis – Real-World Infrastructure Costs Differ from CARB Projections

Comment: Commenter states that real world fleet operations deviate from CARB's analysis that proposes electric truck charging takes place overnight in a depot with lower-kW, lower-cost EV chargers that can utilize low-cost off-peak charging rates. Commenter states that the reality is electric trucks incur significant incremental costs from expensive charging equipment, electrical service, and electrical rates. Commenter states that CARB's analysis that assumes 80kW chargers are suitable to sufficiently charge Class 7-8 tractors is inconsistent with their members experiences. Commenter states that universally 150kW chargers are being used to charge their members fleet of Class 7-8 EVs to support regional delivery operations.

Commenter states that CARB's analysis for the truck to charger ratio that assumes all Class 8 electric truck charging can take place using a ratio of one (1) EV charger for every one (1) electric truck, using individual 80kW chargers is an aggressive assumption given that their members are using 150kW chargers at a minimum to support their operations. Commenter states that member fleets are examining how to use one (1) charger to support two (2) or more electric trucks and that these efforts are adding new labor expense categories to manage the movement of trucks among the chargers, as well as the daily charger-truck communication and software challenges in an emerging technology space with multiple technologies. Commenter states that their members have been surprised by the ongoing networking and management costs required to operate their charging system. These additional annual costs have ranged from $25,000-$200,000 for a single site. [RP1-244]

Agency Response: No changes were made to the regulation in response to this comment. First, the regulation is a manufacturer sales requirement and does not require any individual fleet to purchase ZEVs. The staff cost analysis is intended to be a representative scenario of ZEV deployment costs. The commenter implies that the staff analysis underestimates costs because the staff assumptions are not the same as an example referenced by the commenter. However, the commenter also explains that the project is looking to use a 150kW charger to support two or more trucks. A 150kW charger costs roughly twice that of an 80kW charger; thus, the cost of purchasing two 80kW chargers as staff assumed versus a single 150kW charger as described by the commenter is essentially the same charger cost. Furthermore, if the 150kW charger is used to support two trucks, the charger cost of the example project would be about one half of that assumed in the staff analysis. The commenter also states that in the example project there is additional labor cost for an attendant to move the plug from one vehicle to another that was not included in the staff analysis. However, this example is not representative of the market in 2024 and beyond. Chargers already exist with two plugs that automatically start charging the second truck without an attendant. Therefore, these costs are not representative of the market during the regulatory analysis period.

Economic Analysis – Lack of Standardization for Electric Vehicle Chargers

Comment: Commenter states that there are no universally accepted standards for EV charging because the charging receptacles for each brand of truck are different. Commenter states that successfully scaling up commercial trucking to meet early regulatory targets requires increased standardization of EV charging to ensure that foundational investments in electrification continue to add value and do not require costly new hardware or infrastructure replacement as the market evolves. [RP1-244]

Agency Response: No changes were made to the regulation in response to this comment. Staff acknowledges that there is no single charger that can meet all fleet charging needs currently. This is a challenge for BEV adoption as they increase the likelihood of stranded charging assets for the fleet or additional costs to modify the charging system if a new charging standard is developed. The large-scale deployment of BEVs will benefit from a common charging standard. However, through conversations with manufacturers, staff has determined that the marketplace appears to be heading in the direction of standardization. Most manufacturers appear to be using J1772 chargers for AC charging up to 19 kW, and J1772 CCS chargers for DC charging up to 350 kW. There is no standard currently in place for conductive charging above 350 kW, but a consortium of heavy-duty manufacturers, equipment providers, and charging networks is developing a charging standard for 1 MW or higher charging.

The Society of Automotive Engineering (SAE) is currently developing heavy-duty vehicle charging standards. CARB will be evaluating charging standards and can set requirements on charging standards if determined to be necessary.

Economic Analysis – Over-the-Road Trucking Has Significantly Higher Charging Costs

Comment: Commenter states that the CARB assumed electricity costs in the Staff Report are consistent with their analysis when overnight charging occurs. However over-the-road trucking operations are not regularly able to take advantage of the lowest cost off peak EV charging rates, where some fleets see 50% of their charging during peak hours. Commenter states that the cost of charging EVs is on average costs $0.45/kWh, and with LCFS credit values included, the net cost of electricity to the fleet operator is thus $0.16/kWh to $0.20/kWh, is above CARB's assumption. Commenter states that as the market matures and public access infrastructure becomes one of the strategies employed to charge electric trucks, it becomes much more difficult for the fleet end-user to capture the value of the LCFS credits. [RP1-244]

Agency Response: No changes were made to the regulation in response to this comment. CARB recognizes that applications where vehicles are charging during peak times will face higher electricity costs than at other times. Because the ACT regulation does not require fleets to purchase ZEVs, there is no requirement that any fleet with high electricity costs would need to purchase ZEVs. This scenario is less likely since the total cost of ownership is less favorable than other scenarios. By 2035 about 15 percent of the fleet is expected to be ZEVs. For this reason, manufacturers will likely favor markets where fleets are able to charge overnight when electricity costs are the lowest. Over time, over-the-road trucking fleets may be able to incorporate ZEVs by purchasing vehicles with larger batteries that would not need to be charged during peak periods or by planning their charging sessions so that they occur during off-peak times in the middle of the day or during the night when electricity is cheapest.

Economic Analysis – Demand Charges Are Costly

Comment: Commenter states that demand charges are a significant concern for fleets. Some utilities like SCE offer a demand charge waiver, but when the waiver expires in a few years, it is estimated that the charging cost will increase from an average of $0.15/kWh to $0.50/kWh (more than a 300% increase). Commenter states that most EV operations fall outside of the service territories which may offer special EV rate programs. [RP1-244]

Agency Response: No changes were made to the regulation in response to this comment. CARB's cost analysis fully included demand charges and did not include short-term demand waivers in the analysis. Electricity costs were estimated by using the Charging Cost Calculator by utility as described in the Staff Report and is a tool that individuals can use to understand electricity costs with different assumptions. The $0.50 per kWh estimate is simply not representative of any likely charging scenario. Furthermore, demand charges can be mitigated by ensuring chargers are highly utilized, spreading charging sessions over a longer time period, and using charging management software to stagger charging sessions.

At this point, all three major IOU's have proposed new electricity rate schedules specifically for commercial electric vehicles and two have already been approved by the CPUC. These utilities service the vast majority of California's fleets. Two of these rate schedules, by PG&E and SDG&E, have removed demand charges and replaced them with subscription charges which offer more flexibility and assurance to fleets. Staff anticipates smaller IOUs and POU's will analyze the impacts of these new rates and design their own rates to enable low cost charging for commercial fleets.

Economic Analysis – Cost Analysis Underestimated Combustion-Powered Fuel Efficiency

Comment: Commenter states that the proposed ACT regulation assumes very low fuel efficiency for traditional diesel-fueled vehicles, artificially making battery-electric vehicles compare better. [RP1-218]

Agency Response: No changes were made to the regulation in response to this comment. Staff disagrees with the commenter's assertion. The staff analysis and assumptions are described in detail in the Staff Report. Fuel efficiency values for conventional vehicles are from the EMFAC model and reflect significant fuel efficiency improvements expected as a result of federal and California regulations.

Economic Analysis – Battery-Electric Efficiency Improvements Are Overstated

Comment: Commenter states that the proposed ACT regulation inaccurately assumes that battery-electric powertrains will become significantly more efficient over a short period of time. [RP1-218]

Agency Response: No changes were made to the regulation in response to this comment. As described in the Staff Report, staff assumed that the efficiency of battery-electric and fuel-cell electric vehicles would improve at the same pace as gasoline and diesel vehicles, an increase of roughly 20 percent by 2027.

It is unclear why the commenter claims CARB is inaccurately assuming ZEVs will become more efficient when these improvements are already required for the combustion-powered fleet. Battery electric and fuel cell electric technologies are less developed for heavy-duty applications compared to existing combustion technology, so there is more "room" to improve for these zero-emission technologies. Given this, CARB's assumption that these two technologies will advance at the same pace as conventional technology is likely overly conservative and underestimates further technology improvements.

Economic Analysis – Higher Maintenance Costs for Electric Vehicles

Comment: Commenter states cost per mile for the maintenance of electrified fleets to date have shown to be higher than that for a comparable RNG fleet. [RP1-320]

Agency Response: No changes were made to the regulation in response to this comment. Based on in-use data from light-duty and transit fleets, battery-electric vehicles have a lower maintenance cost per mile compared to their gasoline, diesel, or natural gas-powered counterparts. A battery-electric vehicle has fewer moving parts than a diesel vehicle and does not need many routine maintenance items such as oil changes. In addition, regenerative braking reduces wear on brakes which reduces the number of costly brake replacements/repairs. All studies staff have reviewed to date, and the experiences with light-duty ZEVs, corroborate the reduction in maintenance costs. For these reasons, staff maintains its current assumption that battery-electric vehicles have lower maintenance costs than gasoline or diesel-powered vehicles over their lifetime.

Economic Analysis – Diesel Engine Rebuild

Comment: Commenter states a diesel engine lasts for a million miles with no need for a rebuild as staff assumed. [RP1-169]

Agency Response: No changes were made to the regulation in response to this comment. Staff's analysis in the Staff Report found that Class 8 engines required a rebuild typically near 850,000 miles while engines in lighter weight classes required rebuilds sooner. Based on the expected mileage accrual rate, the only engines that require rebuilds in the analysis timeframe (2024-2040) are Class 4-5 engines who have the shortest useful life. Class 6-8 vocational vehicles are more durable and would not require an engine rebuild in the first 16 years of operation.

Economic Analysis – Underestimated Battery-Electric Vehicle Residual Value Penalty

Comment: Commenter states that the proposed ACT regulation underestimates the negative impacts of low battery-electric truck residual values when residual value is critical to a fleet's purchasing decision. [RP1-218]

Agency Response: No changes were made to the regulation in response to this comment. To provide context, see response detailing staff's methodology in determining vehicle life for the statewide cost analysis and the vehicle TCO analysis in chapter "Written Comments Received during the 30-Day Comment Period", section "Economic Analysis – Vehicle Life Assumption is Too Long".

Economic Analysis – Class 2b-3 Battery Life Assumptions Too Long

Comment: Commenter states that the proposed ACT regulation predicts very long battery replacement cycles, even no replacements over an assumed 26-year life of Class 2b-3 vehicles, when truck operation and charging characteristics will accelerate battery degradation. [RP1-218]

Agency Response: No changes were made to the regulation in response to this comment. Staff assumed battery-electric vehicles would need a battery replacement after 300,000 miles based on data from transit buses and light-duty vehicles with cooling systems. This means that high-mileage vehicles such as Class 8 tractors would need a battery replacement numerous times while low-mileage vehicles may not need a battery replacement. Class 2b-3 vehicles have fairly low annual mileage and are not anticipated to exceed 300,000 miles over the regulatory analysis, so no battery replacement was assumed.

Also note: CARBs economic analysis covers 2024 through 2040, therefore the longest assumption period possible is 16 years, not the 26 years the commenter claims.

<u>Economic Analysis – Fleet Infrastructure Resilience</u>

<u>Comment:</u> Commenter states that many of their member counties are subject to Public Safety Power Shut-Offs and requirements for ZEV vehicles would create an inability to charge municipal vehicle for multiple days and would incapacitate vital and emergency services during these times. [RP1-34]

<u>Comment:</u> Commenter states staff's analysis does not include the backup generators for charging stations. These will become necessary as wildfires cause public safety power shutoffs. Commenter also incorporates comments from the Rural County Representatives of California as reference. [RP1-169]

<u>Comment:</u> Commenter suggests that ACT include a natural disaster reliance assessment to assess natural disaster impacts on ZEV technology. [RP1-206]

<u>Comment:</u> Commenter states ZEVs provide no viable back-up plan during outages and or natural disasters. [RP1-320]

<u>Agency Response:</u> No changes were made to the regulation in response to these comments. Grid resiliency is an evolving issue that is outside of CARB's typical scope of operations. Our sister agencies including the CPUC and CEC are evaluating resiliency and what actions need to be taken to support the grid as directed by SB 350 and other related legislation.

The CPUC has released their draft Transportation Electrification Framework which is designed to offer a holistic strategy for addressing how the state's IOUs will support California's clean transportation and climate goals. This draft framework explicitly identifies resiliency as a focus for the utilities and discusses vehicle to grid integration, micro grids, backup generation by diesel or fuel cell generators, and other solutions. The CPUC is currently soliciting stakeholder input and intends to finalize the Transportation Electrification Framework after incorporating this feedback. In addition, the CPUC has started a rulemaking process regarding microgrids and resilience as directed by SB 1339. The CPUC has released its initial decision as of June 2020 and has issued the scoping memo for the next steps of this rulemaking. This work on microgrids will bolster resiliency and help support vehicle applications which rely on the grid. Lastly, as part of San Diego Gas & Electric's SB350 program, the CPUC approved a V2G pilot using buses to evaluate how these vehicles can provide energy to the grid and potentially boost resilience.

The CEC has recently held a workshop discussing energy resilience and ZEVs. This July 2020 workshop invited several speakers to present on their view on resilience. Some speakers including Envision Solar, FreeWire, and Toyota, where different technology solutions were highlighted including mobile chargers, chargers with battery storage and solar capability, and mobile hydrogen refuelers. Others highlighted the opportunities that vehicle grid integration and bidirectional charging can offer, with the California Transit Association stating that an integrated solution of solar, energy storage, and electric buses can provide resiliency while significantly reducing energy costs. A different presenter from Blue Lake Rancheria showed how they were able to use ZEVs to support their microgrid during the recent power shutoff events through bidirectional charging. Others pointed out that ZEVs can be more resilient than other vehicles, and in some situations with vehicle grid integration, can support the grid during potential power shutoff events. The presenter Next-Dimension highlighted that ZEVs can be a solution to the state's challenges, but doing so will require coordination from state agencies, vehicle manufacturers, emergency responders, and utilities.

Operational concerns associated with power shutoffs is only an issue for extended outages and becomes an issue for all vehicle and fuel types. This issue is highlighted in a 2019 NREL presentation– natural gas stations need electricity to run compressors to move the gas along pipelines and to compress gas to fuel CNG vehicles, and gasoline and diesel stations cannot pump fuel without electricity.

ZEVs have their own trade-offs and benefits but are not the only fuel that faces resiliency issues. Fleets will make their own decisions on how and whether they will plan to have backup measures such as on-site energy storage, backup generators or have larger storage systems onboard the vehicle. Fleets who are not located in areas subject to power shutoff events will not need any measures to improve resiliency. Fleets that operate within these regions will need to evaluate the cost tradeoff of installing storage versus not operating some vehicles on days where the power is shutoff for long periods of time. Because the ACT regulation does not require fleets to purchase ZEVs, only fleets who are comfortable with their resiliency situation would likely purchase ZEVs.

As stated in the Staff Report, increased electricity usage from ZEVs provides an opportunity for a number of benefits to the utilities, their customers, and the overall grid itself. In a 2017 letter to CARB, the California Electric Transportation Coalition, a non-profit whose board of directors is composed of the major California utilities, outlined the benefits of transportation electrification to California's power grid. Electric vehicles are capable of shifting load to off-peak periods and increasing overall demand, both of which help create a more efficient, highly utilized grid. Studies have found that light-duty ZEVs provide a benefit to all utility customers as their electricity utilization drives down rates for all other ratepayers.

Economic Analysis – No Assessment Supports Tractor TCO Findings

Comment: Commenter states that a different set of assumptions in the comparison cost of Class 8 diesel truck tractor will be far more favorable when compared to an all-electric Class 8 truck tractor and states that there is no "financial" analysis to display the capital and annual costs through the "eyes of the fleet owner". [RP1-169]

Agency Response: No changes were made to the regulation in response to this comment. As stated in Attachment C to the Notice of 30-Day Changes, numerous studies assessing the TCO of zero-emission tractors have been released. While they differ in their assumptions on vehicle capabilities and duty cycles, they show a common message – while zero-emission tractors are anticipated to have a higher upfront cost, their lower operating costs mean that fleets will see a positive TCO by the time the rule begins in 2024. While it is possible to create assumptions that would show ZE tractors as being less favorable, staff's analysis represents a typical case rather than a best-case or worst-case scenario and is appropriate for a manufacturer requirement.

Economic Analysis - Ignores CNG Investments and Impacts from Stranding Those Investments

Comment: Commenter states that the ACT analysis did not take into account the billions of dollars spent on CNG fueling infrastructure, facility maintenance, and training. [RP1-169]

Agency Response: No changes were made to the regulation in response to this comment. To the extent that the comment casts doubt on the validity or comprehensiveness of the economic analysis of the regulation, CARB disagrees with that assertion. As part of staff's regulatory development, staff performed a macroeconomic analysis assessing the impact of the regulation on the state's overall economy. This analysis found that the ACT regulation is anticipated to have a negative impact on the state's oil and gas extraction industries as well as related businesses. This negative impact is offset by positive impacts in infrastructure installation, ZEV manufacturing, and other benefits to the state's economy. Broadly, the ACT regulation is anticipated to have a neutral or positive impact on the state's overall economy in spite of potentially negative effects on industries related to oil and gas extraction.

Staff notes that because this is a manufacturer requirement, no fleet is required to purchase ZEVs unless they choose to do so. Fleets will purchase ZEVs if it makes financial sense for them to do so, including infrastructure costs and expenses. To the extent that some fleets rent their facilities or are unable to access capital for financing, they have no obligation to purchase ZEVs. The approved regulation is a requirement for manufacturers to sell ZEVs into California, but does not require any individual fleet to purchase ZEVs; therefore, the comment does not appear to be directly applicable to the regulation, and would only be relevant if the regulation required CNG fleets to purchase ZEVs.

The commenter asserts that the cost burden of the regulation is higher for a fleet that invested in CNG infrastructure than for fleets that have not similarly invested in CNG infrastructure. That assertion is incorrect for the following reasons. First, the implication that CNG fleets would not be able to recoup their investments means such fleets would not be as likely to purchase ZEVs compared to another fleet that has not made the same investment. Therefore, it is reasonable to assume that fleets that have not invested in CNG infrastructure would purchase ZEVs as was done in the staff analysis. The staff analysis is intended to reflect a representative scenario of what is likely to happen with the approved regulation and it would not be useful to model situations or scenarios that are simply unlikely or are outlier examples.

On a related note, the approved ACT regulation includes a mandatory large entity reporting requirement that includes questions about existing infrastructure investments to better inform future ZEV regulations that may affect fleets, which is discussed further in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Large Entity Reporting – Gather Information on Existing Infrastructure Costs”.

Economic Analysis – Impact of COVID-19

Comment: Commenter states that due to COVID-19, the market analysis should be updated to reflect the current and future economic conditions that will affect availability of ZEV’s and sources of available funding for government agencies to procure them. [RP1-181]

Comment: Commenter states that COVID-19 will reduce the lead time that manufacturers need to comply with the rule, reduce the needed capital and financial assistance to fund the higher truck purchase prices and operational costs associated with the ACT regulation, and reduce the time and capital available to develop the necessary charging infrastructure, and considering California’s budget situation it will be much harder for the state to fund incentive programs needed to offset the higher purchase and operational costs of ZE trucks. [RP1-218]

Comment: Commenter states that manufacturers have been impacted by COVID-19 and it is unclear how they will prioritize OEM's capital investments and MDE/HDE platform development. [RP1-232]

Comment: Commenter states that they have started to invest in RNG which runs 90% cleaner than diesel and making a premature push towards electrification when ratepayers are already experiencing financial hardship from COVID-19 will stop the progress made towards California's climate goals. [RP1-233]

Comment: Commenter states concern regarding the budgetary impact of COVID-19 and CARB should prioritize robust funding levels and ongoing market assessments to ensure the 2024 implementation dates remain reasonable and that the Advanced Clean Truck regulation is successful in achieving its goal of stimulating technology development and improved EV market options. [RP1-244]

Comment: Commenter states that CARB needs to consider the economic impacts of COVID-19 on the trucking industry. [RP1-247, RP1-260-Form-300]

Agency Response: No changes were made to the regulation in response to these comments. Staff recognizes there is an economic impact of the COVID-19 pandemic on truck owners and manufacturers. However, for a number of reasons, staff finds that the regulation’s requirements are feasible in spite of this. First, the ACT regulation does not place any requirements until 2024 MY, giving manufacturers time to plan and position themselves for the rule's requirements. The ACT regulation is anticipated to deliver economic benefits to trucking fleets and health benefits to Californians. These ZEV deployments will create green, high-quality jobs in infrastructure and zero-emission vehicle manufacturing to stimulate the state's economy. Lastly, the ACT regulation does not require fleets to purchase ZEVs. It requires manufacturers to sell ZEVs, and it will ensure that manufacturers bring competitive ZEV products to market at price points that will meet fleet needs. For these reasons, staff believes the ACT regulation will support the state's recovery from the COVID-19 pandemic and will not be a hindrance.

Economic Analysis – Incorrect Assumptions for Class 2b-3 Vehicles

Comment: Commenter states that the proposed ACT regulation incorrectly analyzes the TCO of Class 2b-3 vehicles, including incorrect vehicle lifetime/ownership period, assumes decreasing fuel economy of gasoline trucks, no battery replacement assumed for class 2b-3 vehicles, an underestimate of the number of individuals and small businesses ineligible for LCFS credits, and assumes too small battery sizes for vehicles which will be used to tow. [RP1-218]

Comment: Commenter states that the TCO analysis for the Class 2b-3 appears to be using unrealistically small battery sizes – 55 kWh and 80 kWh. In addition, the TCO for Class 2b-3 assumes these vehicle operators will earn LCFS credits, which is unrealistic to assume for non-fleet operators. [RP1-265]

Agency Response: No changes were made to the regulation in response to these comments.

Staff evaluated vehicle life in both the statewide cost analysis and the fleet TCO analysis to assess cost impacts to the state and individual vehicles. See response detailing staff's methodology for vehicle life in chapter "Written Comments Received during the 30-Day Comment Period", section "Economic Analysis – Vehicle Life Assumption is Too Long".

Gasoline fuel economy did not "decrease" as the commenter states. Fuel economy for Class 2b-3 gasoline and diesel vehicles is assumed to rise steadily from 2021 to 2027 and remain constant afterwards. This represents the fuel efficiency standards established in the federal Phase 2 GHG requirements for Class 2b-3 vehicles. See response detailing staff's methodology to calculate fuel economy in chapter "Written Comments Received during the 30-Day Comment Period", section "Economic Analysis – Cost Analysis Underestimated Combustion-Powered Fuel Efficiency".

The LCFS regulation allows non-residential EVSE owners to earn LCFS credits from charging EV's. Residential EV owners cannot claim LCFS credits as the credit is awarded to the utility delivering electricity to the residence. The commenter is conflating two separate topics by claiming that individuals and small businesses cannot claim LCFS credits. Staff does not disagree that a significant portion of Class 2b-3 sales are to small businesses. However, staff's 30 percent assumption discussed in the Staff

Report only apples to individuals. There is no restriction preventing small business owners from claiming LCFS credits. A business who installs a charger at their office can earn LCFS credits with no restrictions and, in fact, some small businesses owning EVs have already begun claiming credit in the LCFS program. Thus, stating that small businesses have “absolutely no opportunity to benefit from LCFS credits” as the commenter claims is factually incorrect.

Staff calculated battery sizes for all vehicles based on the expected efficiency, average daily miles traveled, and adding an additional buffer. Based on these calculations, staff arrived at the 55 kWh and 80 kWh values for Class 2b-3 battery size. Based on these battery sizes, staff estimated the vehicle price would be in the range of $65,000-70,000 in 2024. This was intended to represent small scale production of electric cargo or passenger vans. In the months since the Staff Report was released, staff has observed new announcements of several zero-emission pickups, vans, and SUVs as described in Attachment C to the 30-Day Changes to the ACT regulation. Many of these advertise higher battery capacities and lower prices simultaneously, indicating staff was overly conservative in our assessment of the Class 2b-3 ZEV market. For these reasons, staff is maintaining the current assumptions for Class 2b-3 vehicles as the resulting price appears reasonable.

Large Entity Reporting – General Support

Comment: Commenter states their support to expand the definition of large entity reporting to include fleets that have 50 or more vehicles. [RP1-140]

Comment: Commenter states support for the exemptions of military vehicles and streamlined reporting due to the elimination of the facility reporting section. [RP1-197]

Comment: Commenter states they support the clarification of the term "broker" in Section 2012(d)(2). [RP1-238]

Comment: Commenter states the vehicle fleet data CARB collects as a part of this process will be an important tool to the utility planning and preparedness efforts to accommodate increased MD/HD EV loads. [RP1-259]

Comment: Commenter supports staff’s removal of the facility category reporting requirement. [RP1-302]

Agency Response: Staff appreciates the supportive comments. Additional issues raised by commenters, if any, will be addressed in the applicable sections.

Large Entity Reporting – Regulation Requires Hard-to-Collect Information

Comment: Commenter states it is impossible to comply using 2019 and 2020 data as entities do not have this on record. [RP1-238]

Comment: Commenter states entities have not been previously required to collect emergency dispatch data over the previous three years, so compliance with the requirement to report the prior three years of vehicle emergency dispatches would be impossible. [RP1-238]

Comment: Commenter states that the following required reporting data are not currently available or are challenging to gather for their fleet: dispatch group, vehicle group, vehicle group mileage averages. [RP1-273]

Agency Response: No changes were made to the regulation in response to these comments. As a part of staff's 30 day modifications, more flexibility has been added to how fleets can collect data for the large entity reporting requirement. More details on this answer are provided in chapter "Comments Received During Original Proposal's 45-Day Comment Period", sections "Large Entity Reporting – Regulation Requires Hard-to-Collect Information" and "Large Entity Reporting – Timing of Data Collection".

Large Entity Reporting – Unclear Language, Unclear Requirements, Unnecessary Information

Comment: Commenter states that the survey is intrusive and does not clearly define the purpose of the collected information. [RP1-210]

Agency Response: See response detailing proposed clarifications and streamlining of the large entity reporting requirement in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Large Entity Reporting – Unclear Language, Unclear Requirements, Unnecessary Information".

Large Entity Reporting – Cost Burden

Comment: Commenter states that there is no consideration of cost to companies for completing the survey. [RP1-210]

Comment: Commenter states that CARB has underestimated the number of personnel hours and costs that will be required to produce the information requested for larger fleets. [RP1-44]

Agency Response: No changes were made to the regulation in response to these comments. A detailed streamline of the large entity reporting requirement and updates to cost modeling can be seen in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Large Entity Reporting – Cost Burden".

Large Entity Reporting – Insufficient Outreach

Comment: Commenter states that there has been very little outreach to rural local governments regarding the potential impacts of the proposed regulation, especially considering the scale that urban local governments have engaged in the rulemaking. [RP1-34]

Comment: Commenter states that outreach has been limited and requests that CARB host statewide workshops specifically for government fleets to gather comments and feedback. [RP1-181]

Comment: Commenter states that due to minimal CARB outreach, many smaller companies are unaware of the ACT. [RP1-210]

Comment: Commenter requests statewide workshops for government fleets to comment because opportunities to comment have been limited to date. [RP1-255]

Comment: Commenter requests CARB consider extending its current timelines and establish additional public sessions where concerns can be discussed and addressed. [RP1-320]

Agency Response: Staff disagrees with these comments. CARB created a technical workgroup that comprises interested stakeholders including manufacturers, fleets, environmental groups, utilities, technology providers, and fuel providers. In addition to coordinating public workgroup meetings, CARB staff met with over 50 stakeholders, often multiple times, for a total of over 100 individual meetings.

Since 2016, CARB staff held seven workshops, and four workgroup meetings to provide information to the public and solicit feedback. CARB staff posted information regarding these events and any associated materials on the ACT website and distributed notice of these meetings through two public list serves; "actruck" and "zevfleet" that include 3,092 and 1,356 recipients, respectively. The majority of the meetings were available by webcast and teleconference.

In the April 2017 workshop, staff asked fleets to submit answers to a draft fleet survey questionnaire in an effort to gather detailed information about everyday operations of local fleets. This survey was sent to roughly 500 addresses through mail and 1,500 email addresses through the “actruck” list serve on CARB’s website. However, the survey failed to provide a sufficient amount of responses to gather the required fleet information, and as a result, staff included the Large Entity Reporting requirement at Governor Jerry Brown’s direction in his August 1, 2018 letter to Mary Nichols, Chair of CARB.

In July 2019, staff also mailed notice letters to the 11,000 large entities and fleets that would likely be required to report to seek their participation.

Large Entity Reporting – Bifurcate the Large Entity Reporting from the ACT Regulation

Comment: Commenter states that the reporting requirement for fleet owners and brokers is too cumbersome and should be removed from the rule to be discussed in separate workshop. [RP1-169]

Comment: Commenter states that the reporting requirements should be separated into a new rulemaking. [RP1-238]

Agency Response: No changes were made to the regulation in response to these comments. See response explaining the time constraints that led staff to include this reporting requirement in the regulation in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Large Entity Reporting – Bifurcate the Large Entity Reporting from the ACT Regulation”.

Large Entity Reporting – Unrepresentative Data or More Time Needed Due to COVID-19

Comment: Commenter is concerned that the reduced vehicle usage in 2020 due to COVID-19 would not be typical or representative of the facilities’ normal operations and the use of uncharacteristic data as basis for future rulemaking [RP1-172]

Comment: Commenter suggests data quality for section 2012 will be greatly diminished by the coronavirus pandemic and that ARB should consider alternative means to collect data through an ongoing, iterative process, similar to the approach to be used for collecting facility-specific data. Commenter is concerned that the collection of poor-quality data could have negative consequences for future rules. [RP1-215]

Comment: Commenter states that CARB needs to provide clarification on how the reporting of statewide trucking data collected will be corrected for the impact of COVID-19 and how the data will inform fleet rules if they are already in progress. [RP1-216]

Comment: Commenter suggests that implementation should begin with the industries (warehousing, regional distribution, local delivery and food supply chain) that have not been impacted by COVID. [RP1-192]

Comment: Commenter states that the reporting requirement should be delayed due to COVID-19. [RP1-206]

Comment: Commenter states that there should be more time for reporting because of COVID-19 impacts. [RP1-238]

Comment: Commenter recommends to extend the submittal date to at least April 2022 to allow time to create a data collection procedure and to capture data in the year 2021 due to COVID-19, as data collected for 2020 will not be representative. [RP1-172]

Agency Response: While staff recognizes that the COVID-19 pandemic will affect fleets, much of the information gathered is anticipated to be valid. For example, all of the general information requested in section 2012.1 and facility locations and vehicle counts in section 2012.2 will not be affected by the pandemic. In addition, while the pandemic is having significant impacts on the economy as a whole, many sectors in the trucking industry appear to be relatively unaffected by the economic slowdown. Because of this, the data submitted will still be useful and critical as staff continues developing future zero-emission fleet rules.

Additionally, staff included additional flexibility in selecting representative time periods for data collection, described in chapter “Comments Received During Original

Proposal's 45-Day Comment Period", section "Large Entity Reporting – Timing of Data Collection".

Large Entity Reporting – Data Collection Timing and Reporting Deadline Issues

Comment: Commenter states that entities will need additional time (15 months from enactment) to collect the required information to comply with the reporting requirement and allow businesses sufficient time to learn the process and submit the data correctly the first time. [RP1-169]

Comment: Commenter states if the rule is adopted in June 2020, the earliest possible effective date is October 2020, which leaves facilities only Q4 2020 to collect data, regardless of whether this period is representative as described by staff. This would only leave October 1, 2020 through March 1, 2021 (to give time to consolidate and report collected information) which may not be representative of a fleet's "busy season". The timeframes are impractical, and will result in poor quality data. [RP1-215]

Comment: Commenter states they are concerned about the timeline for reporting (by April 1, 2021) provides less than six months for entities to collect information, count vehicles, and report in order to provide accurate information. [RP1-238]

Comment: Commenter states that the survey should be pushed out to September to not interfere with other reporting deadlines in April. [RP1-210]

Comment: Commenter states in Section 2012(e)(1) that it is not feasible to report by April 1, 2021. Instead, CARB should allow for a full year after adoption for reporting [RP1-238]

Comment: Commenter requests that the ACT regulation provide reporting entities more time to gather the required data, suggesting a deadline of July 1, 2021 instead of April 1, 2021. [RP1-302]

Agency Response: Staff added more guidance language and expanded the potential data collection periods, which directionally addresses some commenter concerns, as discussed in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Large Entity Reporting – Timing of Data Collection". Staff still need to gather the information and have sufficient time to analyze it to draw conclusions that will inform the fleet focused strategy that staff has committed to bring to the Board in 2021. Delaying the reporting deadline would be contrary to a speedy return to the Board, as directed by the Board members.

Large Entity Reporting – Only Require Reporting from Fleets

Comment: Commenter states that the reporting requirement should be based on the size of the fleet, not the size of the entity. [RP1-169]

Comment: Commenter in reference to Section 2012(b)(1) states small fleets are subject to the $50 million revenue threshold and data collected from these entities is better suited for a non-regulatory facility survey, not regulatory reporting. Commenter recommends this applicability criterion be removed and suggests raising the vehicle threshold so that the administrative burden is commensurate with the value of data collected. [RP1-215]

Agency Response: No changes were made to the regulation in response to these comments. The Large Entity Reporting Requirement is designed to capture information on a cross section of large fleets and large businesses. The reporting requirement was limited to large fleets with 50 or more vehicles and large businesses with greater than $50 million in annual revenue regardless of fleet size. These thresholds were approved by the Board to balance between collecting information and minimizing administrative burden. These entities have the resources to collect and report the needed information to help inform future regulations. These regulations are expected to affect all fleets in order to meet the Board's Resolution and Governor's Executive Order to achieve a fully zero-emission truck and bus fleet by 2045 where feasible. Gathering information on both large fleets and large businesses is critical to the development of future ZE fleet rules.

Large Entity Reporting – Define Large Fleet as 50 or more Vehicles

Comment: Commenter states that the definition of "large fleet" should be 50 or more vehicles. [RP1-223]

Agency Response: No changes were made to the regulation in response to this comment. The regulation requires fleets of 50 or more vehicles to report information. This is not a definitive definition of "large fleet" as staff will evaluate what an appropriate definition should be for the purposes of the zero-emission fleet rule.

Large Entity Reporting – Smaller Fleet Considerations

Comment: Commenter recommends the strengthening of the ACT regulation reporting by lowering the requirement threshold to fleets of 25 or more vehicles to inform future programs and improve compliance in difficult market segments, such as port drayage. [RP1-46]

Comment: Commenter asks how the ACT regulation will ensure that smaller fleet sizes (<= 50) will not be underrepresented and ensure that incentives will be applied to these smaller fleets. [RP1-26]

Agency Response: No changes were made to the regulation in response to these comments. Based on available information, staff believes that lowering this number further would result in exponentially more fleet respondents with diminishing returns on the value added by the additional data, along with additional time required to process the much larger volume. This would be contrary to the Board's direction to streamline the reporting requirement and to return to the Board expeditiously with fleet recommendations in 2021. Staff is in the process of developing the specifics of a future fleet rule to identify which segments and associated fleet sizes are most suitable for electrification. Please see the discussion about staff targeting initial requirements to larger businesses and larger fleets because they are in better capitalized positions in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Large Entity Reporting – Level Playing Field Analysis”. In addition, regulations are generally not predicated on incentives, as discussed in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Out of Scope – Incentive and Funding Policies”.

Large Entity Reporting – Oppose Decreasing Fleet Size Cutoff

Comment: Commenter states that they are disappointed that CARB has increased the number of fleets required to respond to the survey by reducing the vehicle threshold from 100 to 50. [RP1-210]

Comment: Commenter is concerned with changes that decrease the vehicle threshold for reporting entities, as this will require many more fleets to report data. [RP1-238]

Agency Response: No changes were made to the regulation in response to these comments. While the Board did provide direction to streamline the reporting requirement at the First Board Hearing, they also gave direction to consider lowering the threshold for fleet size. The manufacturer ZEV sales requirements have become more stringent which will mean more fleets need to electrify. As a result, more information on smaller fleets is necessary to develop ZE fleet regulations to support higher manufacturer ZEV sales requirements.

Large Entity Reporting – Allow Public Entities to Report Subsidiaries

Comment: Commenter requests that the ACT regulation clearly allow independent reporting for state and local governments, as is allowed for subsidiaries, joint ventures, or parent companies (as POUs and public water agencies are often departments of city government). [RP1-302]

Agency Response: No changes were made to the regulation in response to this comment. Section 2012(e)(1) states that parents may report on behalf of their subsidiaries. This flexibility option is available to both public and private entities affected by the reporting requirement.

Large Entity Reporting – Inclusion of Vehicles Supporting Emergencies

Comment: Commenter asks if non-emergency vehicles that assist with emergencies are subject to reporting requirements. [RP1-215]

Comment: Commenter states that there needs to be clarification on Section 2012.2(b)(2)(O) because it is unclear if they have to report emergency vehicles that responded to an incident or only the vehicles that are non-emergency but responded. [RP1-238]

Agency Response: No changes were made to the regulation in response to these comments. Vehicles classified as an “emergency vehicle” as defined in California Vehicle Code section 165 are exempt from the reporting requirement. Vehicles not meeting the definition of “emergency vehicle” need to report even if they assist with emergencies.

Large Entity Reporting – Exempt Light-Duty Vehicles

Comment: Commenter states in Section 2012(c) there should be an exemption to the reporting requirement for all passenger and light duty trucks since they are not a part of this rulemaking. [RP1-238]

Agency Response: No changes were made to the regulation in response to this comment. There are no requirements on light-duty vehicles in the regulation as all references are to vehicles with a GVWR over 8,500 lbs. or more. For this reason, it is unnecessary to add an explicit exemption for light-duty vehicles.

Large Entity Reporting – Exempt Class 2b Pickups

Comment: Commenter states that 3/4 ton pickups should not be included in the ACT reporting requirements because they are governed by other regulations and that the lower limit of the gross vehicle weight should be increased from 8,500 to 10,000 pounds. [RP1-169]

Agency Response: No changes were made to the regulation in response to this comment. The ACT regulation requires manufacturers to produce Class 2b-8 ZEVs. During the development of a future ZE fleet rule development, staff will be evaluating the deployment of ZE Class 2b-8 vehicles. Therefore, it is critical to collect operational information on Class 2b vehicles as part of the reporting requirements.

Large Entity Reporting – Exempt Utility Vehicles

Comment: Commenter states that vehicles operated by utilities should be added to the list of emergency exempt vehicles from the ACT regulation. [RP1-181]

Comment: Commenter requests that CARB add vehicles operated by utilities to the list of exempt emergency vehicles. [RP1-255]

Agency Response: No changes were made to the regulation in response to these comments. Utilities have been identified as a beachhead category and through the Resolution, staff aims to fully electrify the utility sector by 2040. To achieve this goal, gathering specific information on the operations of utility vehicles is critical.

Large Entity Reporting – Remove Off-Road Yard Tractors

Comment: Commenter in reference to Section 2012(e)(3) states that “off-road tractors” should be deleted from the reporting requirements for consistency with the ACT regulation. [RP1-169]

Comment: Commenter recommends that "off-road yard tractors" should be removed and dealt with outside of the regulation, especially as it appears not to be part of the scope of the ACT regulation. [RP1-215]

Agency Response: No changes were made to the regulation in response to these comments. While the manufacturer ZEV sales requirements of the ACT regulation do not place requirements on off-road yard tractors, the upcoming ZE fleet rule and Cargo Handling Equipment regulations will affect yard tractors regardless of whether they operate on-road or off-road. For these reasons, getting a better understanding of their inventory and operations is critical.

Large Entity Reporting – Exempt Small Municipalities

Comment: Commenter recommends that smaller municipal jurisdictions be exempt from the reporting requirement because light-duty and heavy-duty applications are not conducive to ZEV's, rural communities lack the charging infrastructure, and reporting will place an undue economic burden on local agencies. [RP1-34]

Agency Response: No changes were made to the regulation in response to this comment. The Board adopted, through the Resolution, a goal to electrify all government fleets by 2035. Meeting this goal will require deploying ZEVs into public fleets, which may include those belonging to small municipalities. The Resolution does not discriminate between large and small municipalities so staff will need to gather information on these small municipalities to ensure future ZE fleet rule requirements are feasible.

Large Entity Reporting – Remove Fleet Category Definitions

Comment: Commenter states the "facility category" definition should be deleted. [RP1-247]

Agency Response: No changes were made to the regulation in response to this comment. The facility categories are required as stated in section 2012.2(a)(2). Therefore, the definitions for facility categories remain necessary.

Large Entity Reporting – Remove Reporting Requirements for Tax ID and Annual Revenue

Comment: Commenter states that “Federal Taxpayer Identification Number”, and the “Total Annual Revenue for the Entity” is not necessary for compliance with the proposed ACT regulation and therefore should be deleted. [RP1-169]

Comment: Commenter states entities should not have to report how much revenue they generate at all. [RP1-238]

Agency Response: No changes were made to the regulation in response to these comments. The Federal Taxpayer Identification Number is necessary because it is a unique identifier that can be used to identify companies with similar names or identify subsidiaries of the same company. Total annual revenue for the entity is necessary to ascertain the relative size of different entities. Future fleet rules may have different requirements for larger and smaller businesses, so identifying the relative revenue of different entities is critical

Large Entity Reporting – Remove Reporting Requirements for Emergency Operations

Comment: Commenter recommends that Section 2012(b)(2)(O) should be removed because entities involved with emergency response are not tracking vehicle usage or deployment in those situations; they are focused on assisting with emergencies. The way the question is phrased would require three years of data to be able to answer, which fleets have not been keeping records of, which is impractical to comply with. [RP1-215]

Agency Response: No changes were made to the regulation in response to this comment. Understanding how vehicles that support emergencies operate is critical in ensuring these vehicles receive sufficient flexibility in the upcoming zero-emission fleet rules. Fleets have indicated they typically will send a portion of their fleet to aid in emergency situations, with the size of the dispatched fleet being dependent on the scale and location of the emergency. Staff does not agree that fleets maintain no records of which vehicles are used to support emergency operations as fleets will need to ensure all equipment is tracked and provide logistic support to these vehicles.

Large Entity Reporting – Remove Weight Limit Question

Comment: Commenter in reference to Section 2012(b)(2)(L) states that this provision is geared toward long haul trucks that have access to scales rather than for businesses that simply use trucks at their facilities. Most companies do not have data on daily or typical weight limits. CCEEB requests to have this provision removed. [RP1-215]

Agency Response: No changes were made to the regulation in response to this comment. Many trucks across all weight classes face weight challenges as shown in Appendix F to the Staff Report. Because of this, information on potential weight limitations is needed from all vehicles. Because exceeding weight limits is illegal, staff anticipates fleets keep track of which vehicles are operating near their weight limit.

Large Entity Reporting – Remove Useful Life Questions

Comment: Commenter in reference to Section 2012.2(b)(4) states that in order to respond accurately, entities would need more than 20 years of historical data, i.e. data for the useful life of each vehicle. Commenter suggests this provision should be removed. [RP1-215]

Agency Response: No changes were made to the regulation in response to this comment. Fleets commonly keep records of their assets and other major cost elements such as maintenance and depreciation, which are dependent on the vehicles' age. This question is intended to reflect general business practices for the most appropriate response category (bin) provided in the regulation, and staff recognizes it could change in the future for a variety of reasons. Furthermore, the question provides easy to categorize response options in five-year increments which should be sufficient for the entity to assess the approximate number of years an asset is typically kept after acquisition.

Large Entity Reporting – Define “Most of the Vehicles”

Comment: Commenter states that CARB should clarify the phrase "most of the vehicles," and identify the ratio or percentage they intend to capture (e.g., a fleet that has more than 75% of their vehicles within approximately 50 miles of the facility). [RP1-172]

Agency Response: No changes were made to the regulation in response to this comment. “Most” has a generally accepted meaning of “more than 50 percent” so no additional definition is required in this rulemaking.

Large Entity Reporting – Define “Tractor”

Comment: Commenter states that the term "tractor" is undefined in the rule. [RP1-238]

Agency Response: No changes were made to the regulation in response to this comment. The term “tractor” is commonly understood to refer to a tractor trailer or semi-truck used to haul trailers on highways.

Large Entity Reporting – Rephrase “Van-Dry” and “Van-Reefer”

Comment: Commenter in reference to section 2012(3)(A) & (B) states that "van-dry" should read "dry van" and "van-reefer" should read "reefer van" or “reefer” to reflect common nomenclature. [RP1-145]

Agency Response: No changes were made to the regulation in response to this comment. The regulation text was phrased this way to list the two types of vans next to each other when displayed alphabetically in a reporting system.

Large Entity Reporting – Avoid Using “You”

Comment: Commenter in reference to section 2012.2(a)(8) suggests that the word "you" should be replaced with fleet or entity. [RP1-145]

Agency Response: No changes were made to the regulation in response to this comment. “Your entity” and “you” are used in multiple places throughout the regulation to indicate information requested from the reporting entity. “You” is correct terminology in these instances.

Large Entity Reporting – Need to Report Data Collection Year

Comment: Commenter asks for clarification on why the distinction in Section 2012.1(a)(20) is necessary. [RP1-238]

Agency Response: No changes were made to the regulation in response to this comment. The regulation allows reporting entities to report their fleet as it was in any time during 2019 or 2020. This question asks what date was used to gather this information. This is necessary to give time frame context to the data reported, and to better allow comparisons between time periods.

Large Entity Reporting – Insufficient Records for Infrastructure Installation

Comment: Commenter in reference to Section 2012.2(a)(6) and (7) asks to clarify the terms "initially installed" and "on or after" because facilities were not required to keep records of whether or not fueling infrastructure had been installed in 2010 or any time since then, which makes compliance record keeping challenging. This would be particularly true for a facility that changed ownership since 2010. [RP1-215]

Agency Response: No changes were made to the regulation in response to this comment. The requirement is for fleets to report if they installed fueling infrastructure at any of their vehicle home bases since 2010. Because fueling infrastructure represents a major investment on the part of fleets, staff expects fleets to maintain records of recent infrastructure installations.

Large Entity Reporting – Require Pre-2010 Infrastructure Information

Comment: Commenter states that in section 2012.2(a)(6)(A) to 2012.2(a)(6)(G) the word “initially” should be removed, and modify “after January 1, 2010” to read “after January 1, 2000” to inform future TCO analysis based on the 20-year amortization period. [RP1-145]

Agency Response: No changes were made to the regulation in response to this comment. In comments at the December 12, 2020 hearing, the Board directed staff to streamline the reporting requirement. Increasing the amount of information required would go against the Board direction. In addition, staff does not currently plan for future fleet rules to require full electrification prior to 2030, meaning that infrastructure installed prior to 2010 will be able to be fully amortized.

Staff will include a field in the reporting template for the reporting entity to share additional information. This can include information on older infrastructure if the respondent so chooses.

Large Entity Reporting – Reporting Facilities Outside of California

Comment: Commenter states Section 2012.2 needs to explicitly exclude locations outside of California. [RP1-247]

Agency Response: No changes were made to the regulation in response to this comment. The regulation states regulated entities must report facilities within California with vehicles. In addition, for vehicles that accrue the majority of their miles within California, either the company headquarters or the vehicle facility outside of California must be reported. Facilities with vehicles that do not accrue the majority of their miles within California do not need to be reported.

Large Entity Reporting – Clarify Exempt Military Facilities to be "Operational" not "Tactical"

Comment: Commenter in reference to Section 2012(c)(4) requests the exemption for military facilities be for "operational" rather than "tactical" because the description better meets CARB's stated intent for which facilities should provide information. [RP1-197]

Agency Response: No changes were made to the regulation in response to this comment. Military tactical vehicles and military tactical facilities are exempt from the approved regulation to minimize any potential national security concerns and because staff does not foresee including them in any future ZEV fleet regulations.

Large Entity Reporting – Clarify Record Keeping for Dispatched Vehicles

Comment: Commenter requests clarification of the term "brokers" that dispatch vehicles because the term "dispatched" are specific to brokers except this one, which also appears to be directed toward brokers but is it not specified as such. [RP1-215]

Comment: Commenter recommends clarification of language in Section 2012(e)(3)(B) because there are no requirements in the rule that use the term "dispatch" that are not related to brokers, except this section. [RP1-238]

Agency Response: No changes were made to the regulation in response to these comments. Section 2012(e)(3)(B) states what types of records would need to be retained for vehicles "not owned but dispatched by the entity." This certainly would apply to Brokers, but could also apply to any other company that directs the movement of vehicles. For example, some motor carriers own vehicles and also provide brokerage services.

Large Entity Reporting – Clarify Language Regarding Fueling Infrastructure Installation

Comment: Commenter states in Section 2012.2(a)(7) there needs to be clarification for the difference between "fueling infrastructure" and "refueling infrastructure", and to provide clarification on whether the question is referring to a single point in time or a period in which the station was opened. [RP1-238]

Agency Response: Staff did not intend for there to be a difference between "fueling infrastructure" and "refueling infrastructure". Staff has made a non-substantive change to the regulation text to refer to both as "fueling infrastructure."

The date of initial installation is treated as a single point in time. The phrase "on or after" was used to provide more clarity as to whether January 1, 2010, was included rather than leave it ambiguous.

Large Entity Reporting – Clarify What Type of Infrastructure to Report

Comment: Commenter states there needs to be clarification on the "Refueling Infrastructure", which can refer to the equipment/system that dispenses fuel to vehicles or can also refer to equipment that supports the fuel dispensing activities. [RP1-230]

Agency Response: No changes were made to the regulation in response to this comment. The purpose of this particular reporting requirement is to gather information on what fueling capabilities currently exist on fleets' property and what investments were made recently. This can include both fueling infrastructure and infrastructure used to support refueling such as fuel dispensing devices.

Large Entity Reporting – Clarify How to Determine If Locations Are Similar

Comment: Commenter in reference to Section 2012.2(b)(7) asks if two or more "locations" should be deemed "similar" if operations are similar but they have different sized service areas, or different numbers of vehicles domiciled there. [RP1-215]

Agency Response: No changes were made to the regulation in response to this comment. There is no limitation that the service areas need to be identical or the number of vehicles be different, these can differ and still be substantially similar.

Large Entity Reporting – Clarify Requirements Regarding Sustainability Plans

Comment: Commenter requests clarification of intent in Section 2012.1(a)(17)-(18). Commenter states the term sustainability plan means different things to different industries. Will entities that have a sustainability plan be exempt from future rulemaking? If so, what should this sustainability plan look like? Must it include electric vehicles use as a component? Will it have an emissions reduction requirement? [RP1-238]

Agency Response: No changes were made to the regulation in response to this comment. The purpose of the sustainability plan questions is to understand how many companies in which sectors have or have not incorporated sustainability into their business plan, with a focus on transportation issues. This is meant to inform future decision making for the zero-emission fleet rule and does not place requirements on fleets to develop future sustainability plans

Large Entity Reporting – Clarify Requirements on Vehicles Not Registered with the Department of Motor Vehicles

Comment: Commenter would like know how to handle vehicles that operate on private property but are not registered with DMV? Under this definition, these vehicles would not have fleet owners. [RP1-215]

Comment: Commenter states Section 2012(d)(10) and Section 2012 (e)(3)(C) need clarification about vehicles that operate on private property and are not registered at DMV. [RP1-238]

Agency Response: No changes were made to the regulation in response to these comments. The regulation does not exclude on-road vehicles who are not registered with the DMV. Fleets should report their on-road vehicles regardless of whether they are registered with DMV or not.

Large Entity Reporting – Clarify Language Regarding Light-duty Vehicles

Comment: Commenter recommends that the definition of light-duty vehicles be removed since this vehicle class is outside the scope of the ACT regulation. [RP1-215]

Comment: Commenter states that Section 2012.2 should clarify that information on vehicle home bases should only be required for locations that have vehicles over 8,500 GVWR, and not for a location where only light-duty vehicle or those under 8,500 GVWR are domiciled. [RP1-215]

Comment: Commenter states in Section 2012.2 that entities that meet the income threshold that have light-duty vehicles but no heavy-duty should not be required to report. [RP1-238]

Agency Response: No changes were made to the regulation in response to these comments. The "weight class bin" definition contains a sub-definition of "light-duty". Including this definition is simply meant to help fleets determine what is, and what is not, a light-duty vehicle.

Light-duty vehicles have no reporting requirements and vehicle home bases with only light-duty vehicles do not need to be reported.

Large Entity Reporting – Clarify How to Calculate Mileage Bins

Comment: Commenter in reference to Section 2012.2(b)(2)(A) through (E) asks to clarify whether responses in (B) through (E) are additive to (A) and so on down the list. [RP1-215]

Comment: Commenter states Section 2012.2(b)(3)(A) through (E) needs clarification if the responses to (B), (C), (D), etc. are additive with the percentages from (A) or should be listed separately for each category [RP1-238]

Agency Response: No changes were made to the regulation in response to these comments. As clearly described in Sections 2012.2(b)(2)(A) through (E), the percentage responses should add up to 100% and each individual vehicle should only be reported in one bin.

Large Entity Reporting – Clarify Meaning of "Vehicle Group"

Comment: Commenter in reference to section 2012 states that CARB should define "vehicle group" as the "vehicle's body type", "weight class bin, and "fuel type" [RP1-145]

Agency Response: No changes were made to the regulation in response to this comment. The regulation states that vehicle responses must be grouped by vehicle body type, weight class bin, and fuel type. The regulation then asks for information by vehicle group. The vehicle group refers to vehicles with the same vehicle body type, weight class bin, and fuel type.

Large Entity Reporting – Clarify Meaning of "Common Ownership and Control"

Comment: Commenter states that in Section 2012(d)(3) there needs to be clarification on the meaning of the term "common ownership or control" and how it applies to the various entities the rule applies to. [RP1-238]

Agency Response: No changes were made to the regulation in response to this comment. The term "common ownership or control" aligns with the same definition in the Truck & Bus regulation and the In-Use Off-Road Diesel Fueled-Fleets regulation. Vehicles under "common ownership and control" means they are owned by the same person, corporation, partnership, or association. In addition, vehicles managed day to day by the same directors, officers, or managers, or by corporations controlled by the same majority stockholders are considered to be under common control even if their title is held by different business entities. This includes vehicles that are rented or leased from a business that regularly engages in the trade or business of leasing or renting motor vehicles without drivers where the vehicle rental or leasing agreement for the use of a vehicle is for a period of one or more years. This term applies to regulated entities subject to the reporting requirements as specified in sections 2012.1 and 2012.2.

Large Entity Reporting – Clarify Meaning of "Represent Your Brand"

Comment: Commenter states CARB should clarify what is meant by "represent your brand" and "to serve your customers?" Does this mean the truck must have a company's logo on it, or that contractors are delivering product in containers with a company's logo? [RP1-215]

Comment: Commenter states Section 2012.1(a)(15) is unclear. Commenter requests clarification of what it means to "represent your brand" and "serve your customers." Does this mean the truck or its container must have a logo on it? Does the contract have to specify a vehicle over 8,500 lbs. in order to trigger this section? [RP1-238]

Agency Response: No changes were made to the regulation in response to this comment. As described in the Staff Report, the intent of this section is to determine whether regulated entities use subcontractors or subhaulers that use vehicles over 8,500 lbs. GVWR in their typical business, the number of trucks that subhaulers use, and whether subhaulers are operating under the regulated entity's authority. This information will help answer questions about whether an entity uses its own trucks or relies on other entities to conduct their business. Establishing a level playing field for future rule development is our primary concern.

Large Entity Reporting – Clarify Meaning of "Dispatched"

Comment: Commenter states entities that deliver cargo from material suppliers should be excluded from the "dispatched" definition to be consistent with guidance for the Truck and Bus Regulation "How to verify if hired fleets comply." [RP1-145]

Comment: Commenter would like to know if materials delivered by a third-party are considered "dispatched" by the entity, such as pick-up and transport of recycling? [RP1-215]

Agency Response: No changes were made to the regulation in response to these comments. As written, the regulation's definition of "dispatched" does not include ordering items or materials where the purchaser is not involved in determining how the delivery is made. For example, if a purchaser orders material from a supplier, then the supplier ships the order, the purchaser did not dispatch the shipment. The intent of the definition "dispatch" is to identify entities, including third-parties such as brokers or subcontractors, that provide direction or instruction for the routing of a vehicle to a specified destination for a specific purpose, including the pick-up and transport of materials for recycling.

Large Entity Reporting – Clarify Meaning of "Operated"

Comment: Commenter states that "operated" should mean that the entity, fleet owner, broker, or agency operated vehicles at a California facility whether or not it was owned or leased by the entity, fleet owner, broker, or agency. [RP1-145]

Agency Response: No changes were made to the regulation in response to this comment. The term "operated" correlates to the one of the preceding terms "common ownership or control" or "dispatched" as it relates to the Large Entity Reporting Requirements. Please see the definitions of "common ownership or controlled" and "dispatched" for further clarification.

Large Entity Reporting – Define "Fleet" Same as Truck and Bus Regulation

Comment: Commenter states the "fleet" definition should be the same as the definition used in the Truck and Bus Regulation, Title 13, California Code of Regulations, Section 2025(d)(29). [RP1-215]

Agency Response: No changes were made to the regulation in response to this comment. The definition of "fleet" in the Truck and Bus Regulation includes definitions of "federal fleet" and "rented or leased fleets" which are unnecessary for this regulation. In addition, the definition in the Truck and Bus Regulation does not mention "common ownership or control" which is necessary for the Large Entity Reporting. For these reasons, the definition within the Truck and Bus Regulation was not used.

Large Entity Reporting – Enforcement Policy Concerns

Comment: Commenter requests that CARB clarify in the rule or final Staff Report what enforcement standards it will use to determine violations. [RP1-215]

Comment: Commenter states Section 2012(e)(4) should specify how CARB will enforce penalties and what exactly would cause a penalty to occur when the reporting is based off of best estimates. [RP1-238]

Comment: Commenter states CARB should reconsider strict, prescriptive timelines for enforcement of reporting entities because the short time frame [to respond to a CARB request for clarification] can be problematic and that good faith efforts should guide enforcement and potential violations. [RP1-216]

Comment: Commenter states that a 14-day period to respond to CARB requests for clarification is not sufficient, as it takes time to route CARB requests to proper staff, and time to gather the information requested. More time should be provided. [RP1-215]

Agency Response: No changes were made to the regulation in response to these comments. Staff added language to the originally proposed regulation stating that regulated entities have 14 days to respond to a request by CARB for clarification of reported information. This helps ensure that if reported data is unclear, there is a pathway for remediation without enforcement action. For more detail on this topic please refer to chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Large Entity Reporting – Enforcement Concerns”.

Large Entity Reporting – Specifically Exclude Light-Duty in Home Base Scope

Comment: Commenter states the language in Section 2012.2(a) is inconsistent with Section 2012.2 and 2012.2(b) and recommends reporting for vehicle home bases with at least one vehicle above 8,500 lbs. [RP1-172]

Agency Response: No changes were made to the regulation in response to this comment. Section 2012.2 states that vehicles with a GVWR greater than 8,500 lbs. must report general information about the vehicle home base and the vehicle operating characteristics as specified in Section 2012.2(a) and 2012.2(b), respectively. The purpose of the ACT regulation is to accelerate the adoption of zero-emission technologies in the medium- and heavy-duty vehicle sectors, which are vehicles over 8,500 lbs. GVWR. For this reason, it was unnecessary to add the 8,500 lbs. GVWR threshold to Section 2012.2(a).

Large Entity Reporting – Allow Optional Vehicle Usage Metrics

Comment: Commenter states that in order to capture the unique operation of high usage vehicles that are not represented solely using mileage, CARB should include an optional measurement of usage category for each bin (e.g. hours/day or a percentage of time the equipment is used.) [RP1-288]

Agency Response: No changes were made to the regulation in response to this comment. The ACT Regulation balances the need to collect important and critical fleet information with Board direction to streamline the reporting and reduce burden on affected entities. Staff intends to allow fleets to submit voluntary information as part of their reporting. Additionally, staff intends to request and accept additional information from fleets as part of a future zero-emission fleet rule.

Large Entity Reporting – Add Reporting of Auxiliary Equipment Utilization

Comment: Commenter recommends including the percentage of vehicles in each weight bin that utilize auxiliary equipment (> 50 bhp), and the power requirements for the auxiliary equipment as responsive categories for the large entity reporting requirement. [RP1-288]

Agency Response: No changes were made to the regulation in response to this comment. The information commenter is asking for would provide information about power take off units and vehicles that rely on that auxiliary equipment. The goal of the regulation is designed to enable a large-scale transition to zero-emission technologies in the medium- and heavy-duty truck market. Electric power take-off technologies are already fully commercialized, so gathering information about them is not necessary. Additionally, the Board directed staff to streamline the reporting requirement. Adding more questions that would not significantly help drive the zero-emission transition is contrary to Board direction. Respondents may add clarifying or contextual information to their reports if they so choose, which is directionally consistent with the commenter’s request.

Large Entity Reporting – Modify Questions on Emergency Usage

Comment: Commenter states that the definition of emergency should not be limited to "infrequent acts of nature," and should include imminent threats to public health and safety.

Commenter recommends asking facilities whether a majority of a fleet vehicle group is generally subject to emergency usage, making sure to define what is considered as “majority” (e.g., more than 75%), rather than the current emergency usage question. [RP1-172]

Agency Response: No changes were made to the regulation in response to this comment. The regulation states: “The highest approximate percent of the fleet vehicle group that was dispatched at the same time over the last 3 years on the behalf of a local, state or federal government to support an emergency operation such as repairing or preventing damage to roads, buildings, terrain, and infrastructure as a result of an earthquake, flood, storm, fire, terrorism, or other infrequent acts of nature”; that statement includes but is not limited to the types of listed emergencies. This list is not exhaustive and can include other threats to public health and safety which can reasonably be categorized as emergencies.

The purpose of this reporting requirement is to determine the relative portion of vehicles who have been actively involved in responding to emergency situations. During emergency scenarios, a portion of the fleet will need to respond to the emergency while a separate portion will need to remain at the home base to service the local territory. This reporting information is designed to better understand how fleets use their vehicles during emergencies to determine which can and cannot be electrified.

Large Entity Reporting – Inconsistent Definition of Backup Vehicle

Comment: Commenter states that the definition of back-up vehicle in the ACT regulation is not consistent with the definition in the Truck and Bus regulation or Solid Waste Collection Vehicle regulation. [RP1-145]

Agency Response: No changes were made to the regulation in response to this comment. Different regulations use different definitions of “backup vehicle”. The definition of “backup vehicle” for this regulation was intentionally broad, and was meant to capture vehicles not commonly used in daily operations across all of California’s trucking sectors.

Furthermore, the definition of “backup vehicle” was removed in the 2019 amendments to the Solid Waste Collection Vehicle regulation and can no longer be cited as a relevant definition.

Large Entity Reporting – Determining Representative Vehicle Mileage

Comment: Commenter asks in Section 2012.2(b)(2) how an entity would determine if the data is representing 90 percent of a vehicles operating day. [RP1-238]

Agency Response: No changes were made to the regulation in response to this comment. As written, the regulation provides flexibility in how the reporting entity can determine the 90 percent threshold for their own vehicles. The regulation language was expanded to include addition guidance on how to select a timeframe based on the information available to the fleet owner. In addition, language was added on how to interpret existing data to complete the reporting. The language clarifies that a fleet may collect information from a sample of their vehicles to complete their responses and decrease the administrative burden.

Large Entity Reporting – Expand “Responsible Official” Definition for Public Agencies

Comment: Commenter states there needs to be an expanded definition of "Responsible Official" in Section 2012(d)(16)(C). Commenter recommends “For a municipality, state, federal, or other governmental agency: Either a principal executive officer or ranking elected official or their delegate, designee, or any other person who performs similar policy or decision-making functions for the agency.” [RP1-230]

Comment: Commenter suggests added flexibility in definition for “Responsible Official” in section 2012 (d)(16)(C), requesting that the flexibility currently extended to corporations and partnerships be extended to public agencies. The ACT regulation should allow for principal executive officer's delegate/designee to report and retain records. [RP1-288]

Agency Response: No changes were made to the regulation in response to these comments. As described in Section 2012(e)(3) of the ACT regulation, the term “responsible official” is only used to specify who the record retention provisions apply to. Thus, the current definition is appropriate for its usage.

Large Entity Reporting – Develop Two Reporting Systems

Comment: Commenter would like to know if the online reporting system will allow for both a main response method and an alternative response method. Commenter recommends that CARB work with users to beta test the system well in advance of the April 1, 2021 deadline, allowing enough time to fix any bugs or flaws. [RP1-215]

Comment: Commenter states that the needed reporting system should allow a main response method and an alternative response method, both of which are built in a time frame to allow user testing. [RP1-238]

Agency Response: No changes were made to the regulation in response to these comments. Staff intends to develop a reporting template based on an Excel spreadsheet-based reporting system which is anticipated to be quick and easy to complete. Staff anticipates releasing the reporting template and the upload site by the end of 2020. Due to this, there is no need to develop two separate reporting systems for the Large Entity Reporting.

Large Entity Reporting – Separately Report Renewable Diesel Infrastructure

Comment: Commenter states that renewable diesel should be included as an option for fuel types dispensed at a facility in the reporting requirement. [RP1-07]

Comment: Commenter states they support adding "renewable diesel" as a selectable fuel type to the revised section 2012.2. [RP1-232]

Agency Response: No changes were made to the regulation in response to these comments. Because renewable diesel is chemically similar to fossil diesel, it can function as a “drop-in” replacement fuel. This means that there is no difference between renewable diesel infrastructure and conventional diesel infrastructure.

Large Entity Reporting – Clarification on Why Brokers Need to Report Directed Vehicles

Comment: Commenter states Section 2012(e)(1) needs clarification as to why brokerages or entities with motor carrier authority must report vehicles if they do not own them. [RP1-238]

Agency Response: No changes were made to the regulation in response to this comment. A goal identified for future fleet rules is to ensure a level playing field between different companies. For example, this includes ensuring that a fleet with 100 trucks has similar requirements to a broker directing 100 trucks as they can compete for the same job. Information on the size and operation of brokers is necessary to inform future decision making in zero-emission fleet rules. Gathering information on the vehicles they direct is needed to determine whether the vehicles they direct can be electrified.

Large Entity Reporting – Use "Four-Wheel Drive" instead of "All-Wheel Drive"

Comment: Commenter in reference to section 2012 states that "all-wheel drive" vehicles should include "four-wheel drive" vehicles. [RP1-145]

Agency Response: No changes were made to the regulation in response to this comment. Four-wheel drive and all-wheel drive are different technologies and are not interchangeable. Staff choose to use the term "all-wheel drive" to specifically describe vehicles where power is delivered to all wheels as this is a good indicator for off-road operation and other activities which may pose a challenge to electrification. In the heavy-duty world, four-wheel drive could refer to a wide variety of vehicles and gives insufficient clarity to determine how the vehicle is being used. For these reasons, "all-wheel drive" is preferred.

Large Entity Reporting – Add Additional Questions for Fueling Stations

Comment: Commenter states that additional information should be reported for natural gas, hydrogen, and electric fueling stations. [RP1-145]

Agency Response: No changes were made to the regulation in response to this comment. At the December Board Hearing, the Board gave broad direction to streamline the reporting requirement where feasible. These additional reporting requirements would offer minimal information while increasing the reporting burden. Thus, the value added does not support this additional burden.

Large Entity Reporting – Request More Detailed Information than Average Daily Miles

Comment: Commenter states that fleet survey questions should attempt to better understand and collect data on fleet services and the communities they serve to ensure an accurate understanding of the all-electric range (AER) potential of PHEV trucks [RP1-64]

Comment: Commenter suggests instead of asking for the daily average miles for each vehicle body type, it may be beneficial for CARB to take into consideration the maximum hourly usage, the maximum fuel range within the fleet, and a description of common tasks being performed.   This data shows how long a vehicle is operating within a fuel range that is capable of efficiently handling the facility's day-to-day operations. [RP1-172]

Comment: Commenter states average miles per day may be a poor indicator of whether or not a vehicle is suitable for electrification, as it does not describe the upper range of miles at which a vehicle operates. Average daily miles also do not capture information regarding vehicles who travel short distances but idle at job sites, such as aerial bucket trucks. Other metrics would be appropriate for these scenarios. [RP1-215]

Comment: Commenter requests the reporting requirement include the percent of the total vehicles that have devices that run off of the engine to power equipment (e.g., PTOs) and average hours of vehicle operation per day (may be broken into 8-hour shifts) to better characterize commenter's vehicle usage. [RP1-230]

Agency Response: No changes were made to the regulation in response to these comments. While staff recognizes that daily average miles presents some issues in representing vehicle usage, requiring more detailed data would significantly increase the reporting burden on fleets. Given Board direction to streamline reporting, staff chose to maintain the current requirements for vehicle operations reporting.

Large Entity Reporting – Use TRUCRS to Export Existing Fleet Data

Comment: Commenter states the TRUCRS should allow the export of data to satisfy the reporting requirement for the body type, weight bin and fuel types. Furthermore, the commenter states that TRUCRS should be modified to allow manual data entry and large fleet importing for Class 2b-3 trucks and larger vehicles of multiple fuel types not currently available in TRUCRS (e.g., CNG/LNG). [RP1-145]

Agency Response: No changes were made to the regulation in response to this comment. Please see the discussion about the use of TRUCRS and the development of a new reporting system for the collection of information in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Large Entity Reporting – Use TRUCRS System for Reporting”.

Large Entity Reporting – Data Security Standard

Comment: Commenter states if the survey is completed online, how can CARB assure that confidential information will be protected? [RP1-210]

Agency Response: No changes were made to the regulation in response to this comment. CARB will follow Federal and State guidelines to secure confidential and personally identifiable information. For further details on this subject, please refer to chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Large Entity Reporting – Confidentiality, Proprietary Info, Security, and Public Record Act Requests”.

Large Entity Reporting – Allow Voluntary Submission of Real-World Data

Comment: Commenter suggests the regulation include a voluntary method to collect real-world data from fleets. [RP1-64]

Agency Response: No changes were made to the regulation in response to this comment. Staff intends to allow fleets to submit voluntary information as part of their reporting. However, submitting real-world vehicle data will require significant additions to the reporting system. Staff will evaluate if and how to voluntarily collect real-world data as part of the implantation process for this regulation.

Large Entity Reporting – Limit Scope to Facilities with Infrastructure or Tractors

Comment: Commenter suggests changing the language to identify facilities with fueling infrastructure and/or tractors instead of capturing all facilities with all the submitted information to decrease workload and provide relevant data. [RP1-172]

Agency Response: No changes were made to the regulation in response to this comment. Limiting the scope to only facilities with fueling infrastructure or to only those facilities with tractors would leave out information about many other vehicle categories that are well suited for electrification, and would undermine the Board's direction to achieve zero-emission goals in those categories. The Board directed staff to streamline the reporting requirement, but also to ensure needed data are collected. The Board also directed staff to bring a fleet rule to the Board in 2021, as stated in the Resolution. In order to craft a well-informed fleet rule that seeks to achieve the zero-emission goals adopted by the Board in the resolution and other statewide goals, including achieving carbon neutrality by 2045, staff will need data on where trucks are located, regardless of where fueling infrastructure currently exists, and how those vehicles are used across the entire medium- and heavy-duty vehicle spectrum.

Large Entity Reporting - Implementation Guidance and Standards

Comment: Commenter states that CARB should develop standards describing the level of data accuracy required, and provide entities with clear and transparent guidance on how compliance will be determined, as well as priorities for enforcement. [RP1-215]

Agency Response: No changes were made to the regulation in response to this comment. The regulation contains guidance that gives regulated entities direction on how to complete their reporting requirement to the level of data accuracy that is required. Staff has additionally added language to the regulation in the 30-day changes specifying the process that staff will be able to contact regulated entities to clarify reported data if discrepancies appear to exist. These modifications create a balance between allowing fleets to use data that is simple to correct and allowing CARB the ability to validate data received. For further discussion on enforcement policy for the regulation, see chapter "Written Comments Received During the 30-Day Comment Period", section "Large Entity Reporting – Enforcement Policy Concerns".

Future ZEV Policy – Accelerate Zero-Emission Fleet Rules

Comment: Commenter states that ARB should accelerate the fleet rule to begin no later than the ACT regulation sales requirement in 2024. [RP1-46, RP1-188]

Comment: Commenter urges an earlier adoption of the fleet purchase requirement. [RP1-120]

Comment: Commenter supports strong resolution language linking the ACT regulation to the ACT fleet regulation. Commenter states the fleet rule should support the ACT regulation by creating demand for the truck segments that are market ready, like Class 4-6 and Class2b3 vans. [RP1-241]

Comment: Commenter recommends developing and adopting fleet purchase requirements that mirror the sales targets in the proposed ACT regulations built around the beachhead strategy and applications. Commenter states for other M-HDV classes, CARB is developing fleet rules before the OEM rule, and other rules already adopted (Innovative Clean Transit, Airport Shuttles) took many years to develop, even though they only applied to a very small sector of the MHDV market. Commenter sees a risk of the fleet mandate timeframes lagging the OEM timeframes, which could substantially undermine the successful rollout of the trucks and the regulation. [RP1-265]

Comment: Commenter states development of complementary regulations, including a strategic link of a fleet rule to ACT, is imperative. [RP1-281]

Comment: Commenter recommends CARB expeditiously pursue standards for truck fleet electrification, similar to policies passed for transit buses and airport shuttle buses. [RP1-294]

Comment: Commenter urges accelerating the development of the CARB fleet rule for adoption in late 2021, but ensuring that the rule is implemented no later than 2024. Commenter urges CARB to require that the upcoming CARB fleet rule is stringent enough to reach Governor Jerry Brown's carbon-neutrality by 2045 goal established in Executive Order B-55-18. [RP1-297]

Comment: Commenter recommends accelerating the development of the fleet rule for adoption in late 2021, but ensuring that it is implemented no later than 2024. [RP1-330]

Agency Response: No changes were made to the regulation in response to these comments. The Board directed staff to return with a ZE fleet rule in 2021 when they approved the Resolution, which directionally meets commenters' requests. Staff recognizes that ZE fleet rules will be a key factor in ensuring fleet uptake of ZEVs to meet the targets established in the Resolution. Staff has begun the regulatory process for developing the ZE fleet rules with a goal of returning to the Board with a recommendation by the end of 2021.

Future ZEV Policy – Commit to 100 Percent Zero-Emission Targets

Comment: Commenter states that the rule should articulate a clear vision for when each truck segment should be 100% zero-emission and explain how those targets are consistent with the state's climate and clean air objectives. [RP1-46]

Comment: Commenter states that CARB should formally commit to transition ZEV timelines and that giving tax credits to fleet purchasers will support this effort. [RP1-125]

Comment: Commenter states CARB should formalize goals for 100 percent ZEVs in each truck class and demonstrate how reaching these goals is consistent with attaining state and federal air quality and GHG requirements. [RP1-188]

Comment: Commenter states CARB should electrify all modes of transportation. [RP1-260-Form-2507]

Comment: Commenter states after the ACT regulation, we need to electrify all tractors. [RP1-260-Form-3838]

Comment: Commenter urges requiring a 100% ZEV fleet of local buses, refuse trucks, and first/last mile delivery trucks by 2030, instead of 2040. [RP1-287]

Comment: Commenter recommends CARB formally commit to timelines for transitioning trucks in California to electric technologies, so that most, if not all, trucks in the state will be electric within the next 20 years. [RP1-294]

Comment: Commenter urges CARB to institutionalize targets on reaching zero-emissions: ZE drayage fleet by 2035 or sooner; ZE first/last mile delivery, refuse and local buses by 2040; ZE/plug-in hybrid for utility and government fleet by 2040; ZE/plug-in hybrid for all other truck segments, 'where feasible' by 2045 [RP1-297, RP1-330]

Comment: Commenter urges CARB to clearly articulate when our communities can expect all truck sales must be 100% zero-emission. [RP1-297, RP1-330]

Agency Response: No changes were made to the regulation in response to these comments. Although this is outside the scope of this regulation, the Board has committed through the Resolution to develop complementary zero-emission fleet rules with an ultimate goal of transitioning the state's fleet to zero-emission by 2045 where feasible. Achieving this goal and converting the state's fleet to the cleanest possible technologies will put us on a pathway to achieve our state's 2045 carbon neutrality goal. The ACT regulation takes the first step in ensuring manufacturers are building the needed ZEVs at high volumes to eventually achieve 100% ZEV fleets. Please see the discussion on establishing 100 percent zero-emission targets in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Future ZEV Policy – Set Clear 100 Percent ZEV Targets". Also, see the discussion about staff's efforts to develop a future fleet rule in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Future ZEV Policy – Adopt Zero-Emission Fleet Rule in 2021".

Future ZEV Policy – Exempt Rural and Low Throughput Ports

Comment: Commenter states that the revised ACT should exempt rural areas and low through-put ports because it is cost prohibitive and emissions are low. [RP1-169]

Agency Response: No changes were made to the regulation in response to this comment. The ACT regulation does not place any ZEV purchase requirements on fleets or ports. The Board directed staff to set a goal to electrify the state's drayage fleet by 2035, as discussed in the Resolution, and staff will be evaluating strategies to achieve this target. In doing so, staff will consider special provisions for rural areas and low throughput ports if necessary.

Future ZEV Policy – Rule Puts Small Businesses at a Disadvantage

Comment: Commenter states that stricter timelines for ZEV compliance will put smaller transportation companies out of business and urges the Board to reconsider aggressive timelines. [RP1-05]

Comment: Commenter states that small businesses are at a financial disadvantage and suggests subsidies for replacements. [RP1-15]

Comment: Commenter states we need to subsidize small trucking businesses. [RP1-179]

Agency Response: No changes were made to the regulation in response to these comments. The ACT regulation does not require smaller fleets to purchase ZEVs. Manufacturers must build ZEVs and market their products to fleets where electrification makes sense. This may prove advantageous to small fleets as ZEVs are projected to have a lower total cost of ownership that their combustion-powered counterparts. Staff will evaluate how to address small fleets in the future ZE fleet rule.

Future ZEV Policy - Add Targets for Light Duty Vehicles

Comment: Commenter states that targets should include trucks in the Class 1-3 range [RP1-77]

Agency Response: No changes were made to the regulation in response to this comment. The ACT regulation is designed to regulate all vehicles not included in the light-duty ZEV regulation. Including light-duty vehicles is outside the scope of this regulation. In addition, CARB is currently developing the Advanced Clean Cars II regulation which will set future regulatory goals for the light-duty ZEV market. Therefore, light-duty ZEVs will be addressed, but not in the ACT regulation.

Future ZEV Policy – Develop a Zero-Emission Fleet Rule that Achieves Carbon Neutrality

Comment: Commenter requests that CARB requires the fleet rule to be stringent enough to reach carbon-neutrality by 2045. [RP1-330]

Agency Response: The Board has committed through the Resolution to develop complementary zero-emission fleet rules with an ultimate goal of transitioning the state's fleet to zero-emission by 2045 where feasible. Achieving this goal and converting the state's fleet to the cleanest possible technologies will put us on a pathway to achieve our state's 2045 carbon neutrality goal. The ACT regulation takes the first step in ensuring manufacturers are building the needed ZEVs at high volumes.

Future ZEV Policy – Evaluate Zero-Emission Zones

Comment: Commenter states that well-located urban ZEV zones could help to increase market penetration of ZEVs in California and could align closely with needed fleet rules. Beachhead applications ready for zero-emissions technology are highly aligned with suburban and urban region duty cycles. Targeting zero-emission zones for urban California regions would have the benefit of spurring adoption and use of vehicles most conducive to electrification where unhealthy air quality persists. [RP1-265]

Agency Response: No changes were made to the regulation in response to this comment. Although this comment is outside the scope of this Rulemaking, staff recognizes the potential of zero-emission zones in driving ZEV adoption in fleets and will evaluate them as a part of the upcoming zero-emission fleet rules.

Future ZEV Policy – Allow Early Action Credit in the ZE Fleet Rules

Comment: Commenter suggests that early credits for compliance be allowed in any future complimentary fleet ZEV program. [RP1-208]

Agency Response: No changes were made to the regulation in response to this comment. Although this comment is outside the scope of this rulemaking, staff recognizes the value of early ZEV adoption by fleets and will look to encourage this in the future ZE fleet rules.

Future ZEV Policy – Award Fleets Credit for Using Low Carbon Fuels

Comment: Commenter states that many government fleets have already made significant investments in CARB's past alternative fuels programs and allowing Low Carbon Fuel Standard (LCFS) to be counted as offsetting emissions would take into account these previous investments. [RP1-44]

Comment: Commenter states that the rulemaking should facilitate the use of biodiesel and renewable diesel in those heavy-duty vehicle applications where the transition to electrification is not yet feasible. [RP1-85]

Comment: Commenter requests CARB to allow fleets using Low Carbon Fuel Standard fuels to be counted as offsetting emissions in future fleet rules. [RP1-181, RP1-255]

Comment: Commenter believes that, in their fleet of HD solid waste vehicles, a combination of near-zero NOx engines and renewable natural gas deserves recognition and credit within the proposed ACT regulation. Commenter points to their purchase of an anaerobic digester to produce their own renewable natural gas for use in their solid waste vehicles, citing SB 1383 and a $3M grant from CEC to expand their digester's capacity. Commenter requests this RNG option be available for entities in direct control of solid waste or waste water treatment with obligations under SB 1383. Commenter provides City of Roseville's Waste-to-RNG Facility pamphlet to support their point [RP1-312]

Agency Response: No changes were made to the regulation in response to these comments. ACT requires manufacturers to build ZEVs but does not require fleets to purchase ZEVs. As a result, it would be inappropriate to award fleets credit under this regulation. Additionally, emissions associated with new combustion-powered vehicles and engines are being addressed by other CARB programs including the approved Low NOx Omnibus regulation, which requires manufacturers to build engines that meet the Low NOx standards, and the existing Low Carbon Fuel Standard regulation. The LCFS regulation is already reducing lifecycle emissions from transportation fuels and the benefits resulting from that regulation cannot be claimed again as suggested by several commenters. The commenter's suggestions to include low NOx engines and low carbon fuels would only duplicate what is already expected from the LCFS and the low NOx Omnibus regulation and would not result in any new emission benefits for NOx nor GHG emissions beginning in 2024, as discussed further in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Credit for Low NOx Engines and Renewable Fuels".

Future ZEV Policy - Waste Stream Conversion

Comment: Commenter suggests allowing conversions of waste streams, such as biomethane, for use in their fleets as compliance pathways for entities with control over solid waste or wastewater treatment with obligations under the SLCP strategy. [RP1-202]

Agency Response: The approved regulation is a requirement for manufacturers to sell ZEVs into California and does not require any individual fleet to make ZEV purchases. This comment is outside the scope of the approved regulation. The comments pertain to fleet owners. Staff recommends the commenter participate in the public process for developing the Advanced Clean Fleets regulation to have their concerns addressed.

Emissions Methodology – Focus Needs to Be on VOC Reductions, Not NOx Reductions

Comment: Commenter states that the proposed ACT regulation will further delay California's ozone attainment by generating an even more imbalanced atmospheric NOx reduction largely due to California environmental policy shifting focus from reducing VOCs to reducing NOx. Commenter states that before adopting the proposed ACT regulation, the Board should re-examine why ozone violations increased in Southern California during the recession years (2009-2014), which reduced fuel sales by 2-4 billion gallons per year – the equivalent of replacing 5.7-10.5 million ICE vehicles with ZEVs statewide. Commenter provided supporting documentation, articles, and references to support their comment. [RP1-86]

Agency Response: No changes were made to the regulation in response to this comment.

Ozone is formed through a complicated series of chemical reactions involving NOx and VOCs in the presence of sunlight. Depending on the relative levels of NOx and VOCs in the atmosphere, ozone can be more or less sensitive to changes in NOx and/or VOC emissions. Under certain conditions, where NOx emissions are high relative to VOC emissions, NOx can suppress ozone formation and reducing NOx can lead to higher ozone. This phenomenon can be observed in the “weekend effect” where ozone levels are enhanced on weekends owing to reduced heavy-duty truck activity and lower NOx emissions. With continued NOx reductions, the weekend effect becomes weaker and eventually becomes a reverse weekend effect, where reduced heavy-duty truck activity results in lower ozone on the weekend. This shifting relationship in ozone sensitivity to NOx reductions has been observed in the South Coast over the last decade, where in the early 2010’s the majority of the basin exhibited a strong weekend effect. In contrast, the weekend effect is now much weaker everywhere in the basin and some parts of the basin have already begun exhibiting a reverse weekend effect, which points to the success of the NOx focused control strategy. During this “transition” period, where the basin is shifting from a weekend effect to a reverse weekend effect, ozone becomes relatively insensitive to NOx reductions until the NOx reductions are sufficiently large to fully shift the region into a chemical regime consistent with a reverse weekend effect.

VOC reductions can also have an effect on ozone levels, particularly when a strong weekend effect is present. However, natural emissions of VOCs from plant life represent an uncontrollable source of VOCs that can exceed anthropogenic sources during summer months, when ozone levels are at their highest. Consequently, even if anthropogenic emissions of VOCs were reduced to zero, there would still be sufficient VOCs in the atmosphere to form enough ozone to exceed the ozone NAAQS at current NOx levels. In addition, the non-linearity of ozone chemistry means that ozone formation becomes much less sensitive to changes in VOCs at the NOx levels needed to meet the ozone NAAQS. All of this points to the need for a strongly focused NOx strategy to attain the ozone NAAQS as expediently as possible.

VOC reductions in the near-term may offer some benefit, but in the long-term those same VOC reductions will have little to no effect on ozone levels as the basin nears attainment of the ozone NAAQS.

Emissions Methodology – ZEVs Produce No Benefits Versus Diesel and Natural Gas

Comment: Commenter states that CARB's analysis has errantly determined surplus ZEV criteria emission reductions versus diesel and gasoline. Commenter states that the “super-clean” diesel and natural gas vehicles sold today are far cleaner than CARB assumed in their emissions analysis. ZEVs would need to be compared against these “super-clean” vehicles to generate surplus benefits.

Commenter states that today’s laboratory testing methods do not account for the fact that air contains pollutants. When accounting for this fact, commenter claims that “super-clean” diesel and natural gas vehicles produce negative emissions of VOCs, carbon monoxide, and PM_{10}.

In addition, commenter states that only 2-4 percent of $PM_{2.5}$ emissions come from mobile sources and substantially more come from other sources. Commenter states that the ACT regulation will reduce PM emissions by 3-11 percent, while transitioning the fleet to “super-clean” diesel vehicles would reduce PM emissions by 38 percent. Commenter provided supporting documentation, articles, and references to support their comment. [RP1-86]

Agency Response: No changes were made to the regulation in response to this comment. This comment mischaracterizes the staff analysis and raises several related issues described below.

The emissions analysis for the ACT regulation compared the regulatory proposal versus a baseline consisting of all currently adopted regulations. Because the ACT regulation affects new vehicles sold in California, the emissions of new ZEVs were compared against the emissions of new combustion-powered vehicles including gasoline, diesel, and natural gas fueled vehicles. The baseline assumes all new combustion-powered vehicles meet the applicable engine standard for heavy-duty vehicles or LEV III standards for medium-duty vehicles. While these combustion-powered vehicles are significantly cleaner than older vehicles, they remain a sizable portion of the state’s criteria and GHG inventories and further emissions reductions from these sectors are necessary.

The ACT regulation’s emission inventory analysis quantified NOx, $PM_{2.5}$, and CO_2 emissions benefits. Staff did not quantify the emission benefits for VOCs, carbon monoxide, and PM_{10} as new medium- and heavy-duty vehicles are not significant emission sources for these criteria pollutants. Medium- and heavy-duty vehicles are significant sources of NOx and CO_2 emissions, neither of which were included in the commenter’s claims. The proposed ACT regulation will significantly reduce both NOx and GHG emissions, serving to fulfill one of its objectives which is critical to meeting the state’s climate change and air quality goals.

Emissions testing is performed in accordance with 40 CFR § 1066.605. This calculation methodology explicitly includes and corrects for background pollutants contained within the air that reaches the analyzers. Staff is unaware of any studies, analyses, or reports which support the commenter’s claim of negative emissions by diesel powered vehicles. Commenter’s claim implies that the areas with the highest truck traffic would have the lowest emissions while in reality the opposite is generally true.

The commenter appears to be suggesting that the ACT rulemaking is unnecessary since “super- clean” diesel and natural gas vehicles are already on the road. But the commenter ignores the fact that the ACT rulemaking seeks to further reduce the existing emissions from these engines through the acceleration of the transition to zero emission vehicles. The claim that focusing on “super-clean” diesel and natural gas vehicles will generate additional PM benefits is erroneous as the baseline already assumes all vehicles sold will meet today’s engine standards as stated previously. Additionally, diesel vehicles produce diesel particulate matter which is comprised of black carbon and numerous organic compounds including over 40 known cancer-causing organic substances. While mobile sources comprise a small portion of the state’s PM emissions, they represent a significant portion of the state’s diesel PM inventory. ZEVs produce no tailpipe PM emissions and reduce brake wear PM due to regenerative braking.

Based on these facts and rationale, staff finds the ACT regulation’s emissions inventory analysis was appropriate in quantifying the emissions benefits of ZEVs versus the gasoline and diesel fueled baseline scenario.

Emissions Methodology – Analysis Overestimates Emissions Benefits of ZEVs

Comment: Commenter states that the ACT regulation does not properly account for the fact that MHD ZEVs provide no criteria pollutant reduction benefits until the MHD ZEVs provide greater than 97 percent of the daily vehicle miles traveled (VMT) of the new diesel counterpart displaced. Commenter states that based on the 2014 EMFAC criteria emission displacement break-even estimate, the ACT, if adopted, should only provide ZEV credits for MHD ZEVs used in applications and vocations that the ZEV can demonstrate, for the vehicle’s useful life, daily equivalent VMT to the displaced MHD internal combustion vehicle. CARB should properly account for the super-clean diesel vehicles’ minimized emissions, air-cleaning capacity in ambient air violation areas, and their greater population and greater miles driven then perform a comparison with MHD ZEVs to determine if “surplus” emission reductions do indeed occur. Commenter provided supporting documentation, articles, and references to support their comment. [RP1-86]

Agency Response: No changes were made to the regulation in response to this comment. As stated in chapter “Written Comments Received during the 30-Day Comment Period”, section “Emissions Methodology – Focus Needs to Be on VOC Reductions, Not NOx Reductions”, staff disagrees with the commenter’s assertion that “super-clean” diesel vehicles produce negative emissions. ZEVs produce zero tailpipe emissions while diesel vehicles produce criteria emissions as they operate, emission control systems periodically fail and deterioration occurs over the life of the engine, so on a tank-to-wheel basis, ZEVs produce emission benefits for every mile that they operate. In addition, ZEVs produce fewer upstream GHG emissions as well.

Furthermore, staff disagrees with the commenter's assertion that ZEVs will travel fewer miles than the vehicle they are replacing. Because the ACT regulation does not require fleets to purchase ZEVs, fleets will choose to purchase ZEVs in applications where they can make a one-for-one replacement with a gasoline or diesel-powered vehicle. Thus, the VMT should be identical as compared to existing conditions. In addition, manufacturers are already offering ZE straight trucks with over 200 miles of range and ZE tractors with over 500 miles or range, indicating that ZEVs will be able to fit into a wide variety of ZE applications. This indicates that ZEVs will be capable of fitting into most applications given most trucks travel fewer than 100 miles per day and most tractors that operate in California travel less than 200 miles per day.

<u>Emissions Methodology – Comments on CARB's Calculation of Energy Efficiency Ratios</u>

<u>Comment:</u> Commenter states that CARB mischaracterized the energy economy ratio (EER) for medium- and heavy-duty vehicles as being 2-5 times higher efficiency than their diesel counterparts on a tank-to-wheel basis. The correct energy economy characterization is that medium- and heavy-duty vehicles ZEVs have five to fifty percent higher energy efficiency on a well-to-wheels basis. Commenter states that CARB staff footnoted but do not appear to have incorporated the battery charger and round-trip battery losses in their EER calculation, graphics, and analysis. Accounting for the 15 percent battery and charger losses that CARB staff cite in Appendix G lowers ZEVs' EER to 1.7 - 4.25 EER. Further, including power plants 45% efficiency and 6.5% power line losses lowers CARB Staff's estimated EER to 1.1-1.8 (WTW). Commenter provided supporting documentation, articles, and references to support their comment. [RP1-86]

<u>Agency Response:</u> No changes were made to the regulation in response to this comment. This comment represents a misunderstanding on well-to-wheels emissions and how energy economy ratios (EERs) are determined.

Well-to-wheel emissions are accounted for in regulations (e.g., the LCFS regulation) by measuring the carbon intensity (CI) of fuels based on a life cycle assessment, typically expressed in the unit of gCO_2e/MJ. This is done by accounting for the emissions associated with production, distribution, and use of a fuel. CARB uses the CA-GREET model to determine the CI of fuels used in California. For diesel, the CI consists of the emissions associated with extracting, transporting, refining, distributing and using diesel. For electricity, the CI consists of the emissions associated with generating, transmitting and distributing electricity. Included in the CI of electricity are the emissions associated with producing and transporting fuels to the generation unit, if applicable.

Some vehicle technologies are more efficient than their gasoline or diesel counterpart because they can perform more work when given the same amount of energy. This is accounted for in the EER which is the ratio of efficiencies between the alternative fuel-vehicle combination and the baseline fuel-vehicle combination. For example, Figure 3 in Appendix G to the Staff Report illustrates the fuel efficiency of a tractor trailer using diesel and electricity and calculates the EER between the two fuels on a variety of duty cycles. The EER solely represents the ratio of the amount of work performed (i.e., miles traveled) by the two different fuel-vehicle combinations for the same amount of energy (i.e., one diesel gallon equivalent) supplied to the vehicle in the fuel. Power plant efficiencies, transmission losses, and other similar factors are not in the scope for the EER determination as these factors are accounted for in the carbon intensity value of the electricity, just as crude oil extraction efficiencies and refining efficiencies are included in the carbon intensity of the diesel fuel. When properly calculated, the EER between diesel and electricity is shown in Figure 1 in Appendix G which displays the relationship between vehicle average speed and EER.

Lastly, even when accounting for upstream emissions associated with electricity production, BEVs have significantly lower well-to-wheel emissions. In the LCFS, the carbon intensity of ULSD (diesel) is 100.45 gCO_2/MJ, whereas the carbon intensity of California average grid electricity is 82.92 gCO_2e/MJ for the 2020 reporting year (LCFS 2020 Grid Electricity CI link). Roughly half of electricity generated within California came from zero-carbon sources including solar, wind, hydroelectricity, nuclear, and geothermal sources. Factoring in the EERs of the different fuel-vehicle combinations, the resulting EER-adjusted CI values are 100.45 gCO_2e/MJ for a Class 4-8 diesel-fueled vehicle versus 16.58 gCO_2e/MJ for a Class 4-8 battery-electric vehicle using California average grid electricity, representing an almost six-fold reduction in emissions on a per mile traveled basis. Further, using electricity from lower carbon sources (like solar, wind, etc.) for charging a battery-electric truck will significantly increase the emission benefits on a per mile traveled basis.

Emissions Methodology – Lacking Greenhouse Gas Benefits

Comment: Commenter states staff's analysis shows the regulation will not result in greenhouse gas (GHG) emissions reductions until 2028 and starts at 0.1 MMT/yr. Commenter states this is inconsistent with the goals staff has outlined for the regulation; other technologies, such as natural gas, could generate greater GHG emissions benefits. [RP1-228]

Agency Response: No changes were made to the regulation in response to this comment. This comment indicates that the commenter does not fully understand the emissions accounting methodology used in this rulemaking action.

US EPA and California have both adopted Phase 2 GHG regulations which require medium- and heavy-duty manufacturers to meet increasingly more stringent GHG emissions. The Phase 2 GHG regulation allows manufacturers to build ZEVs and use these vehicles to meet their overall GHG requirements. Because of this, CARB does not claim GHG benefits for the ACT regulation until the number of ZEVs required exceed the number of ZEVs needed for Phase 2 GHG compliance. Accordingly, CARB only claims GHG benefits under the ACT regulation after the ZEV sales percentage of medium- and heavy-duty vehicles exceeds 20%. This methodology avoids double-counting benefits between the ACT and Phase 2 GHG regulations, although it may be too conservative in a scenario where a manufacturer decides to build ZEVs for ACT and meet the Phase 2 GHG requirements with only their combustion-powered fleet.

In a scenario where CARB was requiring fleets to transition to renewable natural gas as the commenter is suggesting, CARB would be unable to claim any GHG benefits. The GHG benefit from switching from diesel to fossil natural gas would be accounted for in the Phase 2 GHG regulation, and all GHG benefits associated with using renewable natural gas over fossil natural gas would be accounted for in the LCFS regulation. Therefore, requiring fleets to transition to renewable natural gas would generate zero GHG emission benefits.

Emissions Methodology – Lack of Urgency for Air Quality Benefits

Comment: Commenter states that the cost benefit analysis and Table II-3 shows a lack of urgency related to air quality issues. Commenter asks what is CARB doing to address the air quality issues between now and when the ACT is implemented? [RP1-228]

Agency Response: No changes were made to the regulation in response to this comment. The ACT regulation requires manufacturers to start selling ZEVs beginning with the 2024 MY. In addition to its dozens of programs addressing air quality issues from multiple sources throughout the state, in the context of medium and heavy duty vehicle emissions, the Board recently approved the Low NOx Omnibus regulation which sets lower standards for manufacturers beginning in the 2024 model year with a further reduction of the standard in 2027 MY. Through these two regulations, CARB is reducing the emissions of new heavy-duty and medium-duty trucks as quickly as feasible by encouraging zero-emission where feasible, and the cleanest combustion possible everywhere else. However, because both of these regulations only address new sales, there is a limit to the level of potential emissions reductions as they cannot address vehicles sold prior to the rules' adoption. Generating further emission reductions will require fleet requirements to incorporate cleaner vehicles into fleets. Staff will work on this action in the upcoming ZE fleet rule.

Staff notes that because the ACT regulation is a manufacturer requirement, some lead time is necessary for the manufacturers to give manufacturers ample time to address any technological and supply hurdles required to achieve compliance with the new sales requirements. What this means is that setting requirements before 2024 would be overly burdensome because it wouldn't allow adequate time for manufacturers to meet the new ZEV sales requirements under the ACT regulation. Providing optional early action credits would not generate additional emission reductions as the commenter contends because there is neither a regulatory requirement to provide optional credits. Therefore, the ACT regulation is not designed to provide benefits until after the rule begins in 2024 regardless of the technologies included.

Requiring fleets to turnover their vehicles is outside the scope of this manufacturer-focused rulemaking.

<u>Emissions Methodology – Inconsistency in Emissions Accounting</u>

<u>Comment:</u> Commenter states CARB has not considered the quantities of NOx and $PM_{2.5}$ emission reductions claimed by the Low Carbon Fuel Standard program through 2030 and recommends that staff address this gap in its inventory baseline for the ACT regulation. [RP1-272]

<u>Agency Response:</u> No changes were made to the regulation in response to this comment. Attachment H to the Second 15-Day Modifications to the 2018 LCFS amendments state "An increase in electricity, hydrogen, natural gas, and propane use for transportation is also expected to take place. Increased use of these fuels is primarily dependent upon adoption rates for alternative-fueled vehicles, and therefore, despite the value created for these fuels by the LCFS, staff assigns the air quality benefits of these increases to the ZEV regulation and other vehicle incentive programs and not to the LCFS amendments." Based on this statement, there is no inconsistency between the methodology used in the 2018 LCFS amendments and the ACT rulemaking.

As outlined in Appendix G for the 2018 LCFS Amendments, emissions reductions from switching to vehicles powered by grid electricity or 33% renewable hydrogen are attributed to the regulation or incentive that caused the fuel switch. The LCFS regulation claims incremental credit for vehicles fueled using electricity cleaner than the grid or hydrogen that is more than 33% renewable.

<u>Emissions Methodology – Include Upstream Criteria Pollutants</u>

<u>Comment:</u> Commenter states that the ACT regulation's impact analysis excludes well-to-tank criteria emissions, and states that the rationale for this assumption should be added. [RP1-284]

<u>Agency Response:</u> No changes were made to the regulation in response to this comment. Staff provided an analysis in Chapter VI of the Staff Report of the estimated well-to-wheel GHG emission reductions versus the baseline scenario of GHG emission reductions without the ACT regulation in place. This included both an upstream and downstream emissions analysis.

For criteria emissions, the situation is different than for GHG, which resulted in a different methodology. First, NOx and $PM_{2.5}$ are regional pollutants. Upstream sources of NOx within California such as power plants are regulated separately as stationary sources, so including their emissions again would be double-counting. In addition, upstream emissions sources are not necessarily located where vehicles are operating. For example, electricity imported from outside of California will not have a criteria emissions impact for vehicles operating within California. Lastly, legislation such as SB350 and SB100 are transitioning the state's grid to renewable, zero-emission electricity. This transition will decrease upstream emissions. For these reasons, an upstream criteria emissions reduction is unnecessary and counterproductive to assessing the emissions benefits of the ACT regulation.

Emissions Methodology – Brake Wear and Tailpipe Particulate Matter Should Be Separated

Comment: Commenter states tailpipe emissions should be separated from brake wear. [RP1-247]

Agency Response: No changes were made to the regulation in response to this comment. Staff included the combined $PM_{2.5}$ emissions both from the tailpipe and from brake wear since both are criteria emissions, regardless of their source.

Emissions Methodology – Omnibus Interaction Upstream Emissions

Comment: Commenter states that the ACT regulation should require upstream emission accounting for GHG and criteria emissions from upstream electricity generation because without it, it poses a problem for the Averaging, Banking and Trading (ABT) program for the HD Low NOx Omnibus rulemaking. [RP1-205]

Agency Response: No changes were made in response this comment. See discussion on why staff did not perform upstream criteria emissions accounting in chapter "Written Comments Received during the 30-Day Comment Period", section "Emissions Methodology – Include Upstream Criteria Pollutants". Also, it is outside of the scope of this rulemaking to assess emissions impacts that may result from another rulemaking.

Out of Scope – Incentives and Funding Policy

Comment: Commenter would like to share his support for clean air vehicles and would like to ask for incentives for clean air vehicles for truck owners like individuals receive. [RP1-13-Form-3374]

Comment: Commenter asks if incentives could be provided to a manufacturer for engines that only have NOx emissions during engine start-up? [RP1-16]

Comment: Commenter requests CARB move forward with funding for infrastructure to support electric vehicle rollout. [RP1-66]

Comment: Commenter states there needs to be incentives for the purchase of electric trucks. [RP1-141, RP1-191, RP1-260-Form-2129, RP1-260-Form-4164]

Comment: Commenter states incentives should be available for people who want to switch, but they do not support the forced transition to ZEVs. [RP1-154]

Comment: Commenter states that the revised ACT regulation should not be enacted due to the current economy because there are insufficient funds for incentives. [RP1-169]

Comment: Commenter states their support for continued and increased investment in heavy-duty ZEVs and NZEVs which are essential for motor vehicle suppliers' research and development. Commenter states that the ACT regulation should provide incentives from state public procurement programs to support the development of ZEVs and NZEVs, as well as vehicle purchase premiums. [RP1-205]

Comment: Commenter states that stakeholders will not comply with the ACT regulation without incentives. [RP1-213-Form-814]

Comment: Commenter states that CARB should provide assistance for phasing out polluting vehicles. [RP1-213-Form-1100]

Comment: Commenter states that purchase incentives must be available until such time as HD ZEV actual in-use total costs of operation have reached parity with ICE-powered vehicles. [RP1-214]

Comment: Commenter states the increased cost to purchase and operate ZEVs need to be offset by government funded incentives until life-cycle costs of ZE trucks are lower than costs associated with traditional vehicles. [RP1-218]

Comment: Commenter states that the EV projects being implemented were only possible due to the availability of multiple local, state, and federal incentives. Commenter states that the current prices of Class 6-8 vehicles are 3-5 times higher than traditional vehicle costs and are not economically feasible without incentives. Commenter states that to become an economically self-sustaining marketplace will require significant grant funding to assist in the development, demonstration, and deployment of cost competitive technologies and charging models. [RP1-244]

Comment: Commenter states that the ACT regulation needs incentives for fleet owners in order to be successful. [RP1-249]

Comment: Commenter states that we need to seek funding from the state and federal government for the ACT regulation. [RP1-260-Form-3583]

Comment: Commenter states we need to include financial help for truck drivers in the rule. [RP1-260-Form-2197]

Comment: Commenter suggests creating an incentive ramp up to the rule for the capital and infrastructure costs. [RP1-265]

Comment: Commenter states incentives from CARB & CEC are necessary for ACT success. [RP1-281]

Comment: Commenter recommends ensuring incentive funding availability. [RP1-284]

Comment: Commenter states there needs to be incentives for manufacturers to produce ZEVs. [RP1-296]

Comment: Commenter states that the ACT regulation needs to expand the network of charging stations and fund this through increased fees on gas powered trucks. [RP1-114]

Agency Response: No changes were made to the regulation in response to these comments. See discussion about the availability of incentive programs in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Out of Scope – Incentive and Funding Policies".

Out of Scope – Pollution Tax

Comment: Commenter states that we should impose a pollution tax on polluting vehicles based on miles driven and the level of the pollutants emitted in order to give more people the incentive to switch to ZEVs. [RP1-260-Form-458]

Agency Response: No changes were made to the regulation in response to this comments. See discussion on the taxes in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Out of Scope – Carbon Tax"

Out of Scope – Require Zero-Emission Yard Equipment

Comment: Commenter states CARB should also make all yard maintenance equipment electric as well. [RP1-260-Form-1739]

Agency Response: This comment is outside the scope of this regulation. The ACT regulation focuses on on-road medium- and heavy-duty vehicles; therefore, off-road yard maintenance equipment is outside the scope of the regulation.

Out of Scope – Issues Regarding SCE Rule 18

Comment: Commenter states that staff's cost analysis does not acknowledge CPUC rules (known as Rule 18 in SCE), which excludes private enterprise from infrastructure/refueling by preventing resale of electricity. [RP1-106]

Agency Response: No changes were made to the regulation in response to this comment. The commenter's issue is outside of the scope of CARB's authority. In the past, the CPUC has modified their rules to allow the resale of electricity for light-duty EV charging. In September 2020, the CPUC approved a decision allowing resale of electricity for medium-duty, heavy-duty, and off-road applications making this comment null and void. Broadly, commentary on sister agency policy should be presented to the relevant agency rather than on a different regulatory item.

Out of Scope – Use Rail Instead of Trucks

Comment: Commenter states that we should transport everything by rail and not use trucks. [RP1-260-Form-4701]

Comment: Commenter states we should focus on the implementation of electric trains for people to commute to work and leave the truckers alone. [RP1-260-Form-3526]

Agency Response: This comment is outside the scope of this regulation. Trucks and trains are both components of California's freight system and serve different purposes. California is taking action to reduce the emissions of both trucks and trains.

Out of Scope – Ban Other Dirty Emission Sources

Comment: Commenter states that the ACT regulation needs to include: coal and oil mining reduced to nearly zero by 2029, zero petroleum use by 2030, all nuclear plants shut down by 2022, zero fracking by 2022, and zero synthetic chemical farming by 2023. [RP1-260-Form-2024]

Agency Response: This comment is outside the scope of this regulation. Staff appreciates the comment.

Out of Scope - Encourage Public Transit

Comment: Commenter states CARB should encourage the use of public transportation to reduce air pollution. [RP1-260-Form-1599]

Agency Response: This comment is outside the scope of this regulation. Staff appreciates the comment.

Other - Higher Transportation Cost

Comment: Commenter states they would like to know if the transition to ZEVs will result in a higher transportation cost. [RP1-260-Form-3718]

Comment: Commenter states CARB's efforts are trying to fix something that isn't broken. Commenter states all of the efforts from CARB to clean the air are causing the price of vehicle related items to increase. Commenter states that CARB is causing more financial hardships for truckers. [RP1-260-Form-2778]

Agency Response: No changes were made to the regulation in response to these comments. If commenter is referring to goods movement, staff modeled the costs and benefits of the required numbers of ZEVs in the SRIA, Staff Report, and Attachment C to the "Proposed Amendments to the Proposed ACT Regulation" document released for public comment in April 28, 2020. The regulation is anticipated to resulting in a net cost savings to California of $5.9 billion indicating a net savings to the state's trucking fleet and as a result, the California economy. In addition, because this is a manufacturer mandate, fleets do not have a requirement to purchase ZEVs and would only do so if it made financial sense for them.

Other - Add Lion Vehicles to HVIP

Comment: Commenter states that they would like Lion's zero-emission Class 4-8 trucks and Class 7-8 tractors to be added to CARB's Attachment B to the Modified Proposal as vehicles currently available. [RP1-140]

Agency Response: No changes were made to the regulation in response to this comment. Staff were not aware of Lion’s vehicles at the time the Modified Proposal was released, and will add them in market analysis used to support future rulemakings.

Other – No Market-Based Pollution Approach

Comment: Commenter states that California does not need market-based solutions to address pollution so that corporations can pay their way out of environmental responsibility. [RP1-316]

Agency Response: No changes were made to the regulation in response to this comment. The ACT regulation requires manufacturers to either produce and sell ZEVs and NZEVs, or purchase credits from another manufacturer. This structure ensures that regardless of the actions of any individual manufacturer, zero-emission vehicles will be sold into California. The regulation’s structure gives the needed amount of flexibility to manufacturers to produce battery-electric, hydrogen fuel cell, or plug-in hybrid technologies, but sets firm requirements that manufacturers sell cleaner technologies as there are no other compliance options available to them. In addition, manufacturers who do not meet its requirements cannot “pay-to-pollute” as described in chapter “Written Comments Received during the 30-Day Comment Period”, section “Manufacturer ZEV Sales – No Pay-to-Pollute Penalties”. Therefore, while the ACT regulation could be described as a “market-based regulation” since it allows credit trading, the safeguards embedded within the regulation ensure that there is no way to avoid its requirements or pay to avoid compliance.

Other – Comments Addressed in the Environmental Analysis

Comment: Commenter states disposal of dead batteries need to be addressed. [RP1-13-Form-1296]

Comment: Commenter states we cannot go forward with the ACT regulation until the problems with electric vehicles are addressed. Commenter states children are enslaved to dig up the minerals needed for ZEVs, the process to make the batteries are polluting toxins, how to dispose of the batteries, and asks where the additional power comes from. Commenter states the additional power needed for ZEVs cannot come from hydrogen power because it is too overtaxed, and it can’t be nuclear because it’s too dangerous and polluting. [RP1-260-Form-1812]

Agency Response: These comments are addressed in the “Final Environmental Analysis” document. See the Final Environmental Analysis prepared for the ACT regulation (Final EA link) presented and approved by the Board at the June 25, 2020 hearing.

Other – Comments Addressed in the Environmental Response

Comment: Commenter states that the State of CA has violated CEQA by not studying reductions in VMT, which is an alternative to emission reduction strategies. [RP1-28]

Comment: Commenter states that the manufacturing impacts of COVID-19 were not addressed in the Draft EA. In addition, commenter states the draft EA does not display evidence to support that SB 350 and its affected utilities can or will meet the fleet end users infrastructure needs and that “most or all of the costs” needed for a fleet end user to enable ZEV deployments will be satisfied through SB 350 funds. [RP1-145]

Comment: Commenter wants to know where the lithium batteries will be disposed and if CARB will be liable for the children mining the lithium. [RP1-260-Form-3526]

Agency Response: These comments are addressed in the “Environmental Response to Comments” document. See Response to Comments on Final Environmental Analysis prepared for the ACT regulation (Response to Comments link) presented and approved by the Board at the June 25, 2020 hearing.

Other – Additional Revisions May Be Needed to Achieve Carbon Neutrality

Comment: Commenter provided results from their Freight Action Climate Consistent model to compare the updated ZEV sales percentage schedule to the original proposal and also compares both scenarios against a "climate-consistent" scenario (which aligns with broader 2045 carbon-neutrality goals). The model indicates that the revised proposal will reduce emissions by 54% instead of 36% compared to 2019 levels, however, future revisions to the ACT regulation may be needed to meet carbon neutrality goals. In addition, the model indicates $11 billion in savings over the original proposal, a "climate consistent" ACT proposal would provide an additional $23 billion in savings. Finally, ICE truck populations are modeled which indicate the updated ACT standards show marked improvement, with all classes showing a significant decrease in gas and diesel truck populations. In contrast however, the climate-consistent scenario which necessitates 100% ZEV sales by 2030 across all truck classes would lead to further decreases. [RP1-148]

Agency Response: No changes were made to the regulation in response to this comment. Staff thanks commenter for including the analysis and will consider the information in future actions.

Other – Share Lessons Learned

Comment: Commenter recommends CARB share lessons learned with public agencies and fleets outside of California. [RP1-294]

Agency Response: No changes were made to the regulation in response to this comment. Staff has already made commitments (and will continue to do so) with other State agencies and companies to promote widespread transportation electrification including those outside of California.

Other – Miscellaneous/Outside the Scope Comments

Comment: Commenter states CARB is using COVID-19 to manipulate the ACT agenda. [RP1-260-Form-3526]

Comment: Commenter states the elected officials should take a stand against Amazon and transportation companies that have a history of alleged nefarious business practices in regards to air pollution. [RP1-317]

Comment: Commenter states that CARB should address wood burning in homes. [RP1-13-Form-992]

Comment: Commenter states CARB should make a short-lived climate pollutant reduction strategy and support new green job infrastructures. [RP1-233]

Comment: Commenter states the switch to ZEVs by acquiring resources should not exploit indigenous lands. [RP1-245]

Comment: Commenter states that citizens should adopt a vegan diet to reduce methane emissions and improve the environment. [RP1-213-Form-815]

Comment: Commenter states CARB needs to promote solar energy programs. [RP1-260-Form-3944]

Comment: Commenter states that every home in the country should have solar panels and the energy harnessed from those would power all of the ZEVs. [RP1-260-Form-2088]

Comment: Commenter states we need trucks powered by solar and wind. [RP1-260-Form-2387]

Comment: Commenter states CARB needs to take action to also clean up all water sources and make higher fines for over fishing. [RP1-260-Form-2015]

Agency Response: No changes were made to the regulation in response to these comments. These comments were determined to be outside the scope of this regulation.

Duplicate - Resubmittal of Comments at First Board Hearing

Comment: Commenter resubmits comments submitted on December 12, 2019, as an attachment for the record and for the Board's additional consideration. [RP1-195]

Agency Response: No changes were made to the regulation in response to this comment. To re-address commenter B1-16's original comments, please see the discussion about the TCO of pickups, new information since the original Staff Report, and the role TCO plays in the approved regulation in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Total Cost of Ownership Concerns for Pickups". Additionally, see discussion related to incentives, infrastructure, and fleet purchase requirements in chapter "Comments

Received During Original Proposal's 45-Day Comment Period", sections "Out of Scope – Incentive and Funding Policies", "Manufacturer ZEV Sales – Infrastructure Concerns", and "Manufacturer ZEV Sales – Pair Manufacturer and Fleet Requirements", respectively.

WRITTEN COMMENTS RECEIVED DURING THE JUNE 2020 BOARD HEARING

Manufacturer ZEV Sales - General Support

Comment: Commenter states general support for the proposed changes to the regulation. [B2-01, B2-02, B2-03, B2-04, B2-05, B2-06, B2-07, B2-09, B2-11, B2-12, B2-13, B2-14, B2-15, B2-16, B2-17, B2-18, B2-20, B2-21, B2-22, B2-23-Form, B2-26, B2-28, B2-29, B2-30, B2-31, B2-32, B2-33, B2-34, B2-35, B2-36, B2-37, B2-38, B2-41, B2-42, B2-43, B2-44, B2-45, B2-48, B2-49, B2-50, B2-52, B2-53, B2-54, B2-55, B2-56, B2-57, B2-59, B2-60, B2-61, B2-62, B2-63, B2-64, B2-65, B2-66, B2-67, B2-68, B2-69, B2-70, B2-71, B2-72, B2-73, B2-74, B2-75, B2-76, B2-77, B2-78, B2-79, B2-80, B2-81, B2-82, B2-83, B2-84, B2-85, B2-86, B2-88, B2-89, B2-90, B2-91, B2-92, B2-93, B2-94, B2-95, B2-96, B2-97, B2-98, B2-99, B2-100, B2-101, B2-102, B2-103, B2-104, B2-105, B2-106, B2-107, B2-108, B2-109, B2-111, B2-112, B2-113, B2-114, B2-115, B2-116, B2-117]

Comment: Commenter states support for the proposed changes and that the regulation is a step towards racial justice because communities of color are disproportionally affected by pollution because their neighborhoods are closer to freeways. [B2-47]

Agency Response: Staff appreciates the supportive comments. Additional issues raised by commenters, if any, will be addressed in the applicable sections.

Manufacturer ZEV Sales - Strengthen the ACT Proposal by Including Other Vehicles, Starting Requirements Earlier, and/or Increasing Sales Percentage Requirements

Comment: Commenter is urging CARB to strengthen the ACT Regulation. Commenter believes that CARB should look at both short-term and long-term strategies where zero-emission trucks should be the goal as soon as possible and as a part of the long-term strategy. [B2-10]

Comment: Commenter states their support for a stronger ACT regulation by increasing the mandate as much and as quickly as possible. [B2-17, B2-39, B2-23-Form-4151]

Comment: Commenter states that the timeline for the ACT regulation should be sped up to make ZEVs happen right away. [B2-23-Form-1162]

Comment: Commenter states we need to find a way to get more vehicles electric, not just trucks. [B2-23-Form-1467]

Comment: Commenter states that California should be encouraging electrification for all modes of transportation. [B2-23-Form-3208]

Comment: Commenter states that the ACT regulation should require ZEVs by 2023. [B2-23-Form-3685]

Comment: Commenter states that the ACT regulation should apply to all motor vehicles. [B2-23-Form-4195]

Comment: Commenter states to convert all trucks to electric. [B2-27]

Comment: Commenter states their support for a stronger ACT regulation for heavy-duty class 7-8 trucks and to increase the sales requirement for heavy-duty trucks as high as possible. [B2-31]

Comment: Commenter states they support the electrification of all vehicles and the charging infrastructure to be powered by solar. Commenter states that areas with historically higher pollution and mining operations should take priority. [B2-87]

Agency Response: No changes were made to the regulation in response to these comments. Several challenges currently prevent more aggressive requirements. Staff will evaluate how the zero-emission market develops and can propose modifications in the future to reflect what is feasible. See further discussion on staff's rationale for the regulation's requirements and limitations to increasing the requirements more than staff already did in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Strengthen the ACT Proposal by Including Pickups Earlier and/or Increasing Sales Percentage Requirements".

Manufacturer ZEV Sales – Manufacturer Requirements Are Too Stringent

Comment: Commenter shares their support for a less aggressive approach to implementing the ACT regulation and its reporting requirements due to financial impacts on businesses and consumers. [B2-58]

Agency Response: No changes were made to the regulation in response to this comment. See staff discussion on why the ACT regulation is aggressive and how we plan to meet the states air quality and climate goals in chapter "Written Comments Received during the 30-Day Comment Period", section "Manufacturer ZEV Sales – Manufacturer Requirements Are Too Stringent".

Manufacturer ZEV Sales – Near-Zero-Emissions Vehicle Definition

Comment: Commenter believes that on-road Low NOx medium- or heavy-duty vehicle powered by an engine that is certified to CARB's Optional Low NOx standard of 0.02g/bhp-hr should be considered in the near-zero definition. [B2-10]

Agency Response: No changes were made to the regulation in response to this comment. See response summarizing how the term “near-zero-emission vehicle” is not appropriate to apply to vehicles meeting the upcoming Low NOx engine standard in chapter “Written Comments Submitted During Original Proposal’s 45-Day Comment Period”, section “Manufacturer ZEV Sales – Near-Zero-Emissions Vehicle Definition”.

Manufacturer ZEV Sales - Increasing Class 2b-3 and Pickup Requirements Too Costly

Comment: Commenter states that removing the pick-up truck exemption, and accelerating the implementation of ZEVs by 2024 will be too costly for businesses that are dealing with the financial impact of COVID-19. [B2-58]

Agency Response: No changes were made to the regulation in response to this comment. Staff recognizes the economic impact of the COVID-19 pandemic and its impact on the trucking industry. However, for a number of reasons, staff finds that the regulation’s requirements are feasible in spite of this. The ACT regulation does not place any requirements until 2024 MY, giving manufactures time to plan and position themselves for the rule’s requirements. Further details may be found in chapter “Written Comments Received during the 30-Day Comment Period”, section “Economic Analysis – Impact of COVID-19”. As detailed in Attachment B to the “Notice of Public Availability of Modified text and Availability of Additional Documents and Information” for the ACT regulation, released in April 2020 for public comment, staff moved the requirements for Class 2b-3 vehicles forward one year without changing the start date and removed the pickup truck exemption. The inclusion of Class 2b-3 pickup trucks in 2024 is supported by new information in recent market announcements showing that a number of zero-emission pickup and additional van models will be commercially available from several manufacturers well before the 2024 model year. See further discussion of staff’s rationale for increasing manufacturer’s sales requirements for Class 2b-3 vehicles in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Manufacturer ZEV Sales – Strengthen the ACT Proposal by Including Pickups Earlier and/or Increasing Sales Percentage Requirements”.

Manufacturer ZEV Sales – Delay Until 2026

Comment: Commenter proposes that the sales mandate begin in 2026 to allow time for staff to develop and implement the promised fleet rule, develop the necessary charging infrastructure, for the state to recover from current budget crisis and to allocate incentive funds, and time for manufacturers to recover from the impacts of the COVID crisis and recession. [B2-11]

Agency Response: No changes were made to the regulation in response to this comment. See response detailing why impacts from the COVID-19 pandemic will not affect this regulation in chapter “Written Comments Received during the 30-Day Comment Period”, section “Economic Analysis – Impact of COVID-19”.

<u>Manufacturer ZEV Sales – Pair Manufacturer and Fleet Requirements</u>

<u>Comment:</u> Commenter proposes that staff fully link the ZEV sales mandate with ZEV purchase requirements. [B2-11]

<u>Agency Response:</u> No changes were made to the regulation in response to this comment. See staff response detailing the next rulemaking effort for fleets in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Pair Manufacturer and Fleet Requirements".

<u>Manufacturer ZEV Sales – Add Off-Ramps to the Proposal Due to COVID-19</u>

<u>Comment:</u> Commenter believes a provision should be incorporated into the regulation to ensure, related to the impacts of COVID-19 on the trucking and truck manufacturing industries, truck manufacturers aren't deemed non-compliant for not reaching vehicle sales totals beyond those which can be achieved with limited, disconnected public funding for vehicles and infrastructure, as well as the long lead times for the charging infrastructure installation. [B2-08]

<u>Agency Response:</u> No changes were made to the regulation in response to this comment. See response detailing considerations for the impacts for COVID-19 in chapter "Written Comments Received during the 30-Day Comment Period", section "Economic Analysis – Impact of COVID-19". Additionally, see response summarizing how off-ramps fail to add regulatory certainty in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Add Off-Ramps to the Proposal".

<u>Manufacturer ZEV Sales – Ban Internal Combustion Engines</u>

<u>Comment:</u> Commenter states that only ZEVs should be allowed to operate in California and if out-of-state and federal fleets do not abide, then trucks can trans-ship at the state border. [B2-23-Form-3797]

<u>Agency Response:</u> No changes were made to the regulation in response to this comment. See discussion about why staff is not proposing a combustion engine ban in this rulemaking due to varied suitability of vehicle use cases to transition to ZEVs in chapter "Written Comments Received during the 30-Day Comment Period", section "Manufacturer ZEV Sales – Ban Internal Combustion Engines".

<u>Manufacturer ZEV Sales – Pollution Tax Instead of Sales Mandate</u>

<u>Comment:</u> Commenter states the transition to clean engines should be driven by setting annually increasing pollution taxes based on miles driven and how much pollution they emit. [B2-23-Form-5242]

Agency Response: No changes were made to the regulation in response to this comment. See discussion about CARB's inability to levy taxes and other policies in place that are reducing the number of polluting engines on the road in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Out of Scope – Carbon Tax".

Manufacturer ZEV Sales - Alternative Fuels Instead of ZEV Sales Mandate

Comment: Commenter states the ACT regulation could accomplish the reduction of pollution by transitioning to an alternative fuel, and not forcing electric vehicles. [B2-23-Form-5400]

Agency Response: No changes were made to the regulation in response to this comment. The primary objectives of the ACT regulation include accelerating the use of zero-emission vehicles in California. Vehicle emissions associated with combustion-powered vehicles and engines are being addressed in the approved Low NOx Omnibus rulemaking and existing cleaner fuels policies. Further detail are found in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Credit for Low NOx Engines and Renewable Fuels".

Manufacturer ZEV Sales – ACT Targets ZEV Replacements for all Class 2b-3 in CA

Comment: Commenter states that there is a disconnect between stated objectives and its proposed application. Commenter points out that while the ACT regulation states it applies to fleets, objectives in ongoing presentations and assessments speak directly to targeting ZEV replacements for the 1.04 million Class 2b-3 vehicles on California's roads. [B2-58]

Agency Response: No changes were made to the regulation in response to this comment. The Board directed staff, through the approved Resolution, to begin regulatory development for turning over certain trucking sectors to 100% ZEVs by certain dates in California, but none of those sectors are comprised entirely of Class 2b-3 vehicles. See further discussion of staff's rationale for increasing manufacturer's sales requirements for Class 2b-3 vehicles in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Strengthen the ACT Proposal by Including Pickups Earlier and/or Increasing Sales Percentage Requirements".

Manufacturer ZEV Sales - Infrastructure Concerns

Comment: Commenter states that businesses and taxpayers will bear the brunt of the costs associated with infrastructure and maintenance. [B2-58]

Comment: Commenter also states that infrastructure and market deficiencies are obstacles to successful development. [B2-58]

Comment: Commenter states that the charging infrastructure should be included in the ACT regulation. [B2-102]

Agency Response: No changes were made to the regulation in response to these comments. See staff discussion about infrastructure costs taken into consideration in chapter “Written Comments Received during the 30-Day Comment Period”, section “Economic Analysis – Regulation Does Not Address Infrastructure Challenges”. Additionally, see discussion about current efforts to develop widespread infrastructure, including funding available, in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Manufacturer ZEV Sales – Infrastructure Concerns”.

Economic Analysis – Cost Analysis Underestimates Vehicle Cost

Comment: Commenter states estimated costs of suitable replacements (Tesla’s 500-mile, $70K [pickup]) are prohibitive and do not reflect assumptions in CARB’s market assessment. Commenter provided supporting documentation, articles, and references to support their comment. [B2-58]

Agency Response: No changes were made to the regulation in response to this comment. See discussion about the higher upfront cost of ZEVs that may decrease over time in chapter “Written Comments Received during the 30-Day Comment Period”, section “Economic Analysis – Cost Analysis Underestimates Vehicle Cost”.

Economic Analysis – Independent Review

Comment: Commenter states that the infrastructure and electric utility costs require an independent review and deeper analysis of the ACT regulation’s impact on businesses and consumers. [B2-58]

Agency Response: No changes were made to the regulation in response to this comment. As described in the Staff Report, the economic impacts to businesses and consumers was thoroughly analyzed. In the analysis, all costs including the incremental vehicle costs, infrastructure upgrades, fueling, maintenance, and other costs are assumed to be the direct costs of the regulation in California despite the lack of a specific fleet purchase requirement. Staff determined that the ACT Regulation will reduce costs to the overall state’s trucking fleet as the operational cost savings of the ZEVs outweigh the potential infrastructure and vehicle prices. Amortizing the vehicle and infrastructure help with these company’s cash-flow so they can have positive cash-flow shortly after purchase. Staff also determined that ZEVs are 2 to 5 times as efficient as similar vehicles with internal combustion engines technologies and significantly reduce petroleum and other fossil fuel use and use less total energy. Battery-electric fuel prices depend on how they are charged and include energy costs, fixed fees and demand fees. Vehicles charged at high power or during peak periods will have higher electricity costs than if charging overnight over an extended period.

Additionally, electricity and hydrogen are eligible to earn LCFS credits which can be sold and used to offset the costs of electric and hydrogen fuels.

Economic Analysis – Rural Infrastructure Cost Impact Not Analyzed

Comment: The commenter states that there should be further analysis of the infrastructure cost impact on rural areas, due to the difficulty to maintain charging stations these environments. [B2-58]

Agency Response: No changes were made to the regulation in response to this comment. Staff incorporated infrastructure cost impacts in the statewide economic analysis, which includes rural areas, detailed in chapter "Written Comments Received during the 30-Day Comment Period", section "Economic Analysis – Regulation Does Not Address Infrastructure Challenges".

Economic Analysis – Incorporate ZANZEFF Experiences for More Realistic Cost and Timeline Assumptions

Comment: Commenter recommends that CARB and other state agencies incorporate into the regulation lessons learned about realistic project timelines and cost estimates from ZANZEFF-funded projects. [B2-08]

Agency Response: No changes were made to the regulation in response to this comment. Staff took into account all information available at the time to draft the regulation and will continue to incorporate new information during the implementation stage as it becomes available. For additional information, please see chapter "Comments Received During Original Proposal's 45-Day Comment Period" section "Manufacturer ZEV Sales – Wait for Results of Demonstrations".

Economic Analysis – Underestimated Time Needed for Fleets to Plan for Replacements

Comment: Commenter states that zero-emissions models won't hit the market until maybe a year or two before the requirement takes effect which leaves little opportunity for cost consideration in planning vehicle and fleet replacements. [B2-58]

Agency Response: No changes were made to the regulation in response to this comment. The ACT regulation does not require fleets to purchase ZEVs. It requires manufacturers to sell ZEVs, and it will ensure that manufacturers develop competitive ZEV products at price points that will meet fleet needs. Manufacturers will need to ensure that fleets are prepared to accept ZEVs into their fleets by communicating when their ZE products will become available and ensuring fleets are aware of potential issues such as infrastructure and technician training. The ACT regulation gives manufacturers lead time to both prepare their products and help prepare the overall marketplace for acceptance of ZEVs, both of which are necessary for a successful rollout.

Economic Analysis – Fleet Infrastructure Resilience

Comment: Commenter states that resiliency is not addressed in the TCO. Commenter states that one day of resiliency through battery storage for a fleet would require a 6 MWh battery system costing approximately $3M; and vehicles are backed up with a 700 kW diesel or NG genset which would cost $500k-$1M. [B2-40]

Agency Response: No changes were made to the regulation in response to this comment. See discussion on the work California is undertaking to bolster resilience and the role of ZEVs in chapter “Written Comments Received during the 30-Day Comment Period”, section “Economic Analysis – Fleet Infrastructure Resilience”.

Economic Analysis – Impact of COVID-19

Comment: Commenter states that CARB should consider the timing of the ACT regulation due to COVID-19 which has put many people out of work and disrupted truck distribution. [B2-23-Form-5400]

Comment: Commenter states she does not support the ACT regulation because it puts a financial burden on truck drivers after going through COVID-19. [B2-23-Form-2194]

Comment: Commenter doubts the market’s readiness to absorb the volumes proposed in this regulation due to the economic impacts of COVID-19 which have reduced product development budgets for manufacturer's and reduced carbon auction revenue (HVIP funding) to support ZEV sales. [B2-08]

Agency Response: No changes were made to the regulation in response to these comments. See response detailing why COVID-19 does not affect staff’s analysis in chapter “Written Comments Received during the 30-Day Comment Period”, section “Economic Analysis – Impact of COVID-19”.

Economic Analysis – Long Range Pickups Not Addressed

Comment: Commenter states Class 2b-3 pickups and their associated longer-range needs are not addressed in the TCO. [B2-58]

Agency Response: No changes were made to the regulation in response to this comment. Staff updated the cost benefit and analysis in Attachment C to the “Notice of Public Availability of Modified text and Availability of Additional Documents and Information” for the ACT regulation, released in the April 2020 30-day public comment period, to include long-range Class 2b-3 vehicle sales. See the Attachment C for additional details about how the cost calculations were updated to account for these types of vehicle sales for the increased Class 2b-3 requirements.

Economic Analysis – Multi-Shift Operation Impacts on Infrastructure Cost

Comment: Commenter states that staff based the TCO model on nearly idealized assumptions about the operation of fleets, specifically that trucks can charge overnight at their home base. However, the model would have to be extensively revised to capture the impacts on a two-shift fleet, in particular, reassessing the infrastructure and electricity costs. [B2-40]

Agency Response: No changes were made to the regulation in response to this comment. As described in Appendix E, the only segments where multishift operations are common is in regional and long-haul trucking with tractors. Multi shift operations grade poorly due to the high-power needs and short time between shifts necessitating high-power charging. The lower grading for these segments has been reflect in the lower percentage requirements in the Class 7-8 tractor category versus other segments.

The ACT regulation does not contain a requirement that fleets purchase ZEVs. Therefore, there is no requirement that fleets with multishift operations would need to purchase ZEVs unsuited for their application. Because there is no mandate that fleets purchase ZEVs, there is no reason to assume manufacturers will sell vehicles into categories where they are unsuited. Some manufacturers have indicated that multi shift operations may enable higher cost savings for fleets and are targeting this segment.

Lastly, staff's definition of zero-emission includes both battery-electric and hydrogen fuel cell vehicles. While battery-electric vehicles may not be ideal for multi shift operations, hydrogen fuel cell vehicles are anticipated to perform better due to their ability to quickly refuel and travel longer ranges without refueling. Manufacturers who want to target multi shift operations have the option of pursuing hydrogen fuel cell vehicles.

Economic Analysis – Ignored Insurance Cost

Comment: Commenter states that insurance costs are not included in the TCO. Commenter states that because ZEVs are more expensive, insurance costs are greater. [B2-40]

Agency Response: No changes were made to the regulation in response to this comment. While protecting a company's vehicles can be a component of insurance, most of the value of an insurance policy is to cover liability in the event of causing property damage or personal injury to another party. ZEVs are equally likely to be liable in the event of an insurance claim as a combustion-powered truck and therefore there is no difference in the cost in the largest portion of an insurance policy. Staff is not aware of any studies or reports which show higher insurance costs for electric trucks. Adding insurance costs to the TCO analysis would not significantly change the outcome of needing to significantly increase the number of ZEVs deployed by this regulation in order to meet state goals and the Board's direction.

Economic Analysis – Underestimated Infrastructure Network Service Costs

Comment: Commenter states there is missing analysis from the TCO such as charger network service costs. Commenter states that the TCO includes a $500 per charger cost for maintenance, however the actual cost for Class 8 vehicles is between $2,500 and $10,000 per charger a year. [B2-40]

Agency Response: No changes were made in response to this comment. See staff discussion on infrastructure costs and assumptions in chapter "Written Comments Received during the 30-Day Comment Period", section "Economic Analysis – Real-World Infrastructure Costs Differ from CARB Projections".

Economic Analysis – Underestimated Tractor Battery Capacity Needs

Comment: Commenter states that the analysis underestimates the battery capacity required for ZEVs and states data from the 2018 California VIUS survey and several other studies of drayage trucks and goods movement trucks in Southern California suggests that a Class 8 tractor's maximum daily mileage is approximately 1.65 times higher than the average daily mileage. Commenter makes a comparison on how an individual would not purchase a ZEV with a range of 70 miles when their average commute is 50 miles. Commenter states that staff should be using a higher average VMT when sizing the battery (but not when calculating activity) because trucks are specified by buyer to meet the higher daily activity of a new truck. Commenter states that because battery capacity has such a significant impact on the TCO model that ignoring mileage factors dramatically overestimates the utilization of the battery and underestimates the TCO of the EV. Commenter states that staff is underestimating the TCO of a Class 8 electric truck by 30-40%. [B2-40]

Agency Response: No changes were made to the regulation in response to this comment.

Staff's assumptions regarding battery size for tractors is appropriate for fleet usage. In the Staff Report, staff assumed ZE tractors would be sold to drayage and other shorter-range applications. Based on statements from manufacturers and demonstrations currently underway, these shorter-range applications are well suited for ZEV deployments in the tractor segment due to their predictable routes, access to infrastructure, and ability to remain parked overnight. Staff acknowledges that a portion of drayage trucks operate using multi shifts, but because there is no mandate that fleets purchase ZEVs, manufacturers have the option to comply by selling ZEVs to other applications which do not use multi shift operations such as local food and beverage delivery. Staff will evaluate multi shift operations in drayage during the development of future requirements for zero-emission drayage.

Staff disagrees with the commenter's claim that the battery sizes are inappropriate and unrepresentative of how businesses operate. When evaluating the cost of a ZEV, fleets face a tradeoff between the range of the vehicle and the upfront capital cost. Fleets are unlikely to purchase a vehicle with limited range that will not be able to meet their needs, nor will they purchase a vehicle with excessive range that results in excess cost. Because fleets face no requirement to purchase ZEVs, manufacturers must ensure that they are selling vehicles with sufficient range at a price point that is attractive to fleets. Fleets have flexibility in how they choose to incorporate ZEVs into their fleet as they can elect to dispatch their ZEVs on shorter range, more predictable routes and leave the longer-range routes to the remaining combustion-powered vehicles in their fleet. Because of factors like this, decision making for fleets is fundamentally different to that of individuals and comparing the two is not appropriate in this scenario.

Large Entity Reporting – Burdensome to Business

Comment: Commenter states that the compliance and reporting requirements of ACT are too burdensome, even though they generally support improving air quality. Commenter also states the reporting requirement duplicates processes and information that is already available, which adds unnecessary bureaucracy that businesses must navigate. Commenter states CARB has not taken time to consider that abruptly lowering the reporting requirement from 100 to 50 vehicles will be adding back a considerable number of businesses that will now be forced to report. Commenter states that this maneuver blindsides businesses without sufficient time to assess the impacts of the regulation. [B2-58]

Agency Response: No changes were made to the regulation in response to this comment. The lowering of the reporting requirement from 100 to 50 vehicles was proposed during the 30 day comment period in compliance with APA requirements. Staff recognizes the potential unintended burden that the regulation may impose on businesses. Consistent with Board direction to streamline the reporting requirements, staff made several key changes to the original proposal: First, the changes would limit regulated entities to only those that own or direct the operation of medium- or heavy-duty vehicles. Second, the changes would also reduce the burden of reporting by completely removing the facility-based data and truck trip counting. Please see the discussion about staff's recognition of the potential unintended burden that the regulation may impose on businesses in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Large Entity Reporting – Regulation Requires Hard-to-Collect Information". In addition, please see response detailing the proposed streamlining of the large entity reporting requirement in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Large Entity Reporting – Cost Burden". Lastly, see discussion on the extensive outreach staff has conducted during the rulemaking process to inform fleets in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Large Entity Reporting – Insufficient Outreach"

Future ZEV Policy – Target Large Entities

Comment: Commenter states large entities that can afford ZEVs should be held accountable to meet fleet compliance requirements. [B2-31]

Agency Response: See response detailing the Board direction for staff to bring a fleet based recommendation to the Board in 2021, work so far on launching the next rulemaking effort for fleets, and why it is premature to discuss future ZE fleet rules at this time in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Future ZEV Policy – Adopt Zero-Emission Fleet Rule in 2021”.

Future ZEV Policy – Phased Fleet ZEV Rollout

Comment: Commenter states that the ACT regulation should start phasing in requirements beginning with local last mile operations, then regional operations, and lastly address long hauls. Commenter states the infrastructure costs are more gradual when using these phases. [B2-23-Form-2714]

Agency Response: No changes were made to the regulation in response to this comment. See discussion about the infrastructure costs to implement ZEVs in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Manufacturer ZEV Sales – Infrastructure Concerns”. Also, see the discussion about the rationale for the compliance strategy detailed in the approved ACT regulation in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Future ZEV Policy – Considerations to Include in Future ZE Fleet Rule”.

Future ZEV Policy – Employee Misclassification Impact on Trucking Emissions

Comment: Commenter states that we need to look into trucking contractors. Trucking companies, brokers, and other contracting entities often misclassify drivers as ‘independent contractors’ when they are, by law, employees. He states that 70-90% of drayage trucks are contractors that operate in firms of less than 100 trucks. [B2-06]

Agency Response: See response discussion on the importance of labor issues and their impact on air quality, and staff’s proposed changes to the large entity reporting requirement to ensure more potentially misclassified drayage workers are covered by the data reporting requirement for the entities that contract with them, in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Future ZEV Policy – Employee Misclassification Impact on Trucking Emissions”.

Future ZEV Policy – Mandate ePTO Use in Non-Attainment Zones

Comment: Commenter recommends mandating the use of ePTO technology in certain zones with high NOx emissions. Commenter states that ePTO systems can be installed on existing trucks as a retro-fit to reduce emissions without the purchase of newer vehicles. [B2-25]

Agency Response: No changes were made to the regulation in response to this comment. See discussion about why staff did not include ePTO technology in the manufacturer ZEV sales mandates in chapter "Written Comments Received during the 30-Day Comment Period", section "Manufacturer ZEV Sales - Add Credit for Electrified Power Take Off". Additionally, see discussion about why it is premature to discuss potential future ZE fleet mandates in this rulemaking in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Future ZEV Policy – Considerations to Include in Future ZE Fleet Rule".

Future ZEV Policy – Commit to 100 Percent Zero-Emission Targets

Comment: Commenter states they support goals to have half of all trucks in California be zero-emissions by 2035, and all trucks be zero-emissions by 2045. [B2-77]

Agency Response: No changes were made to the regulation in response to this comment. Please see the discussion on establishing 100 percent zero-emission targets in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Future ZEV Policy – Set Clear 100 Percent ZEV Targets". Also, see the discussion about staff's efforts to develop a future fleet rule in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Future ZEV Policy – Adopt Zero-Emission Fleet Rule in 2021".

Out of Scope – Disadvantaged Community Policy

Comment: Commenter states that CARB should address the systemic marginalization of low-income communities of color that are more likely to be exposed to diesel pollution because their communities are usually located near freeways. [B2-37]

Agency Response: Staff made numerous modifications to the original proposal to increase the number of ZEVs deployed in California consistent with commenter and the Board's direction. Increases in class 7 and 8 tractor group sales percentages ensure there are sufficient tractor sales to meet the goal of achieving an all zero-emission drayage fleet by 2035, which would directly benefit disadvantaged communities. For further details on the changes made to the original proposal that positively impact the environment and disadvantaged communities, please refer to chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Strengthen the ACT Proposal by Including Pickups Earlier and/or Increasing Sales Percentage Requirements". In July 2017, Governor Brown signed Assembly Bill (AB) 617 to reduce air pollution and the associated health impacts in highly impacted communities. To implement AB 617, CARB Board approved the Community Air Protection Blueprint on September 27, 2018, which includes strategies to reduce emissions and establishes Program requirements. For more information about CARB's implementation of AB 617, see https://ww2.arb.ca.gov/our-work/programs/resource-center/ab-617-implementation.

Out of Scope – Incentive and Funding Policies

Comment: Commenter states it is important that the ACT regulation includes incentives to encourage the purchase of ZEVs. [B2-104, B2-23-Form-1503, B2-23-Form-3517, B2-23-Form-3583]

Comment: Commenter supports the ACT regulation and states that adequate funding be sought from the state legislators and the federal government to be put it in place, even if a tax increase or hike in the fees assessed under cap-and-trade is required. [B2-23-Form-2138]

Agency Response: No changes were made to the regulation in response to these comments. See the discussion about incentives in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Out of Scope – Incentive and Funding Policies".

Other - General Opposition

Comment: Commenter states that the efforts made to clean California's air has caused the quality of life to decrease for Californians. Commenter states the efforts of CARB are misleading and are trying to fix something that is not broken and causes economic harm to the poorest people in the state. Commenter states the ACT regulation will force the poor and middle-class truckers out of business leaving the state to only large trucking companies. [B2-23-Form-2943]

Agency Response: No changes were made to the regulation in response to this comment. See discussion in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Other – General Opposition".

Other – Comments Addressed in the Environmental Analysis

Comment: Commenter would like to know where people would dispose of the lithium batteries and who is held accountable for the children mining the lithium. [B2-23-Form-2194]

Comment: Commenter states that CARB needs to solve the problems associated with electric vehicles, such as issues with child enslavement to mine minerals, the polluting from the battery manufacturing process, where/how to dispose of the batteries, and where does all the additional power to charge the batteries come from. [B2-23-Form-3900]

Comment: Commenter states that there is no regulatory assessment on the impacts on the power grid as a result of CARB's aggressive approach to adding ZEVs. [B2-58]

Agency Response: These comments are addressed in the "Final Environmental Analysis" document. See the Final Environmental Analysis prepared for the ACT regulation (Final EA link) presented and approved by the Board at the June 25, 2020, hearing. Related to the assessment of impacts on the power grid, the Final Environmental Analysis found that short term impacts on energy demand were less than significant, and that long-term impacts on energy demand were net beneficial. Details can be found in the discussions for Impacts 6-1 and 6-2. Overall, ZEVs will be a small portion of overall electricity demand, and utilities are planning for this load as required by the CEC and CPUC.

Other – Support for Other Commenters

Comment: Commenter shares their support for EMA's recommendations to connect mandates to sales, and delay the implementation to improve the chances of successful fuel-engine replacements with ZEV. [B2-58]

Agency Response: No changes were made to the regulation in response to this comment. Please see staff's response to EMA's comment to delay the ZEV sales mandate until 2026 in chapter "Written Comments Received during the June 2020 Board Hearing", section "Manufacturer ZEV Sales – Delay Until 2026". Also, please see staff's response to EMA's comment to link the ZEV sales mandate with the ZEV purchase requirements in chapter "Written Comments Received during the June 2020 Board Hearing", section "Manufacturer ZEV Sales – Pair Manufacturer and Fleet Requirements".

Other – Miscellaneous/Out of Scope Comments

Comment: Commenter states that agricultural vehicles, dust, and burning are also major factors of pollution. [B2-23-Form-3183]

Comment: Commenter states the ACT regulation should not only clean the air but also the water. Commenter states that water ways are polluted with plastic, chemicals, noise, and over fishing. Commenter states there should be high penalties for over fishing. [B2-23-Form-3695]

Comment: Commenter states we should look at London's hybrid double decker bus and how it decreased the air pollution, doing the same in California will change the air and soundscape. [B2-23-Form-2350]

Comment: Commenter states California needs to urge people to drive less. [B2-23-Form-2639]

Comment: Commenter states that social change must advocate for decreased use of foreign made products and increased investment in sustainable manufacturing within the USA. [B2-23-Form-2297]

Comment: Commenter states we need to promote more solar energy programs for California residents for cleaner electricity. [B2-23-Form-1725]

Comment: Commenter states CARB should require replacement of all yard equipment with electric. [B2-23-Form-3973]

Comment: Commenter states that it is time to make coal, oil, fracking, and nuclear power illegal. Commenter states that the ACT regulation should require cutting oil and coal mining in half annually to be zero by 2029, reducing petroleum use in half each year to be zero by 2030, shutting down nuclear power plants by 2022, zero fracking by 2022, and have aero synthetic chemical farming by 2023. [B2-23-Form-3685]

Comment: Commenter states there should be more transportation by rail and if people are still burning rice fields they should compost instead. [B2-23-Form-971]

Comment: Commenter states that trucks need to be powered by solar and wind. [B2-23-Form-3327]

Comment: Commenter states that trucks crossing the state should have to meet certain clean energy criteria. [B2-23-Form-4126]

Comment: Commenter states that pipeline gas will require permanent infrastructure and will keep the ports and goods movement industry locked into old tech instead of moving into modern, 21st Century solutions. Commenter states that we cannot let pipeline gas become the new normal in running our vehicles, trucks or other infrastructure. [B2-23-Form-1503]

Comment: Commenter states that all vehicles should be powered by solar, hydroelectric, tidal, wind, and or geothermal energy to recharge batteries. [B2-23-Form-1008]

Agency Response: These comments are outside the scope of this rulemaking, however, staff appreciates the comments.

VERBAL COMMENTS RECEIVED DURING THE JUNE 2020 BOARD HEARING

Manufacturer ZEV Sales – General Support

Comment: Commenter states general support for the proposed changes to the regulation. [T2-01, T2-02, T2-03, T2-04, T2-05, T2-06, T2-08, T2-10, T2-11, T2-13, T2-15, T2-16, T2-17, T2-18, T2-19, T2-20, T2-21, T2-22, T2-23, T2-24, T2-26, T2-27, T2-28, T2-29, T2-30, T2-31, T2-32, T2-33, T2-34, T2-35, T2-36, T2-37, T2-38, T2-40, T2-44, T2-45, T2-46, T2-47, T2-48, T2-50, T2-51, T2-53, T2-56, T2-57, T2-58, T2-59, T2-60, T2-61, T2-62, T2-63, T2-64, T2-65, T2-66, T2-67, T2-68, T2-71, T2-72. T2-73, T2-74, T2-76, T2-77, T2-83, T2-84, T2-85, T2-87, T2-88, T2-89, T2-90, T2-92, T2-93, T2-97, T2-98, T2-99, T2-100, T2-101, T2-102, T2-103, T2-104, T2-106, T2-107, T2-108, T2-110, T2-111, T2-112, T2-113, T2-115, T2-116, T2-118, T2-119, T2-120, T2-122, T2-123]

Comment: Commenter states that his constituents are electricians who look forward to the enactment of ACT because of the job opportunities that will be created to build the charging infrastructure needed for electric vehicles. [T2-42]

Comment: Commenter states support for ACT regulation because it will provide economic stimulus, further environmental justice efforts, help fight climate change, improve working conditions, and transform our markets. [T2-55]

Comment: Commenter states that last-minute changes to definitions that invite fossil fuels into this rule are unacceptable because it undermines the intent of the ACT regulation. [T2-72]

Agency Response: Staff appreciates the supportive comments. Any additional issues raised by each commenter, if any, are addressed in the applicable sections of this document based on the nature of the issue being raised.

Manufacturer ZEV Sales - Strengthen the ACT Proposal by Increasing Sales Percentage Requirements

Comment: Commenter states the sales requirements for heavy-duty Class 7 and Class 8 tractors should be stronger. [T2-22, T2-35, T2-53, T2-73, T2-81, T2-84, T2-114]

Comment: Commenter states that the ACT regulation is not ambitious enough. [T2-96]

Comment: Commenter states the ACT regulation should start in 2021. [T2-97]

Agency Response: No changes were made to the regulation in response to these comments. Staff recognizes several challenges that currently appear to be barriers to more aggressive requirements. Staff will evaluate how the zero-emission market develops and can propose modifications in the future to reflect what is feasible. Please see the discussion on staff's rationale for increasing the regulation's requirements and limitations to increasing them further or starting them earlier in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Strengthen the ACT Proposal by Including Pickups Earlier and/or Increasing Sales Percentage Requirements".

Manufacturer ZEV Sales – Manufacturer Requirements Are Too Stringent

Comment: Commenter states that CARB should maintain the original sales purchase requirements for model years 2024 through 2030. [T2-23]

Agency Response: No changes were made to the regulation in response to this comment. Staff recognizes that the ACT regulation's requirements are aggressive but are technically and economically feasible. These requirements are necessary in order to enable large-scale electrification at the scale necessary to meet the states air quality and climate goals. Without transitioning as much of the medium- and heavy-duty sector to zero-emission where feasible, California will not be able to meet its air quality goals, climate change targets, nor its carbon neutrality goals. Further detail on this topic may be found in chapter “Written Comments Received during the 30-Day Comment Period”, section “Manufacturer ZEV Sales – Manufacturer Requirements Are Too Stringent”.

Manufacturer ZEV Sales – Credit for Low NOx Engines or Alternative Fuels

Comment: Commenter is requesting an addition to the definition of near-zero-emission vehicle to include the certified low NOx 0.02-gram engine and allow these vehicles to earn credits. [T2-09, T2-14]

Comment: Commenter states the need to incentivize low NOx trucks to prevent fleet operators from defaulting to dirtier diesel models. Commenter states that the Omnibus Rule does nothing to deploy the most stringent low NOx trucks prior to 2027. [T2-09]

Comment: Commenter is requesting an addition to the definition of near-zero-emission vehicle to include the certified low NOx 0.02-gram engine to allow these vehicles to earn credits. Commenter requests corresponding changes to the NZEV credit provisions, such that near-term air quality benefits are incentivized in this rulemaking. [T2-25, T2-82, T2-91]

Comment: Commenter requests partial credits for low NOx trucks until the Omnibus rule requires manufacture of such trucks in 2027 and beyond. [T2-54]

Comment: Commenter states that we need to make sure that combustion trucks on the road continue to get cleaner without undermining zero-emission mandates by providing credits for fuels that do not advance zero-emission technology. [T2-67]

Comment: Commenter requests clarification on the interplay between the ACT regulation and the Omnibus rule so that OEMs and fleets can understand how the compliance requirements interact. [T2-70]

Comment: Commenter states that the proposed ACT regulation should consider including technologies such as low emission diesel, renewable diesel, biodiesel, natural gas hybrids, and natural gas vehicles as technologies that can meet the immediate need to reduce both air quality and greenhouse gas emissions at lower costs. Commenter states that separating out near-zero technologies from the ACT regulation undermines CARB's process to find a comprehensive solution to air quality problems by comparing different technologies and pick the best pathway. [T2-80]

Comment: Commenter states that because Class 7 and Class 8 vehicles are more difficult to electrify, 0.02 low NOx vehicles would be a more accessible solution to meet near-term emission goals. [T2-82]

Comment: Commenter states the ACT regulation does not support the manufacture and purchase of low NOx engines, risking near-term progress towards San Joaquin and South Coast deadlines. Commenter states that the Board is, in effect, encouraging the purchase of today's diesel technology over RNG and low NOx technology. [T2-121]

Agency Response: No changes were made to the regulation in response to these comments. The ACT regulation is focused on accelerating the use of zero-emission vehicles where emissions associated with new combustion-powered vehicles and engines are being addressed in the recently approved Low NOx Omnibus rulemaking and existing cleaner fuels policies. Further details are found in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Credit for Low NOx Engines and Renewable Fuels".

From a process perspective, CARB provides the following general explanation about its procedural approach to conducting review of emission impacts in the context of adopting regulations.

CARB's emission analyses are based on the expected compliance responses of the regulated entities covered a proposed regulation. In other words, the potential indirect physical changes to the environment will be the result of reasonably foreseeable actions undertaken by other entities (both private and public) in response to a CARB regulation. For example, individual vehicle manufacturers or major refiners for hydrogen and renewable fuels could choose other compliance responses that result in different project impacts. It is not possible, however, to know with a reasonable level of certainty the specific actions that would be selected by regulated communities to comply with a CARB regulation. Such regulated entities, in addition to local communities, would be required to undergo project-level environmental review once they decide specific actions they need to take, which could conclude there are more adverse or less substantial environmental effects as those contained a CARB environmental review document.

Ultimately, CARB takes a conservative approach and considers some environmental impacts as potentially significant because of the inherent uncertainties in the relationship between the potential compliance responses that are reasonably foreseeable under the ACT Regulation and environmentally sensitive resources or conditions that may be affected by those responses. In other words, the speculative nature of trying to predict how the regulated community will respond with the level of specificity that would inform a detailed impact analysis is inherently uncertain given the high variability of potential physical development projects that could result in response to the ACT regulation. Therefore, in an effort to acknowledge the inherent uncertainty and speculative nature of attempting to forecast compliance responses and potential resultant physical projects (e.g., uncertainty about the location and extent of construction for new manufacturing and associated facilities, the ability to repurpose existing infrastructure, the number of manufacturers that will decide not to sell vehicles in California, and how fleets will respond by purchasing ZEVs or installing onsite energy storage) while still seeking to make good-faith, full-disclosure to the public, CARB tends to overstate environmental impacts.

Where a potentially significant environmental effect could not be feasibly mitigated with certainty, CARB identifies the impact as significant and unavoidable. These are significant and unavoidable impacts because all of the physical projects associated with compliance responses will be permitted by local land use agencies whose jurisdiction govern the use of the project site; CARB has no land use permit authority over development projects. These land use agencies are likely to employ a range of different approaches to mitigating impacts related to new infrastructure and manufacturing facilities that may be built as part of the compliance response to regulations, such as the ACT Regulation. Moreover, even if CARB had land use authority over future development projects, CARB does not have enough information about potential impacts to impose mitigation measures that meet the two constitutional requirements for the imposition of mitigation measures: (1) the need for the mitigation measures to show a connection that they mitigate actual, specific impacts from a project; and (2) the need for the mitigation measures to be "roughly proportional" to the impacts of the project. (Nollan v. California Coastal Commission (1987) 483 U.S. 825, 837; *Erlich v. City of Culver* (1996) 12 Cal.4th 854, 879-880; Title 14 CCR section 15126.4, subd. (a)(4).) As a result, CARB determined that the potential impacts from the reasonably foreseeable compliance responses and associated speculative projects could be significant and unavoidable in certain resource areas.

Manufacturer ZEV Sales – Near-Zero-Emission Vehicle Definition

Comment: Commenter requests the inclusion of the low NOx 0.02 gram engines as part of the near-zero definition because the proposed near-zero definition in the ACT is in conflict with the widely used near-zero definition. [T2-43, T2-54, T2-91]

Comment: Commenter states that they would like to change the definition of "near-zero" to include vehicles with Low NOx engines in order to meet near-term emissions goals before the first ACT compliance deadline. [T2-52, T2-85, T2-94]

Comment: Commenter states that the "Near-Zero" definition should include the 0.02 gram low NOx standard when coupled with renewable natural gas. [T2-70, T2-79, T2-110]

Agency Response: No changes were made to the regulation in response to these comments. See response summarizing how the term "near-zero-emission vehicle" is not appropriate to apply to vehicles meeting the recently approved Low NOx engine standard in chapter "Written Comments Submitted During Original Proposal's 45-Day

Comment Period", section "Manufacturer ZEV Sales – Near-Zero-Emissions Vehicle Definition".

Manufacturer ZEV Sales – Near-Zero-Emission Vehicle Definition - ePTO

Comment: Commenter states that the definition of near-zero should include work trucks that are primarily used to power the work functions. Commenter states a definition of all-electric mile range that provides partial emission credits doesn't allow solutions that would electrify the auxiliary functions and reduce stationary emissions. [T2-96]

Comment: Commenter requests that ePTO systems are included in the definition of near-zero-emission vehicles. [T2-109]

Agency Response: No changes were made to the regulation in response to these comments. Please see further details about why staff did not include ePTO technology in the manufacturer ZEV sales mandates in chapter "Written Comments Received during the 30-Day Comment Period", section "Manufacturer ZEV Sales - Add Credit for Electrified Power Take Off". In addition, please see further details about the "near-zero" definition in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Low NOx Needed for Long-Haul".

Manufacturer ZEV Sales – Adjustments to NZEV Credits

Comment: Commenter proposes that eligibility for the 75-mile all-electric range to continue to at least 2045. [T2-30]

Agency Response: No changes were made to the regulation in response to this comment. Please see the discussion about why extending the sunset date for plug-in hybrids could mean less preferred ZEV technology on the road in chapter "Written Comments Received during the 30-Day Comment Period", section "Manufacturer ZEV Sales – Adjustments to NZEV Credits".

Manufacturer ZEV Sales – Credit for Conventional Hybrids

Comment: Commenter encourages CARB to expand the compliance pathway to include partial credits for conventional heavy-duty hybrids. [T2-23]

Comment: Commenter states that partial credit for hybrid electric vehicles that meet the phase two GHG standards early would provide a path for faster CO_2 reduction. [T2-75]

Agency Response: No changes were made to the regulation in response to these comments. See staff discussion on why conventional hybrids do not need credit in the ACT regulation due to its already commercialized status in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Credit for Conventional Hybrids".

Manufacturer ZEV Sales – Extra Credit for ZEVs Based on Range

Comment: Commenter states CARB should assess how truck manufacturers and fleet operators could be incentivized to push for longer range vehicles through the credit system for trucks, because this aligns with the needs of the truck fleet operators and the longer-range vehicles with maximum payload capacity. [T2-41]

Agency Response: See response summarizing why staff is not proposing modifications to add credit for ZEVs based on range in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Extra Credit for ZEVs Based on Range".

Manufacturer ZEV Sales – Feasibility of Zero-Emission Refuse Trucks

Comment: Commenter requests consideration of a separate compliance pathway for the waste industry to address the industry's unique issues. Commenter states that the waste industry is often grouped with buses because of duty cycle characteristics but that these sectors are different because bus ridership is subsidized whereas the waste industry is funded by unsubsidized rates. [T2-39]

Agency Response: No changes were made to the regulation in response to this comment. The ACT regulation does not require any manufacturer to produce ZE refuse trucks nor does it require any refuse truck fleet to purchase ZEVs. Manufacturers must electrify a portion of their sales based on their own assessment of what they believe is best suited for electrification. Fleets have no requirement to purchase ZEVs as it is the responsibility of manufacturers to build ZEVs that meet fleets needs at an attractive price point. Based on this regulatory structure, it does not make sense to create a separate compliance pathway for the refuse industry given that they face no requirement to purchase ZEVs.

As part of the regulatory process, staff analyzed the feasibility of 87 different market segments as described in Appendix F to the staff report. This analysis included several different types of refuse trucks. Staff did not assess the feasibility of transit buses as they are outside the scope of the regulation, and staff did not base any feasibility assessments on the performance of zero-emission transit buses. For further discussion on the feasibility of zero-emission refuse trucks in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Feasibility of Zero-Emission Refuse Trucks".

Manufacturer ZEV Sales – ACT Labor Requirements

Comment: Commenter urges CARB to include strong labor requirements in the ACT regulation and related rules. [T2-86]

Agency Response: No changes were made to the regulation in response to this comment. See response discussion on the importance of labor issues and their impact on air quality, and staff's proposed changes to the large entity reporting requirement to ensure more potentially misclassified drayage workers are covered by the data reporting requirement for the entities that contract with them, in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Future ZEV Policy – Employee Misclassification Impact on Trucking Emissions".

Manufacturer ZEV Sales – Focus on Beachhead Markets

Comment: Commenter states that if a focused beachhead approach is used, the proposed higher percentage targets in the ACT regulation can be achieved. [T2-05]

Agency Response: No changes were made to the regulation in response to this comment. Please see the discussion about transitioning key beachhead markets to zero-emission in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Pair Manufacturer and Fleet Requirements".

Manufacturer ZEV Sales – Include Hydrogen Stored on Vehicle in AER Calculation

Comment: Commenter states that the definition of "all-electric range" should include energy stored on board the vehicle in the form of hydrogen that converts to electricity. [T2-49]

Agency Response: No changes were made to the regulation in response to this comment. The rationale for this definition is to set forth the meaning and test procedures by which NZEVs must be tested to determine the all-electric range needed to receive NZEV credit for this regulation. NZEVs are not currently expected to use hydrogen fuel cells due to the lack of any commercial product or announcement that manufacturers are developing this technology. Fuel cell vehicles earn full ZEV in the ACT regulation and therefore do not need their all-electric range considered.

Manufacturer ZEV Sales – Pair Manufacturer and Fleet Requirements

Comment: Commenter recommends an alternative approach that links the ZEV sales mandate with ZEV purchase requirements. [T2-12]

Comment: Commenter strongly recommends that the resolution language for the ACT regulation include a direct tie to the Fleet Rule. Commenter recommends that the language explicitly state that the ACT regulation will go into effect no less than two years after the Fleet Rule is adopted. [T2-34]

Agency Response: No changes were made to the regulation in response to these comments. Per Resolution 20-19, the Board directed staff to develop a zero-emission fleet rule that is consistent with the manufacturer rule for Board consideration in 2021. Generally, staff believes that the manufacturer sales mandate coupled with a future ZEV fleet rule is the best approach to give manufacturers lead time to produce vehicles, time for staff to receive and analyze the reporting and usage data, and craft an effective and equitable fleet rule. Infrastructure developments will happen concurrently through other state efforts. See staff response detailing the next rulemaking effort for fleets in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Pair Manufacturer and Fleet Requirements".

Manufacturer ZEV Sales - Add Midterm Reviews, Offramps, Market Reviews, or Appeals Process to Assess Regulation

Comment: Commenter recommends that the resolution language include a date next year for when CARB staff can present an update on the development of the fleet rule, the progress of the ACT regulation, and any amendments necessary. [T2-34]

Agency Response: No changes were made to the regulation in response to this comment. Staff intend to return to the Board with a recommendation in 2021 related to complementary strategies to further the deployment of ZEVs, and the approved ACT regulation can be adjusted at that time if staff and the Board deem it necessary. Staff does not believe mid-term reviews or checkpoints are necessary, as the pathway to meet the various ZEV goals described in the Board's final resolution will require, at minimum, full compliance with the approved regulation. For additional information, see response summarizing how off-ramps fail to add regulatory certainty in chapter "Written Comments Received during the 30-Day Comment Period", section "Manufacturer ZEV Sales – Add Midterm Reviews, Offramps, Market Reviews, or Appeals Process to Assess Regulation".

Manufacturer ZEV Sales – Add Travel and Pooling Provisions for Section 177 States

Comment: Commenter recommends that CARB include an optional compliance pathway for Section 177 states by adding a mechanism such as a credit pooling provision for the ACT regulation that will allow OEMs to pull credits within the east and west regions. [T2-34]

Agency Response: No changes were made to the regulation in response to this comment. Please see the discussion about why travel and pooling provisions were not included for Section 177 states in chapter "Written Comments Received during the 30-Day Comment Period", section "Manufacturer ZEV Sales – Add Travel and Pooling Provisions for Section 177 States".

Manufacturer ZEV Sales – Add Off-Ramps to the Proposal Due to COVID-19

Comment: Commenter believes that due to the pandemic a provision should be incorporated into the regulation to ensure truck manufacturers aren't deemed non-compliant for not reaching vehicle sales totals beyond those which can be achieved with limited, disconnected public funding for vehicles and infrastructure, as well as the long lead times for the charging infrastructure installation. [T2-07]

Agency Response: No changes were made to the regulation in response to this comment. See response detailing considerations for the impacts for COVID-19 in chapter “Written Comments Received during the 30-Day Comment Period”, section “Economic Analysis – Impact of COVID-19”. Additionally, see response summarizing how off-ramps fail to add regulatory certainty in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Manufacturer ZEV Sales – Add Off-Ramps to the Proposal”.

Manufacturer ZEV Sales – No Pay-to-Pollute Penalties

Comment: Commenter requests that CARB, in the final statement of reasons, reiterate that ZEV penalties are not intended to serve as a pay-to-play mechanism and further clarify that penalties applied to deficits that have not been made up in the time allotted, do not obviate the need for manufacturers to fill ZEV credit deficits. [T2-57]

Agency Response: No changes were made to the regulation in response to this comment. See discussion about how manufacturers must still make up deficits even if assessed a penalty for non-compliance in chapter “Written Comments Received during the 30-Day Comment Period”, section “Manufacturer ZEV Sales – No Pay-to-Pollute Penalties”.

Manufacturer ZEV Sales – Infrastructure Concerns

Comment: Commenter supports creating public or private partnerships to address infrastructure challenges. [T2-34]

Comment: Commenter states that there needs to be more focus on fueling infrastructure for the zero-emission trucks because it incentivizes investment in renewable fuel production capacity, both for hydrogen and electricity. [T2-41]

Comment: Commenter states that the ACT regulation needs to address the infrastructure needed to extend the reach of these ZEV technologies with energy that is renewably sourced. [T2-107]

Comment: Commenter urges CARB to collaborate with utilities, local air districts, and manufacturers to implement infrastructure, specifically in Inland Empire communities. [T2-119]

Agency Response: No changes were made to the regulation in response to these comments. See the discussion about infrastructure incentive programs from utilities and the State’s long-term development strategies, as well as how the large entity reporting requirement will support infrastructure development in chapter “Written

Comments Submitted During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Infrastructure Concerns".

Manufacturer ZEV Sales – Delay Until 2026

Comment: Commenter presents an alternative approach that proposes the sales mandate begin in 2026 to allow time for staff to develop and implement the fleet rule, develop the necessary charging infrastructure, recovery from current budget crisis, allocate funds for incentives, and time for manufacturers to recover from the impacts of the COVID crisis. [T2-12]

Agency Response: No changes were made to the regulation in response to this comment. Delaying the start of the rule is inconsistent with Board direction to increase the number of ZEVs deployed. See discussion on staff's rationale to increase the regulation's requirements in chapter "Written Comments Submitted During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Strengthen the ACT Proposal by Including Pickups Earlier and /or Increasing Sales Percentage Requirements". In addition, see response detailing why impacts from the COVID-19 pandemic will not affect this regulation in chapter "Written Comments Received during the 30-Day Comment Period", section "Economic Analysis – Impact of COVID-19".

Manufacturer ZEV Sales – 15- and 30-Day Changes Timeframe Insufficient

Comment: Commenter would like an explanation for the use of 15-Day and 30-Day changes of major regulations (i.e., ACT and At Berth) because staff made significant changes after the initial hearing at the direction of the Board. Commenter states the analyses for these changes has not been as rigorous as it was for the initial proposals and expresses concern that the process may discourage legitimate and valuable course corrections. [T2-70]

Agency Response: No changes were made to the regulation in response to this comment. The regulatory process includes mandatory comment periods for any rulemaking. After the Staff Report was posted and the 45-day comment period and public hearing concluded, direction from the Board and many comments from the public lead to modifications to strengthen the ACT regulation. Any time there are substantial changes made to a proposed regulation, another comment period has to occur. Staff doubled the amount of time required, a total of 30 days, for the public to comment on the modified regulations and the supporting analyses of the now approved ACT regulation to address concerns related to the COVID-19 pandemic. Staff had already performed rigorous analyses in the Staff Report to address technological feasibility, cost, emissions, and health benefits. That initial analysis was expanded and updated with the new information gathered after the Staff Report was released to reflect the ongoing market changes supporting increases to the ZEV sales requirements. The modifications after the First Board hearing can be found in Attachment C to the 30-Day Changes. The additional information added in Attachment C indicated that electrification is more suitable than the original model in the Staff Report, and the new requirements were supported by these new findings.

Manufacturer ZEV Sales – ZEV Reliability

Comment: Commenter asks, what is CARB's expectations for ZEV reliability and how does CARB propose to meet reliability targets to ensure customers/companies have a product that remains in operation and stays within monetary limits? [T2-105]

Agency Response: No changes were made to the regulation in response to this comment. CARB adopted the optional Zero-Emission Powertrain Certification regulation on June 27, 2019. The approved ACT regulation requires that ZEVs sold into California must meet the requirements of the Zero-Emission Powertrain Certification regulation starting with the 2024 model year. This requirement establishes minimum criteria for the quality and reliability of ZEVs, provides emissions warranty to the vehicle purchaser, ensures information regarding ZEVs and their powertrains are effectively and consistently communicated to purchasers, and accelerates progress towards greater vehicle reparability. CARB anticipates that ZEV technology will continue to rapidly improve thereby increasing reliability, and as the market matures, costs will continue to decrease.

Manufacturer ZEV Sales – BEVs vs FCEVs

Comment: Commenter states that hydrogen fuel cell vehicles are verified to be zero-emissions technology, however it is difficult to verify the content of emissions from battery charging. [T2-78]

Comment: Commenter states that hydrogen fuel cells are produced by fossil fuels and are half as efficient as batteries, while the Community Choice electricity the commenter uses to plug-in is 88% carbon free. [T2-90]

Agency Response: No changes were made to the regulation in response to these comments. Staff disagrees with commenter that hydrogen fuel cells are produced entirely by fossil fuels. Hydrogen is produced from several different sources which include electrolysis from water, steam reformation from renewable sources, biomethane capture from the breakdown of organic waste from landfills, wastewater, animal waste, crop residuals, and food waste, and fossil fuel natural gas. In addition, the LCFS program incentivizes the production and use of renewable hydrogen by providing higher credit values per kilogram of hydrogen when compared to fossil fuel hydrogen. Finally, SB1505 emphasizes the use of renewable hydrogen to diversify sources of transportation energy.

Additionally, staff disagrees with commenter that it is difficult to verify the emissions associated with battery charging. CARB is able to determine the carbon intensity of emissions from battery charging (the emissions resulting from the generation and distribution of electricity). Through the LCFS program, there are three Lookup Table pathways available to identify the carbon intensity of electricity used as a fuel for transportation. These pathways include the California Average Grid Electricity, zero-carbon intensity electricity, and smart charging/smart electrolysis. For more information on the LCFS electricity pathways, please visit https://ww2.arb.ca.gov/resources/documents/lcfs-electricity-and-hydrogen-provisions.

Manufacturer ZEV Sales – Remove Zero-Emission Powertrain (ZEP) Certification Requirements

Comment: Commenter states that the zero-emission powertrain rule puts additional compliance costs on every manufacturer which would make it more difficult for start-ups to enter the market without some form of waiver to reduce the costs. [T2-96]

Agency Response: No changes were made to the regulation in response to this comment. The ZEP certification procedures are critical for ensuring manufacturers are developing quality products for consumers through its provisions. Please see the discussion about ZEP certification in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Remove Zero-Emission Powertrain (ZEP) Certification Requirements". In addition, CARB offers a portfolio of incentive programs which are designed to incentivize technology from early demonstrations to full scale commercial deployment. The demonstrations and pilot projects funded through our incentive programs help reduce costs, increase experience with the new technologies, and expand the overall ZEV marketplace.

Economic Analysis – General Cost Concerns

Comment: Commenter states they are concerned about the financial burden to independent and misclassified drivers resulting from the purchase of new equipment. [T2-87]

Agency Response: No changes were made to the regulation in response to this comment. See staff discussion on how ZEVs will save money over time versus diesel vehicle and how there is not a purchasing requirement for fleets in chapter "Written Comments Received during the 30-Day Comment Period", section "Economic Analysis – General Cost Concerns". Also, see staff discussion on changes made that will help gather more information to address misclassification issues in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Future ZEV Policy – Employee Misclassification Impact on Trucking Emissions".

Economic Analysis – Include More Fuel Cell Vehicles

Comment: Commenter states that there needs to be more of a balance between battery electric and fuel cell electric technologies in the proposed regulation. Commenter states the hydrogen fuel cell electric truck option appears to be considered as a marginal contributor in the impact calculations. [T2-41]

Agency Response: No changes were made to the regulation in response to this comment. Battery-electric and fuel cell electric technologies are treated equally as credit generators in the approved ACT regulation. Staff's analyses only included hydrogen fuel cell vehicles as a small percentage due to lack of currently commercial vehicles and larger near-term barriers to adoption of these vehicles.

Economic Analysis – Underestimated Tractor Battery Capacity Needs

Comment: Commenter states, citing a Gladstein, Neandross and Associates analysis, that battery capacity for [tractor] range is underestimated by 50%, which negates CARB's idealized assumptions regarding fleet operations. [T2-54]

Agency Response: No changes were made to the regulation in response to this comment. See discussion about staff's assumptions for fleets used to determine the battery sizing used in the analysis in chapter "Written Comments Received during the June 2020 Board Hearing", section "Economic Analysis – Underestimated Tractor Battery Capacity Needs".

Economic Analysis – Ignored Insurance Cost

Comment: Commenter states that the TCO analysis did not include insurance costs. [T2-54]

Agency Response: No changes were made to the regulation in response to this comment. See discussion on insurance costs in chapter "Written Comments Received during the June 2020 Board Hearing", section "Economic Analysis – Ignored Insurance Cost".

Economic Analysis – Cost Analysis Underestimates Total Cost of Ownership

Comment: Commenter states that the total cost of ownership for ZEVs is underestimated by 80% to 90%. [T2-54]

Agency Response: No changes were made to the regulation in response to this comment. Please see the discussion regarding CARB's methodology to evaluate costs to the state as a whole and the total cost of ownership for a vehicle in chapter "Written Comments Received during the 30-Day Comment Period", section "Economic Analysis – General Cost Concerns". In addition, see the discussion about vehicle cost in chapter "Written Comments Received during the 30-Day Comment Period", section "Economic Analysis – Cost Analysis Underestimates Vehicle Cost".

Economic Analysis – Underestimated Infrastructure Network Service Costs

Comment: Commenter states that the TCO analysis did not include the cost of the charger network service and insurance costs. [T2-54]

Agency Response: No changes were made to the regulation in response to this comment. See discussion on insurance costs in chapter "Written Comments Received during the June 2020 Board Hearing", section "Economic Analysis – Underestimated Infrastructure Network Service Costs". See also discussion on insurance costs in chapter "Written Comments Received during the June 2020 Board Hearing", section "Economic Analysis – Ignored Insurance Cost".

Economic Analysis – Fleet Infrastructure Resilience

Comment: Commenter states that fleet infrastructure redundancy and resiliency were not considered in the TCO analysis. [T2-54]

Agency Response: No changes were made to the regulation in response to this comment. See discussion on the work California is undertaking to bolster resilience and the role of ZEVs in chapter "Written Comments Received during the 30-Day Comment Period", section "Economic Analysis – Fleet Infrastructure Resilience".

Economic Analysis – Impact of COVID-19

Comment: Commenter doubts the market's readiness to absorb the volumes proposed in this regulation due to lack of infrastructure and economic impacts of the pandemic, including reduced carbon auction revenue that will impact HVIP funding to support early ZEV sales. [T2-07]

Comment: Commenter states that due to the pandemic, the degree of difficulty to implement the ACT regulation has increased. [T2-95]

Agency Response: No changes were made to the regulation in response to these comments. For discussion on staff's recognition of COVID-19's impact on the trucking industry and why staff feels the regulation's requirements are feasible see chapter "Written Comments Received during the 30-Day Comment Period", section "Economic Analysis – Impact of COVID-19".

Emissions Methodology – Include Upstream Emissions

Comment: Commenter states that CARB needs look beyond the GHG emissions from the tailpipe and consider the source of electricity generation. [T2-90]

Agency Response: No changes were made to the regulation in response to this comment. See discussion detailing how staff already assessed well-to-wheel GHG emissions and why it is not appropriate to include NOx or PM upstream emissions in the emissions analysis for this regulation in chapter “Written Comments Received during the 30-Day Comment Period”, section “Emissions Methodology – Include Upstream Criteria Pollutants”.

Large Entity Reporting – Clarify Light-Duty Fleets With One Truck Are In Scope

Comment: Commenter states additional clarification is needed on whether light-duty fleet companies that own one large truck are required to report. [T2-85]

Agency Response: No changes were made to the regulation in response to this comment. The reporting requirement applies to entities that had annual revenues greater than $50 million in 2019 and had one or more vehicles over 8,500 lbs. GVWR under common ownership or control in California. For entities below the annual revenue threshold, the reporting requirement applies to fleet owners with 50 or more vehicles with a GVWR greater than 8,500 lbs. under common ownership or control and brokers/entities that dispatch 50 or more vehicles with a GVWR greater than 8,500 lbs. Light-duty vehicles have no reporting requirements and vehicle home bases with only light-duty vehicles do not need to be reported.

Large Entity Reporting – Timing of Data Collection

Comment: Commenter requests that CARB consider the differences between construction fleets and delivery fleets for fleet reporting and the impacts of COVID-19 on the quality of data required in April. [T2-69]

Agency Response: No changes were made to the regulation in response to this comment. While the pandemic is having significant impacts on the economy as a whole, many sectors in the trucking industry appear to be relatively unaffected by the economic slowdown. Because of this, the data submitted will still be of high quality, useful, and critical as staff continues developing future zero-emission fleet rules. Staff have already included additional flexibility in selecting representative time periods for data collection, described in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Large Entity Reporting – Timing of Data Collection”.

With regards to the differences between fleet types, staff is in the process of developing the specifics of a future fleet rule to identify which segments and associated fleet sizes are most suitable for electrification. The fleet segment information collected from the reporting requirement will be considered and critical to the development of the fleet rule.

Large Entity Reporting – Reporting Guidance Needed

Comment: Commenter states that there needs to be proper education on reporting to get all of the data needed to make the ACT regulation successful. [T2-92]

Agency Response: No changes were made to the regulation in response to this comment. Staff is in the process of developing a standardized reporting template/system. Staff will also conduct stakeholder outreach and hold a public workshop in the near future to allow entities the opportunity to provide feedback on the system.

Large Entity Reporting – Insufficient Outreach

Comment: Commenter states that they would like more collaboration with CARB on regulations that impact their industry. [T2-52]

Agency Response: See response detailing outreach actions staff undertook during the public process of this regulation, including workshops, workgroup meetings, and a mass mailout in chapter “Comments Received During Original Proposal’s 45-Day Comment Period”, section “Large Entity Reporting – Insufficient Outreach”.

Large Entity Reporting – Strengthen the Reporting Requirement

Comment: Commenter states the reporting requirement should be strengthened. [T2-89]

Comment: Commenter states that the 50-vehicle threshold is not low enough, as it would not gather information about the majority of small fleets, which is critical. [T2-117]

Agency Response: No changes were made to the regulation in response to these comments. Staff previously lowered the threshold for respondent fleets from 100 to 50 vehicles. Based on available information, staff believes that lowering this number further would result in exponentially more fleet respondents with diminishing returns on the value added by the additional data. Lowering the threshold further would be contrary to the Board’s direction to streamline the reporting requirement. Please see the discussion about lowering the reporting requirement for fleets in chapter “Written Comments Received during the 30-Day Comment Period”, section “Large Entity Reporting – Smaller Fleet Considerations”. The information required captures the information necessary to support the development of the fleet rule; adding more questions could significantly increase the amount of data collection required for fleets. Staff believes an appropriate balance was struck.

Large Entity Reporting – Unclear Language Will Require Technical Support

Comment: Commenter states that the rule requires significant interpretation by the regulated community and doesn't address enforcement penalties. Commenter states that if CARB adopts the ACT regulation without language fixes, resources should be dedicated for technical support to comply with the regulation. [T2-85]

Agency Response: No changes were made to the regulation in response to this comment. See response detailing proposed clarifications and streamlining of the large entity reporting requirement in chapter “Comments Received During Original Proposal’s

45-Day Comment Period", section "Large Entity Reporting – Unclear Language, Unclear Requirements, Unnecessary Information".

With regards to enforcement penalties, staff added section 1963.5(a)(4) in the approved regulation to provide stakeholders clarity in the event of manufacturer noncompliance and to ensure a consistent methodology in determining how the penalty should be assessed. Staff's intent is to collect useful data with the reporting requirement and will work with regulated entities if questions arise. Please see the discussion about remediation pathways without enforcement action in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Large Entity Reporting – Enforcement Concerns". In addition, staff is in the process of developing Large Entity Reporting guidance and a standardized reporting template/system. Staff will also conduct a virtual public workshop in the near future to allow entities the opportunity to provide feedback on the reporting template/system.

Future ZEV Policy – Include Labor Standards as Part of Incentives Used for Future Fleet Rules

Comment: Commenter recommends that CARB include labor standards with any funds distributed as part of the Fleet rule. [T2-29]

Agency Response: No changes were made to the regulation in response to this comment. This comment is outside of the scope of the ACT rulemaking. Please see the discussion on the importance of labor issues and their impact on air quality, and staff's proposed changes to the large entity reporting requirement to ensure that more potentially misclassified drayage workers are covered by the data reporting requirement for the entities that contract with them, in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Future ZEV Policy – Employee Misclassification Impact on Trucking Emissions".

Future ZEV Policy – Adopt Zero-Emission Fleet Rule

Comment: Commenter states the need for a strong fleet rule to attain climate goals and to protect public health. [T2-10]

Comment: Commenter encourages CARB take complementary actions such as accelerating the adoption of the pending fleet rule, and passing a resolution to establish a target date for when the State can achieve hundred percent zero-emission truck fleets. [T2-66]

Comment: Commenter states they support a strong Fleet rule with strong reporting requirements. [T2-87]

Agency Response: No changes were made to the regulation in response to these comments. The Board directed staff to bring a fleet rule for Board consideration by the end of 2021, which is earlier than initially proposed, when they approved the Resolution. For further detail on the topic, refer to chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Future ZEV Policy – Adopt Zero-Emission Fleet Rule in 2021". Please see the discussion on establishing 100 percent zero-emission targets in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Future ZEV Policy – Set Clear 100 Percent ZEV Targets".

Future ZEV Policy – Remove "Everywhere Feasible" from 100 Percent ZEV Targets

Comment: Commenter states that the "everywhere feasible" caveat to the proposed goal of 100% ZE by 2045 should be removed because the caveat leaves room for interpretation and confusion. [T2-72]

Agency Response: No changes were made to the regulation in response to this comment. The Board directed staff to work towards an ultimate goal of 100 percent zero-emission, where feasible, by 2045 when they approved the Resolution. It is not currently feasible to require 100% ZEVs in all use cases. As technology improves, staff and the Board can revisit the goals if needed. See discussion detailing ZEV transition goals in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Future ZEV Policy – Set Clear 100 Percent ZEV Targets".

Future ZEV Policy – Strengthen Timelines and Targets in Future ZEV Rules

Comment: Commenter states that the ACT regulation does not go far enough to protect public health and CARB must institutionalize, strengthen, and speed up the timelines and targets in subsequent rules for electrification and ZEVs adoption. [T2-86]

Comment: Commenter states that they support the transition to ZEVs for all public transportation. [T2-97]

Agency Response: No changes were made to the regulation in response to these comments. See discussion detailing ZEV transition goals in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Future ZEV Policy – Set Clear 100 Percent ZEV Targets".

Future ZEV Policy – Employee Misclassification Impact on Trucking Emissions

Comment: Commenter states the need to address the issue of driver misclassification of independent contractors in the fleet rule. [T2-10, T2-72, T2-101, T2-102]

Comment: Commenter states support for strong labor standards to prevent the exploitation of independent contractors in the truck driving sector. [T2-11]

Comment: Commenter urges CARB to include language in the resolution that addresses the problem of misclassified drivers and illegal contracting industry. [T2-35]

Agency Response: No changes were made to the regulation in response to these comments. See response discussion on the importance of labor issues and their impact on air quality, and staff's proposed changes to the large entity reporting requirement to ensure more potentially misclassified drayage workers are covered by the data reporting requirement for the entities that contract with them, in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Future ZEV Policy – Employee Misclassification Impact on Trucking Emissions".

Future ZEV Policy – Disadvantaged Community Policy

Comment: Commenter states that poor air quality in low income communities must be addressed because these communities are usually located in areas subjected to more pollution which contribute to health issues in these communities. [T2-81]

Agency Response: No changes were made to the regulation in response to this comment. CARB recognizes the need to improve air quality in disadvantaged communities and sees the ACT regulation in combination with future ZE fleet rules as key components of helping these communities. The manufacturer sales requirement does not direct where trucks are to be placed but follows up with other requirements for fleets to report information about their vehicle home base locations.

Staff made numerous modifications to the original to increase the number of ZEVs deployed in California consistent with commenters and the Boards request. One of the many changes included the increase in class 7 and 8 tractor group sales percentages to ensure there are sufficient tractor sales to meet the goal of achieving an all zero-emission drayage fleet by 2035 which would directly benefit disadvantaged communities. For further details on the changes made to the original proposal to positively impact the environment and disadvantaged communities, please refer to chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Strengthen the ACT Proposal by Including Pickups Earlier and/or Increasing Sales Percentage Requirements".

In July 2017, Governor Brown signed Assembly Bill (AB) 617 to reduce air pollution and the associated health impacts in highly impacted communities. To implement AB 617, CARB Board approved the Community Air Protection Blueprint at a September 27, 2018 Board hearing, which includes strategies to reduce emissions and establishes Program requirements. For more information about CARB's implementation of AB 617, see https://ww2.arb.ca.gov/our-work/programs/resource-center/ab-617-implementation.

Out of Scope – Incentives and Funding Policies

Comment: Commenter states that there needs to be incentive funding for successful implementation of the ACT regulation. [T2-05]

Comment: Commenter states that in order to meet sales targets, there must be adequate vehicle and infrastructure incentives, in addition to the Fleet Rule which is currently in development. [T2-56]

Comment: Commenter states that there should be incentives provided for the use of low carbon fuels in ultra-low NOx trucks to accelerate CO2 reduction in the non-electric portion of fleets. [T2-75]

Comment: Commenter states there needs to be incentives and other policies that would align with the ACT regulation during this critical phase amidst the pandemic. [T2-88]

Comment: Commenter states there needs to be more funding for oversubscribed programs. [T2-92]

Comment: Commenter states that there needs to be support for smaller fleets. [T2-92]

Comment: Commenter states that incentives are needed to encourage the adoption of ZEVs to ensure a successful ACT regulation. [T2-104]

Comment: Commenter supports funding for small fleets and independent contractors. [T2-117]

Comment: Commenter supports funding for ZEV medium- and heavy-duty vehicles for either the fleet and/or manufacturers that achieve these higher measures and other advancements. [T2-117]

Comment: Commenter states that ZEV manufacturers are in critical need of more support and programs available for educating fleets, garage services, and dealerships in order to achieve the aimed adoption. [T2-117]

Agency Response: No changes were made to the regulation in response to these comments. Staff did not include incentives in the economic analysis, and the ACT regulation is not predicated on the availability of incentives. See discussion about CARB incentives policy in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Out of Scope – Incentive and Funding Policies".

Out of Scope – Rule Abandons Natural Gas Infrastructure

Comment: Commenter states concern that the natural gas vehicles and infrastructure that they invested in are being abandoned by the current process. [T2-121]

Agency Response: No changes were made to the regulation in response to this comment. See staff discussion on how the ACT regulation does not require fleets invested in natural gas to strand their assets in chapter "Written Comments Received during the 30-Day Comment Period", section "Economic Analysis – Ignores CNG Investments and Impacts from Stranding Those Investments."

Staff will evaluate the status of natural gas infrastructure during development of the future ZE fleet rule to the extent that the rule affects existing infrastructure.

Out of Scope – Support In-State RNG Production

Comment: Commenter states that a strategy that reduces GHG emissions by using in-state RNG fuel in refuse collection vehicles should be encouraged and approved by CARB. [T2-32]

Agency Response: No changes were made to the regulation in response to this comment. Commenter statement is out of the scope of the ACT regulation because it is asking for strategies on clean fuels rather than clean vehicles. The purpose of the ACT regulation is to foster and accelerate the adoption of medium- and heavy-duty ZEVs. CARB has other policies in place to encourage the adoption of low-carbon fuels such as the LCFS regulation. These other policies are incentivizing production of clean fuels including production within California and are the more appropriate path for accommodating these fuels.

Out of Scope – Infrastructure Effects on Small Businesses

Comment: Commenter states that the utilization of charging is impacting electric tariff rate designs resulting in a low load factor barrier which affects small fleets and will produce data gaps if a program is not developed to support small fleets. [T2-117]

Agency Response: This comment is outside of the scope of the modifications to the ACT rulemaking. It is too early to identify the impacts of large-scale EV charging on electricity tariff rates. The IOUs are currently developing Transportation Electrification Plans to ensure that new vehicle loads are integrated into the electrical system efficiently and identify strategies to improve existing EV-specific tariffs. In addition, future fleet rules will likely target larger businesses and segments that are well-suited for electrification in the earlier years, allowing sufficient time for infrastructure issues that may affect smaller fleets to be worked out.

Out of Scope – Encourage Infrastructure Deployment to Stimulate COVID Economy

Comment: Commenter states that due to the economic impact from COVID-19, it is important to encourage infrastructure development to stimulate the economy. [T2-79]

Agency Response: No changes were made to the regulation in response to this comment. See the discussion about infrastructure incentive programs from utilities and the State's long-term development strategies, as well as how the large entity reporting requirement will support infrastructure development in chapter "Written Comments Submitted During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Infrastructure Concerns", and discussion about staff's recognition of COVID-19's impact on the trucking industry and why staff feels the regulation's requirements are feasible see chapter "Written Comments Received during the 30-Day Comment Period", section "Economic Analysis – Impact of COVID-19".

Out of Scope – Zero-Emission Powertrain Certification Performance Standards

Comment: Commenter supports strengthening performance standards through zero-emission powertrain certification in order to promote innovation in clean vehicles. [T2-75]

Agency Response: No changes were made to the regulation in response to this comment. Changes to the Zero-Emission Powertrain Certification program are outside the scope of the current proposal. In addition, see discussion on why performance-based metrics for zero-emission performance are not appropriate in chapter "Written Comments Received during the 30-Day Comment Period", section "Manufacturer ZEV Sales – Set Performance-Based Targets for Zero-Emission Technologies".

Out of Scope – Hydrogen Policies

Comment: Commenter states that to meet SIP and climate goals, more work is needed in areas such as addressing infrastructure issues, integrating hydrogen and fuel cell reversible electrolyzers, vehicle-to-grid integration, and the use of excess renewables in order to move towards 100 percent renewable hydrogen. [T2-33]

Comment: Commenter recommends adding renewable hydrogen production and hydrogen fueling stations in parallel efforts to support the ACT regulation. [T2-78]

Agency Response: No changes were made to the regulation in response to these comments. See discussion about infrastructure concern in chapter "Comments Received During Original Proposal's 45-Day Comment Period", section "Manufacturer ZEV Sales – Infrastructure Concerns". Furthermore, see the discussion about manufacturing Hydrogen vehicles to meet emissions reduction goals in chapter "Written Comments Received during the 30-Day Comment Period", section "Manufacturer ZEV Sales – Promote Hydrogen Fuel Cell Electric Vehicles and Associated Incentives".

WRITTEN COMMENTS RECEIVED DURING THE SECOND 15-DAY COMMENT PERIOD

Comments in Support of the Regulation

Comment: Commenter supports staff's regulatory proposal to reduce emissions from trucks. [RP2-01, RP2-02, RP2-03, RP2-04, RP2-08]

Agency Response: Staff appreciates the supportive comments.

Comments Related to Documents Added to Record

Comment: Commenter states two documents added to record as part of the second 15-day comment period follow the flawed regulatory structure of the ACT Regulation by expecting a sales mandate alone to establish a commercial ZEV market. This ignores barriers such as the need for fleets to earn profit on the vehicle, and challenges from the lack of available infrastructure, lower utility of ZEVs, and higher lifecycle costs. [RP2-07]

Agency Response: No changes were made to the regulation in response to this comment. See staff's response to EMA's various issues with the regulatory structure of the ACT Regulation in chapter "Comments Received During Original Proposal's 45-Day Comment Period", sections "Manufacturer ZEV Sales – Pair Manufacturer and Fleet Requirements", "Manufacturer ZEV Sales - EMA Proposal", and "Manufacturer ZEV Sales – Higher Costs Are Barrier to ZEV Deployment".

Out of Scope – Various

Comment: Commenter provides comments on the regulatory process for the Advanced Clean Fleets regulation. Commenter repeats criticism of the ACT Regulation, including a perceived lack of addressing needed ZEV infrastructure and needed long-term funding to purchase the vehicles. [RP2-07]

Comment: Commenter states the ACT Regulation ignores: the lifetime benefits of fuel cell vehicles compared to battery electric vehicles; the payload, weight, and profit/operations benefits of fuel cells vs battery electric; and the environmental hazards and associated AB617 impacts of battery production and disposal. [RP2-05]

Comment: Commenter states auxiliary or PTO equipment usage and average hours of vehicle operations should be included in the Large Entity Reporting requirement to capture information that better characterizes their fleet usage compared to metrics such as average daily mileage. Commenter also states the regulation does not provide sufficient time to collect the data needed to report which creates additional workload for their staff, and requests CARB create outreach opportunities with fleet managers which will allow agencies to explain their operations and ensure the data is accurately reported by CARB. Commenter requests CARB update their analysis of current and future available ZEVs and sources of funding for government agency procurements. Commenter also requests CARB allow LCFS fuels to be counted as offsetting emissions due to already investing significant capital in alternative fuel vehicles and infrastructure. [RP2-06]

Agency Response: No changes were made to the regulation in response to these comments. Per the “Second Notice of Public Availability of Additional Documents and Information”, comments submitted during the 15-day period must be responsive to the notice or documents added to the record. These comments do not reference the notice or the documents added to the record and therefore are outside of the scope of the notice. Additionally, all topics commenters refer to have been addressed elsewhere in this document and responses can be found in the relevant sections.

V. PEER REVIEW

Health and Safety Code Section 57004 sets forth requirements for peer review of identified portions of rulemakings proposed by entities within the California Environmental Protection Agency, including CARB. Specifically, the scientific basis or scientific portion of a proposed rule may be subject to this peer review process. Here, CARB determined that the rulemaking did not contain a scientific basis or scientific portion subject to peer review, and thus no peer review as set forth in section 57004 needed to be performed.

The regulation requires medium- and heavy-duty manufacturers to produce and sell ZEVs and requires large businesses, fleets, and government agencies to report information on their vehicles and how they use them. Requirements to build and sell ZEVs and report information do not establish “a regulatory level, standard, or other requirement for the protection of public health or the environment,” such as an ambient air quality standard or toxic exposure level. As such, it does not have a “scientific basis” or “scientific portions” that form the foundations of a regulatory standard or level.

The scientific studies and assessments used to analyze the potential environmental impacts of these regulations, such as the findings that diesel particulate is a toxic air contaminant and that greenhouse gases contribute to climate change were developed previously and subject to public review.

Appendix E
Zero Emission Truck Market Assessment

Table of Contents

Table of Figures

This appendix provides a market assessment and discusses the suitability of zero-emission vehicles (ZEVs) in the medium and heavy-duty commercial space.

A. Introduction

The future expansion of the medium and heavy-duty ZEV market is dependent on matching the suitability of zero-emission technologies with fleet operational needs. The California Air Resources Board (CARB) staff worked with various stakeholders during the rulemaking process, including the Truck and Engine Manufacturers Association (EMA), to help identify those truck market segments where the operational nature of ZEVs would be compatible with existing truck uses. EMA developed an initial assessment matrix of the suitability of battery electric applications for Class 2B through 8 commercial vehicles by identifying 87 market segments and 4 suitability factors to rank the compatibility of each market segment for electrification.

In addition to grading the suitability of ZEVs for each market segment, the assessment identified the general vehicle specifications needed by fleets that operate in each segment. The assessment also identified whether vehicles in each segment are built complete by manufacturers, or originally built as an incomplete vehicle (e.g., completed by a bodybuilder). Finally, the assessment includes estimates of the annual sales for each market segment, based on information provided by manufacturers derived from Polk registration data in California. The EMA sales numbers are generally consistent with 2016 and 2017 model year annual registrations in California.

CARB staff updated the suitability analysis to include effects of legislation and other sources of truck operational data and used quantitative method to assign a weighting factor representing the suitability for each vehicle market segment. CARB staff also extended the assessment to include fuel cell electric vehicles (FCEVs). This updated assessment was released by CARB staff as the “Advanced Clean Truck Market Segment Analysis[1]” which includes specific comments addressing all modifications CARB staff made to the original suitability factors developed by EMA. An abridged version of this assessment can be found in section E.

In addition, a more detailed overview of CARB staff’s review and assessment of each suitability factor may be found in section B. CARB staff’s final assessment and suitability results can be found in section C and section D.

The key findings from the “Advanced Clean Truck Market Segment Analysis” indicates that nearly 40 percent of sales may be suitable for transition into ZEV powertrains. The

[1]California Air Resources Board. ACT Market Analysis. February 22, 2019. https://ww2.arb.ca.gov/index.php/sites/default/files/2019-02/190225actmarketanalysis.xlsx

highest suitability for electrification are uses with predictable routes with daily VMT of under 100 miles, where weight or space is not compromised with the ZEV powertrain, and vehicles are expected to be in centralized operations where they return to base. The assessment identified that just over 70 percent of Class 4-7 vehicle sales are into markets that present a good fit for electrification today while roughly 30 percent of Class 2b-3 and Class 8 vehicles provide a good fit for electrification based on operational characteristics. These percentages are expected to increase as further advances are made in zero-emission technologies.

B. CARB Assessment of ZEV Suitability Factors

CARB staff reviewed the four suitability factors presented in the original EMA assessment and this section provides a detailed analysis of the changes made to each of these four suitability factors; weight, route/range, chagrining/fueling infrastructure, and battery/vehicle space constraints.

1. Weight

Battery-electric and fuel cell electric technology could reduce payload or increase weight compared to conventional vehicles depending on range needs, however AB 2061 allows for higher weights in California. AB 2061 which increases the weight limits by 2,000 lbs. for alternative fueled vehicles including zero emission vehicles[2]. The powertrain of a diesel vehicle includes many components not present in electric powertrains, (drivelines, transmissions and the engine) reducing the impact of a ZE powertrain on weight. In addition for some vehicle classes the owner has the option to use a higher weight class to account for any increased weight of ZEVs if necessary. Additionally, some ground-up BEV designs are lighter than their conventional counterparts through use of lightweight composite materials, as demonstrated by Proterra in their transit buses and by Chanje with their vans. In general, the hydrogen powertrain is less than that of a battery-electric powertrain for meeting higher range needs.

2. Route/Range

While high daily range requirements occur, both the US and California Vehicle In-Use Surveys (VIUS) as well as EMFAC analysis and market studies show that, on average, most trucks travel less than 100 vehicle miles travelled per day (VMT per day). This implies that range limitations may not be the primary concern for a wide range of applications. In addition as larger fleets begin to purchase ZEVs, they will be a small

[2]California Legislature. Assembly Bill No. 2061 Chapter 580. (web link: https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB2061)

percentage of the fleet and can use conventional vehicles to meet longer range needs until ZEV technology advances and infrastructure is built out to meet all of their needs. Staff assumed the range of FCEVs would be equivalent to conventional vehicles but that fueling would still primarily occur at the fleet yard.

3. Charging/Fueling Infrastructure

Centralized deployments, where vehicles return to a depot or similar location a night, is expected to be the primary situation where BEVs are initially used and where charging infrastructure can be installed. Charging at night over extended periods also results in lower cost charging during off-peak hours. Similarly, for FCEVs, staff also assumed hydrogen stations would initially be primarily installed in centralized yards except for vehicles in Class 2B-3 because they would likely be able to fuel at light duty hydrogen stations.

4. Battery/Vehicle Space Constraints

The original EMA assessment of battery and vehicle space constraints was generally accepted by workshop participants and no changes were made to the original assessment regarding suitability for space or weight constraints.

C. Final CARB Market Segment and Suitability Analysis

CARB staff released a final market segment and suitability analysis titled “Advanced Clean Truck Market Segment Analysis” to show the suitability of zero-emission (ZE) powertrains for each of the 87 market segments. The analysis reflects estimated suitability for existing ZEV vehicle technology. This assessment is based on four vehicle operating characteristics including the following:

- Weight,
- Route/range,
- Charging/fueling infrastructure access, and
- Battery/vehicle space constraints.

The characteristics for each market segment was ranked by assigning a number value to the suitability factors as follows:

- Poorly suitable characteristics were assigned a value of 10 (RED)
- Challenging suitability characteristics were assigned a value of 3 (YELLOW)
- Highly suitable characteristics are assigned a value of 1 (GREEN)

These values were then averaged for each market segment to assign each segment a value between 1 and 10, where the lowest values would suggest the highest suitability for electrification. Suitability scores that average above 5 have at least two characteristics identified with poor suitability factors and indicate that electrification with today's technology is not likely to be feasible for most of that market segment. Details of the analysis may be found in Section E of this document.

The market segment analysis does not account for ZEV model availability, costs, site specific issues that could impact infrastructure installations, normal truck replacement rates, fleet size, nor other factors that could impact the number of ZEVs that could be deployed.

D. Suitability Results

The market segment and suitability analysis indicates that nearly 40 percent of the 87 identified truck markets have a ZEV suitability score of 1 or 2, indicating that they are the most suitable segments to transition to ZE powertrains. This suitability assessment has similar results for BEV vs. FCEV, largely because infrastructure was assumed to be at central fleet yards. As expected the results show that a transition to ZEVs is more likely to begin with fleets that have predictable route with daily VMT of under 100 miles, and have a centralized operation where infrastructure investments would likely to be installed.

The suitability distribution for all BEVs and FCEVs are presented below in Figure D-1 and Figure D-2.

Figure D-1 - BEV Suitability Distribution by Score

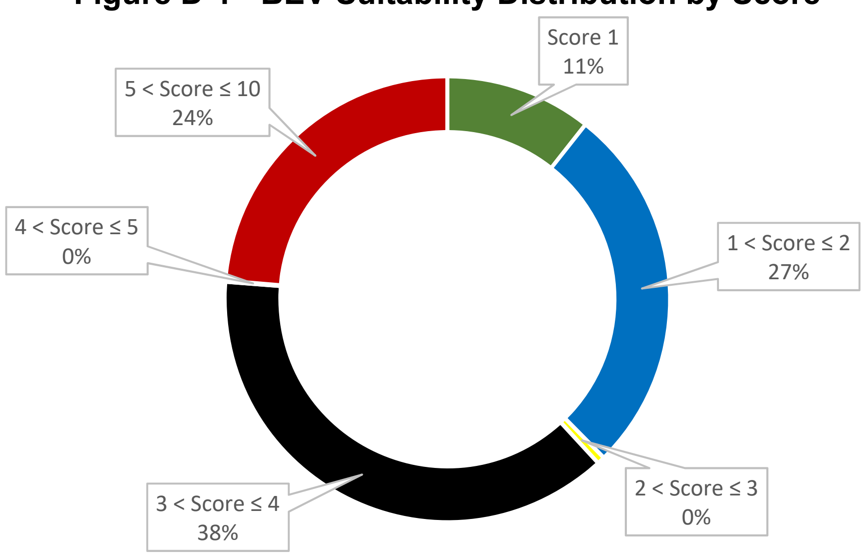
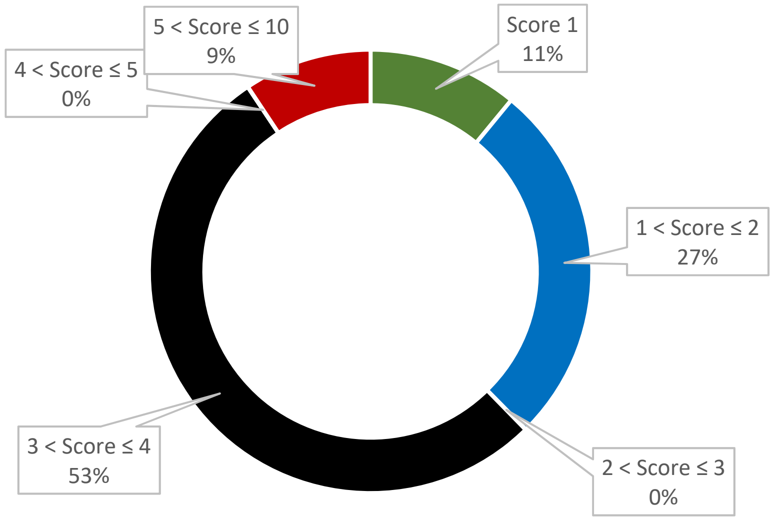


Figure D-2 - FCEV Suitability Distribution by Score



CARB staff also analyzed the suitability factors by weight class, grouping all 87 market segments into three weight categories as determined by the Gross Vehicle Weight Rating (GVWR) of the trucks that operate within each market segment. These categories are Class 2b-3, Class 4-7, and Class 8. The overall results of this assessment show that just over 70 percent of Class 4-7 vehicles received a suitability score of 1 or 2 and are good fits for electrification today while roughly 30 percent of Class 2b-3 and Class 8 vehicles are good fits. CARB staff believe that further advances in ZE technology will increase these percentages. The following is a detailed analysis of the ZE suitability factors for all three weight class categories.

a. Class 2b-3 (GVWR 8,500 to 14,000 lbs.)

Class 2b-3 covers roughly 75,000 California sales on an annual basis and consists of vehicles serving in both private and commercial roles. Figure D-3 and Figure D-4 summarize the suitability scores of Class 2b-3 vehicles from the market segment suitability analysis. The figures show that about 30 percent of trucks in this category received a suitability score of 1 or 2 and have operational characteristics that are suitable for electrification.

Figure D-3 - BEV Suitability, Class 2b-3

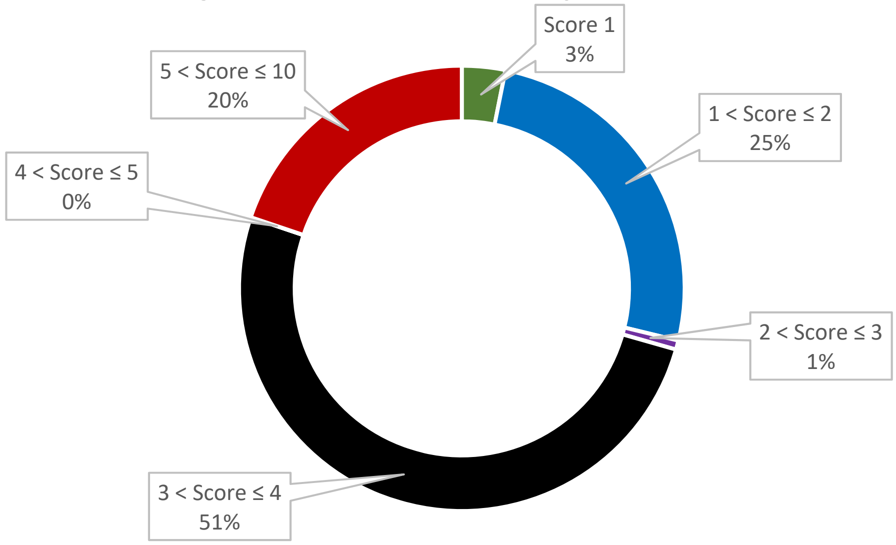
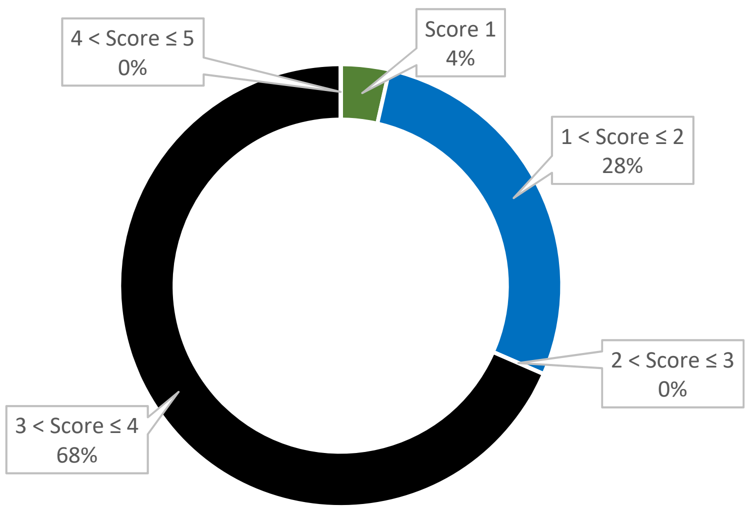


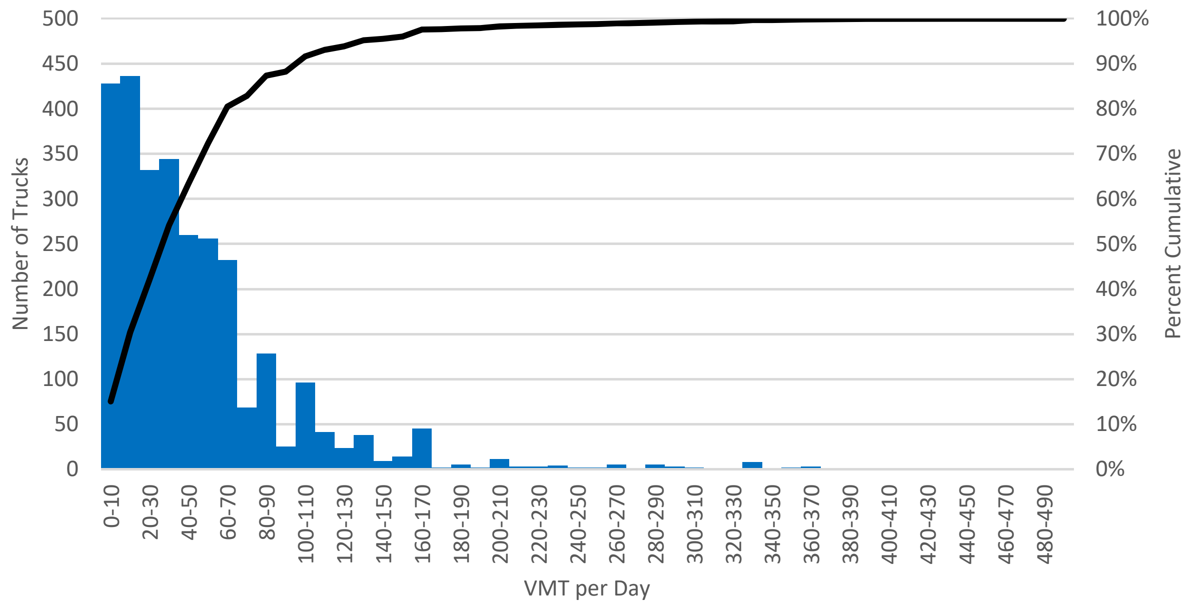
Figure D-4 - FCEV Suitability, Class 2b-3



The 2018 California Vehicle Inventory and Use Survey identifies that almost 90 percent of vehicles within Class 3 accrue less than 100 vehicle miles travelled (VMT) per day. The result of the California VIUS VMT for Class 3 vehicles is shown in Figure D-5. This conclusion is supported by the 2002 US VIUS[3], which identifies around 90 percent of vehicles in Class 3 as having less than 100 daily VMT.

[3]U.S. Census Bureau. 2002 Economic Census Vehicle Inventory and Use Survey Geographic Area Series. (web link: https://www2.census.gov/library/publications/economic-census/2002/vehicle-inventory and-use-survey/ec02tv-us.pdf)

Figure D-5 - Distribution of VMT per Day, Class 3, California VIUS



This population of vehicles is dominated by pickup trucks whose variable towing needs, and lack of space to mount battery systems or hydrogen tanks form the primary obstacles to electrification. Space constraints are not identified as a concern for vans within this segment, which accounts for approximately 30 percent of the Class 2b-3 vehicles, making them well-positioned for transition to zero-emission technologies. Commercial light-duty ZE pickup trucks are planned to be introduced to the market in upcoming years, and it is expected that improvement in battery technology and vehicle designs will make ZE pickup trucks in these higher weight classes more suitable.

b. Class 4-7 (GVWR 14,001 to 33,000 lbs.)

Class 4-7 vehicles account for nearly 19,000 sales annually in California and consist of a wide range of truck body configurations and applications. Figure D-6 and Figure D-7 summarize the suitability score for BEV and FCEV technologies in this vehicle segment. The figures show that about 70 percent of trucks in this category received a suitability score of 1 or 2 and have operational characteristics that are suitable for electrification.

Figure D-6 - BEV Suitability, Class 4-7

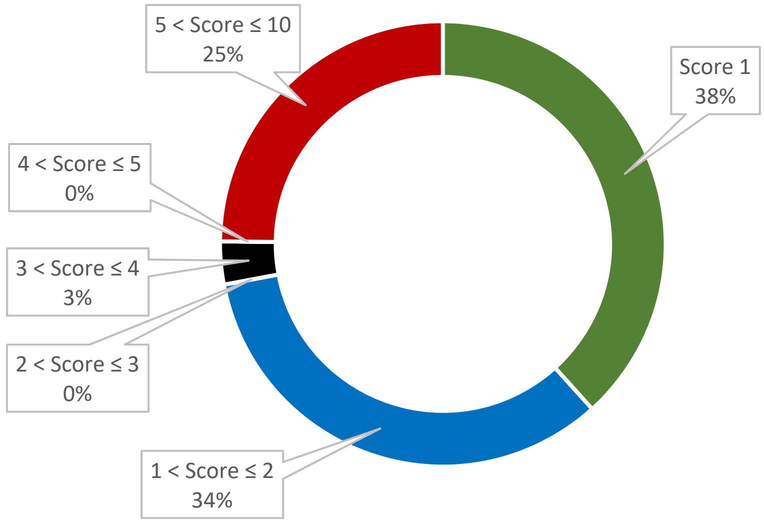
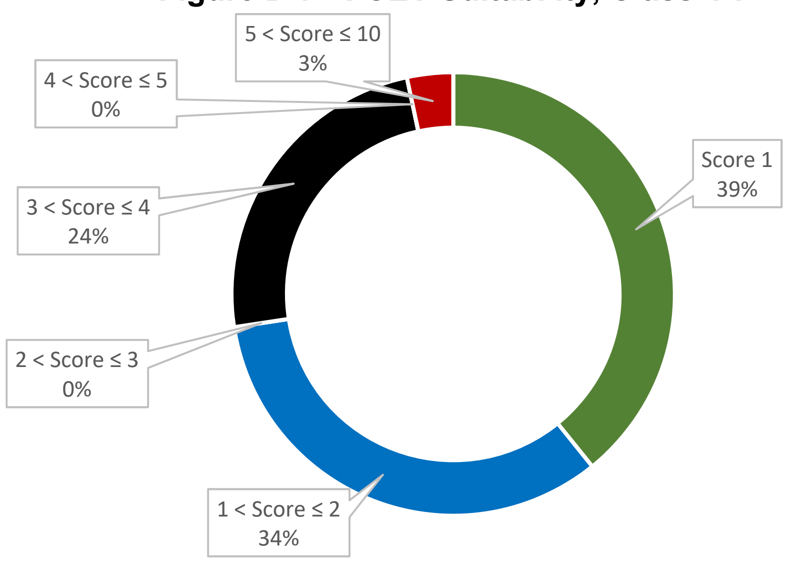
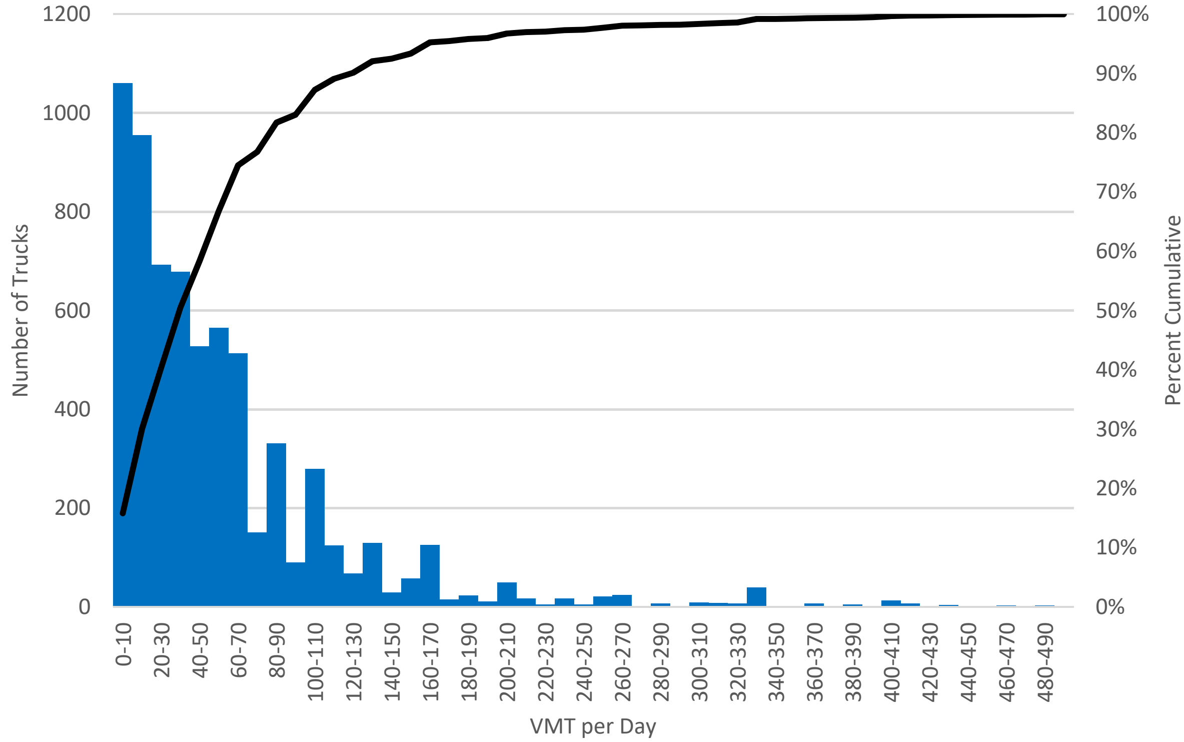


Figure D-7 - FCEV Suitability, Class 4-7



Vehicles in this segment are typically incomplete vehicles (such as cutaway van chassis) used by second stage manufacturers to customize the vehicles' utility to the individual needs of the customer. The California VIUS identifies that more than 80 percent of vehicles in these classes accrue less than 100 daily VMT. The results of the California VIUS is shown in Figure D-8. The US VIUS corroborates this finding and data collected indicates that almost 90 percent of vehicles in these weight categories accrue less than 100 daily VMT.

Figure D-8 - Distribution of VMT per Day, Class 4-7, California VIUS



Class 4-7 represents the segment with highest percentage of vehicles that are suitable for electrification. Centralized deployment, short, predictable routes and the flexibility to accommodate the weight and size of ZE powertrains cause this segment to stand out. These characteristics are reflected in the numerous ZEV options readily available on the market to replace existing conventional vehicles.

c. Class 8 (GVWR >33,000 lbs.)

Class 8 represents nearly 7,600 annual sales in California and consists of large tractors and some vocational vehicles. The results of the market segment analysis are shown in Figure D-9 and Figure D-10. The figures show that about 30 percent of trucks in this category received a suitability score of 1 or 2 and have operational characteristics that are potentially suitable for electrification.

Figure D-9 - BEV Suitability Distribution, Class 8

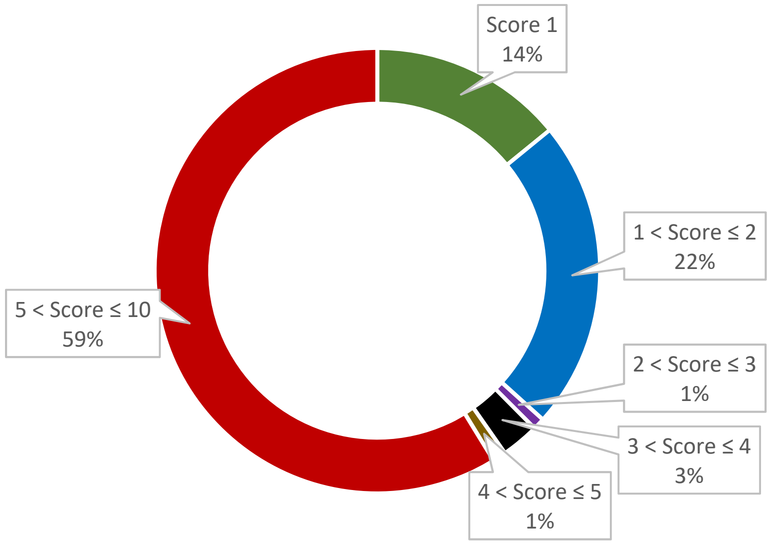
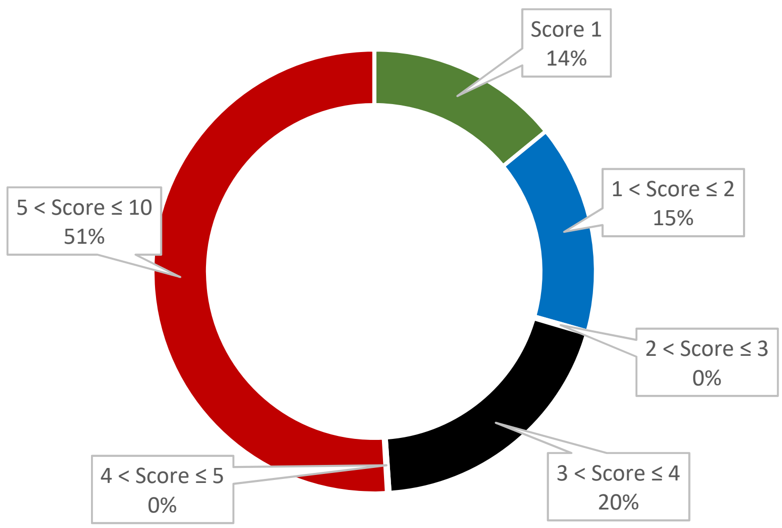
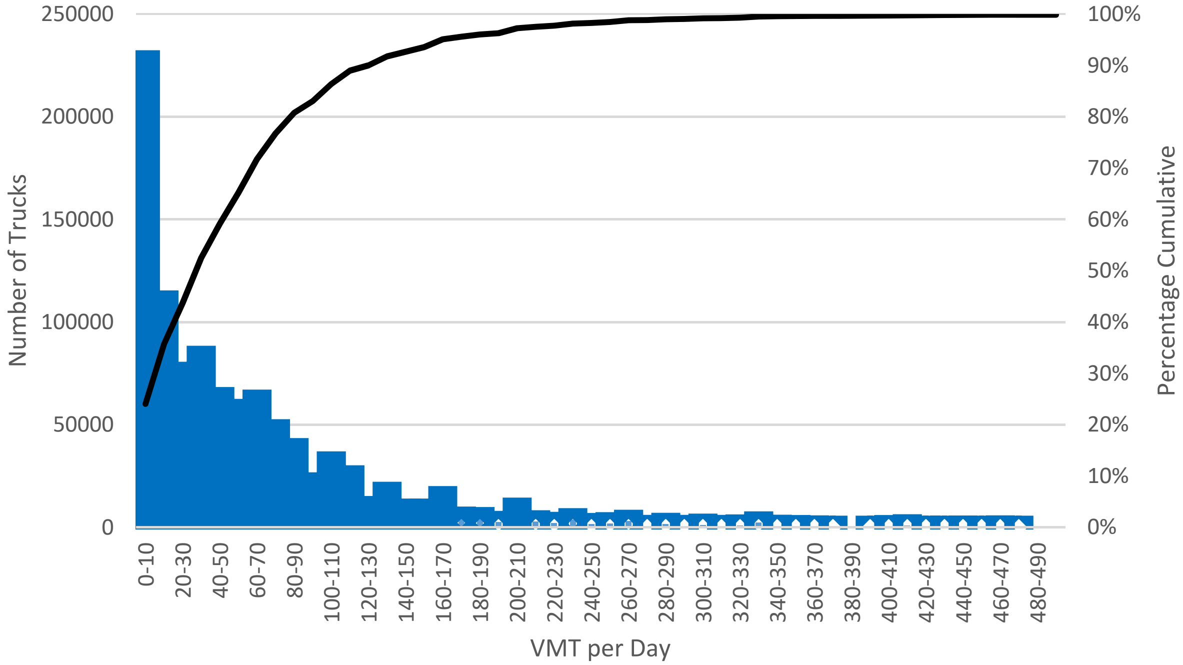


Figure D-10 - FCEV Suitability Distribution, Class 8



The US VIUS indicates that around 80 percent of the Class 8 population accrue less than 100 VMT. The results of the US VIUS is shown in Figure D-11.

Figure D-11 - Distribution of VMT per Day, Class 8, US VIUS



Vehicles in this market segment are operated in a variety of uses, ranging from a good to poor potential for electrification.

Vehicles in Class 8 are generally characterized by heavy loads, long and unpredictable routes, but many also operate short and predictable routes from centralized locations. Some examples include yard tractors and short-haul on-road tractors used for local delivery and drayage operations. Long-haul ZEVs are not expected to offer one-to-one replacements for conventional vehicles for some time due to limited at present. Class 8

E. Advanced Clean Truck Market Segment Analysis

1. Battery Electric Vehicle Suitability Table

Table E-1 - Battery Electric Vehicle Suitability Table

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
1	3.75	**Beverage Tractor**	8	123	I	Start at max load, diminish throughout day (Value=1)	Fixed, 100 miles per day (Value=3)	Centralized, at night (Value=1)	Constrained (Value=10)
2	1.5	**School Bus - Class C (Longer Rural Routes)**	4-7	87	C or I	Light (Value=1)	125 miles per day (Value=3)	Centralized, at night and during the day (Value=1)	Open (Value=1)
3	1	**School Bus - Class C (Shorter Urban Routes)**	4-7	608	C or I	Light (Value=1)	<75 miles per day (Value=1)	Centralized, at night and during the day (Value=1)	Open (Value=1)
4	1	**School Bus - Class C (Special Needs - ADA)**	4-7	87	C or I	Light (Value=1)	50-150 miles per day (Value=1)	Centralized, at night and during the day (Value=1)	Open (Value=1)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
5	1.5	**School Bus - Class C (Long distance - Field Trip, special Events - just a bus)**	4-7	87	C or I	Light (Value=1)	125 miles per day Multiple uses, fixed and flexible routes (Value=3)	Centralized, at night and during the day (Value=1)	Open (Value=1)
6	1	**School Bus - Class Rear Engine (Transit Style) All**	4-7	226	C or I	Light to medium. Higher capacity. (Value=1)	Varied Occassional use on long routes (Value=1)	Centralized, at night and during the day (Value=1)	Open (Value=1)
7	2	**Refuse, Automatic Side Loader (ASL), Residential Service**	8	400	I	Start light, end day at max load (Value=3)	Fixed, 75 miles per day. Occasional long routes (Value=1)	Centralized, at night (Value=1)	Constrained (Value=3)
8	2	**Refuse, Front Loader, Commercial or High Density Residential Service**	8	65	I	Start light, end day at max load (Value=3)	Fixed, 100 miles per day. Occasional long routes (Value=1)	Centralized, at night (Value=1)	Constrained (Value=3)
9	2	**Refuse, Rear Packer, Residential Service**	8	133	I	Start light, end day at max load (Value=3)	Fixed, 75 miles per day. Occasional long routes (Value=1)	Centralized, at night (Value=1)	Constrained

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
10	2.5	**Refuse Hauler (roll on/roll off)**	8	65	I	50% laden, 50% unladen, highly variable from lightly loaded to grossed out. (Value=3)	Variable, up to 250 miles per day (Value=3)	Centralized, at night (Value=1)	Somewhat constrained (Value=3)
11	1	**Step Van - Parcel Delivery**	4-7	1985	I	Light (Value=1)	Fixed, 50 miles per day (Value=1)	Centralized, at night (Value=1)	Open (Value=1)
12	1	**Step Van - Municipal Fleet**	4-7	298	I	Can be heavy (like electrician or plumber) (Value=1)	Can be highly variable, local some days potentially to many sites around municipality in same day (Value=1)	Centralized, at night Can have a need for emergency service (e.g., storms) that force long drives and long hours away from charging (Value=1)	Open (Value=1)
13	1.5	**H-D Van - Parcel Delivery Class 2B-3)**	2B-3	951	I	Light (Value=1)	50-300 miles per day, Medium route variability (Value=1)	Centralized, at night (Value=1)	Constrained (Value=3)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
14	1.5	**H-D Van - Parcel Delivery (Class 4,5)**	4-7	1985	I	Light (Value=1)	50-300 miles per day, Medium route variability (Value=1)	Centralized, at night (Value=1)	Constrained (Value=3)
15	2	**H-D Van - Contractor**	2B-3	11854	C	Heavy (Value=1)	50-150 miles per day, High route variability (Value=1)	Some central dispatch, many go with driver o/n (Value=3)	Constrained (Value=3)
16	1	**H-D Van - Shuttle**	2B-3	1116	I	Light (Value=1)	50-300 miles per day, Medium route variability (Value=1)	Centralized, but 24/7 operation (Value=1)	Open (Value=1)
17	2	**H-D Van - Refrigerated**	2B-3	70	I	Heavy (Value=1)	200-300 miles per day. Refrigeration reduces range, High route variability (Value=3)	Centralized, at night (Value=1)	Constrained (Value=3)
18	1	**H-D Van - School Bus**	2B-3	70	I	Light (Value=1)	65 miles per day, Low route variability (Value=1)	Centralized, at night (Value=1)	Open (Value=1)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
19	6	**H-D Van - Motor Home**	2B-3	29	I	Heavy (Value=1)	300-450 miles per day, High route variability (Value=10)	Dispersed, or infrastructure dependent (Value=10)	Constrained (Value=3)
20	1	**Box Truck - Pickup & Delivery (Fixed Light <100 Miles per Day)**	4-7	3075	I	Light (Value=1)	Variable <100 miles per day (Value=1)	Centralized (Value=1)	Open (Value=1)
21	2	**Box Truck - Pickup & Delivery (Medium to Heavy Load >100 Miles per Day)**	4-7	1538	I	Medium to heavy (Value=3)	Variable >100 miles per day (Value=3)	Centralized (Value=1)	Open (Value=1)
22	6	**Box Truck - Pickup & Delivery (Medium to Heavy Load >200 Miles per Day)**	4-7	1538	I	Medium to heavy (Value=10)	Variable >200 miles per day (Value=10)	Centralized or remote (Value=3)	Open (Value=1)
23	1.5	**Box Truck - Leasing (Daily Rental)**	4-7	152	I	Light (Value=1)	Variable <100 miles per day (Value=1)	Centralized or remote (Value=3)	Open (Value=1)
24	1	**Box Truck - Leasing (Fixed Customer and Application)**	4-7	228	I	Light to medium (Value=1)	Variable <100 miles per day (Value=1)	Centralized (Value=1)	Open (Value=1)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
25	1	**Box Truck - Leasing (Fixed Customer and Application)**	4-7	228	I	Medium to heavy (Value=1)	Variable <100 miles per day (Value=1)	Centralized (Value=1)	Open (Value=1)
26	2	**Box Truck - Leasing (Fixed Customer and Application)**	4-7	76	I	Medium to heavy (Value=3)	Variable >100 miles per day (Value=3)	Centralized (Value=1)	Open (Value=1)
27	3.75	**Box Truck - Leasing (Fixed Customer and Application)**	4-7	76	I	Medium to heavy GVWR limited (Value=3)	Variable >200 miles per day (Value=10)	Centralized (Value=1)	Open (Value=1)
28	1	**Straight Truck Pickup & Delivery (Heavy Load >100 Miles per Day)**	8	1069	I	Heavy (Value=1)	Variable >100 miles per day (Value=1)	Centralized (Value=1)	Open (Value=1)
29	1.5	**Box Truck - Refrigerated**	4-7	390	I	Medium to heavy load (Value=1)	Variable <100 miles per day (Value=1)	Centralized (Value=1)	Constrained if equipped with diesel TRU (Value=3)
30	1	**Flatbed - Stake/Platform**	4-7	370	I	Variable (Value=1)	Variable (Value=1)	Centralized (Value=1)	Open (Value=1)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
31	1.5	**Regional Tractor - Short Haul**	4-7	400	C	Variable, up to 80K GCW (Value=1)	Variable, <100 miles per day (Value=1)	Centralized, at night. Multiple shift operations impact charging times (Value=1)	Constrained - short wheelbase (Value=3)
32	1.5	**Regional Tractor - Short Haul**	8	400	C	Variable, up to 80K GCW (Value=1)	Variable, <100 miles per day (Value=1)	Centralized, at night. Multiple shift operations impact charging times (Value=1)	Constrained - short wheelbase (Value=3)
33	2	**Regional Tractor - Medium Haul**	4-7	200	C	Variable, up to 80K GCW (Value=1)	Variable, 100-300 miles per day (Value=3)	Centralized, at night. Multiple shift operations impact charging times (Value=1)	Constrained, short wheelbase (Value=3)
34	2	**Regional Tractor - Medium Haul**	8	400	C	Variable, up to 80K GCW (Value=1)	Variable, 100-300 miles per day (Value=3)	Centralized, at night. Multiple shift operations impact charging times (Value=1)	Constrained, short wheelbase (Value=3)
35	8.25	**Regional Tractor - Long Haul**	4-7	100	C	Variable (Value=3)	Variable, >200 miles per day (Value=10)	Future retail charging network? Multiple shift operations impact charging times (Value=10)	Constrained - short wheelbase, fairings (Value=10)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
36	8.25	**Regional Tractor - Long Haul**	8	300	C	Heavy (Value=3)	Variable, 200-500+ miles per day (Value=10)	Future retail charging network? Multiple shift operations impact charging times (Value=10)	Constrained (Value=10)
37	2	**Port Drayage**	8	120	C	Heavy (Value=1)	Variable, 100-500 miles per day (Value=1)	Variable / Centralized, depending on owner. Multiple shift operations impact charging times (Value=3)	Constrained - short wheelbase (Value=3)
38	3	**Pickup Truck - Agriculture**	2B-3	500	C or I	Variable--dependent on type of agriculture. (Value=3)	Assume set routes, <100 miles per day, may have extended idling. Likely extended operation (Value=3)	Centralized (Value=3)	Constrained (Value=3)
39	5.5	**Pickup Truck - Contractor**	2B-3	5000	C or I	Moderate to heavy (Value=1)	Variable (Value=1)	Variable (Value=10)	Constrained (Value=10)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
40	6	**Pickup Truck - Towing**	2B-3	3000	C or I	Heavy (Value=1)	Variable--expect several will have long distance (~500 mile) routes. Towing will significantly shorten available EV range. (Value=3)	Variable (Value=10)	Constrained (Value=10)
41	5.5	**Pickup Truck - 4WD Off Road**	2B-3	5000	C or I	Light to moderate (Value=1)	Variable--expect some will have long distance routes. (Value=1)	Variable--off road usage will likely be away from EV grid. Off-highway usage and extended operation will make charging impossible for extended offroad operation. (Value=10)	Constrained (Value=10)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
42	5.5	**Pickup Truck - PTO Equipped**	2B-3	1500	C or I	Moderate to heavy (Value=1)	Assume set routes, <100 miles per day, may have extended idling. (Value=1)	Variable (Value=10)	Constrained (Value=10)
43	7.75	**Line Haul Tractor**	4-7	500	C	Heavy (Value=10)	Variable; 500+ mile days (Value=10)	Variable (Value=10)	Open (Value=1)
44	7.75	**Line Haul Tractor**	8	3000	C	Heavy (Value=10)	Variable; 500+ mile days (Value=10)	Variable (Value=10)	Open (Value=1)
45	10	**Logging**	8	5	C	Heavy (Value=10)	Variable (Value=10)	Variable, Long off-road travel (Value=10)	Constrained, ground clearance (Value=10)
46	7.75	**Concrete Mixer**	8	70	I	Typically 50% empty, 5-% grossed out (Value=10)	Highly variable (Value=10)	Centralized, at night (Value=1)	Highly constrained due to body equipment and weight (Value=10)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
47	10	**Concrete Pumper**	8	37	I	Due to weight of pumping equipment the vehicle is always heavily loaded (Value=10)	Highly variable (Value=10)	Vehicle may remain at construction site for multiple days (Value=10)	Highly constrained (Value=10)
48	4.25	**Mining Hauler**	8	15	I	Heavy (Value=10)	Fixed (Value=1)	Centralized; Long off-road travel (Value=3)	Constrained (Value=3)
49	4.75	**Mining Service**	8	15	C	Medium – fixed (Value=3)	Variable (Value=10)	Centralized; Long off-road travel (Value=3)	Constrained, due to body (Value=3)
50	7.75	**Heavy Equipment Transport**	8	110	C	Heavy (Value=10)	Variable (Value=10)	Variable (Value=10)	Open (Value=1)
51	1.5	**Utility/Lube Service**	4-7	76	I	Can be heavy (like electrician or plumber) (Value=1)	Can be highly variable, local some days potentially to many sites around municipality in same day (Value=1)	Centralized, at night Can have a need for emergency service (e.g., storms) (Value=3)	Open (Value=1)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
52	10	**Oil Field Rig Mover**	8	14	C	Extremely high (Value=10)	Highly variable (Value=10)	May be enroute/onsite multiple days (Value=10)	
53	10	**Oil Field Well Servicing**	8	110	I	Always loaded at or near GVWR (Value=10)	Highly variable (Value=10)	Mixed locations, could need to charge during peak times Many of these vehicles are for off-road use only. (Value=10)	Constrained (Value=10)
54	1.5	**Tow/Wrecker**	4-7	250	I	Variable (Value=1)	Variable, <100 miles per day (Value=1)	Centralized when not in use (Value=1)	Constrained. Need space for bed/hoist and hydraulic mechanisms between the frame rails where batteries would be installed (Value=3)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
55	1.5	**Farm Service - Truck**	2B-3	119	I	Heavy (almost like a dump truck) May be restricted on weight due to heavy produce and need to operate in ag fields (Value=1)	Fixed, but can be long distance from farm to city (Value=1)	Centralized but in rural area at night (Value=3)	Open (Value=1)
56	6.5	**Farm Service - Tractor**	8	90	C	Heavy (almost like a dump truck) May be restricted on weight due to heavy produce and need to operate in ag fields (Value=10)	Fixed, but can be long distance from farm to city (Value=3)	Centralized but in rural area at night (Value=3)	Constrained (short wheelbase) (Value=10)
57	4.25	**Tanker Truck - Liquids or Gases**	8	44	I	Start at max load, may diminish throughout day (Value=3)	Fixed, but can be long distance from depot to destination (Value=3)	Centralized, at night (Value=1)	Constrained due to effort to maximize payload (Value=10)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
58	8.25	**Car Carrier - Class 8**	8	123	I	High (Value=10)	Variable (Value=10)	Variable (Value=10)	Constrained (Value=3)
59	1.5	**Car Carrier - Class 6/7 (Roll Back)**	4-7	150	I	Variable (Value=1)	Variable, local (Value=1)	Centralized Variable origin and destination pairs (Value=1)	Constrained (Value=3)
60	3.75	**Utility Service - Private (Class 8)**	8	87	I				
61	3.75	**Utility Service - Private (Class 6-7)**	4-7	143	I	High (Value=1)	Variable (Value=1)	Variable + remote Extended operation off road (Value=10)	Constrained (Value=3)
62	3.75	**Utility Service - Private Trouble Truck (Class 4-5)**	4-7	277	I	Medium to heavy (Value=1)	Variable (Value=1)	Variable + remote Extended remote operation (Value=10)	Constrained (Value=3)
63	2	**Utility Service - Public (Class 8)**	8	87	I				
64	2	**Utility Service - Public (Class 6-7)**	4-7	143	I	High (Value=1)	Variable (Value=1)	Variable Extended operation off road (Value=3)	Constrained (Value=3)
65	2	**Utility Service - Public (Class 4-5)**	4-7	277	I	Medium to heavy (Value=1)	Variable (Value=1)	Variable Extended remote operation (Value=3)	Constrained (Value=3)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
66	6	**Recreational Vehicle**	4-7	2500	I	Variable (Value=3)	Expected long distance routes (Value=10)	Non-centralized (Value=10)	Open (Value=1)
67	1	**Airport Service**	2B-3	1167	I	Light (Value=1)	Set routes, <100 miles per day (Value=1)	Centralized, Close proximity to charging infrastructure (Value=1)	Open (Value=1)
68	5.5	**Rail Service**	2B-3	100	I	Light (Value=1)	Expected long distance routes (Value=10)	Centralized (Value=1)	Constrained. Need physical space to mount rail wheels, lift mechanism, and upfitter body. (Value=10)
69	1	**Shuttle Bus**	4-7	331	I	Variable, light (Value=1)	Fixed <100 miles per day (Value=1)	Centralized (Value=1)	Open (Value=1)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
70	1.5	**Armored Car**	4-7	100	I	Variable (depends on drop-off or pick-up work) (Value=1)	Variable, <100 miles per day (Value=1)	Centralized, at night (Value=1)	Constrained. Armor plating and security defenses would take up underbody battery storage opportunities (Value=3)
71	3.25	**Mobile Laboratory**	4-7	81	I	Variable (depends on use requirements) (Value=1)	Variable, <100 miles per day (Value=1)	No central charging available when in use Occasional use on long routes and dependent on deployment needs (Value=10)	Open (Value=1)
72	8.25	**Digger Derrick**	4-7	52	I	High (Value=10)	Variable (Value=10)	Extended operation off road (Value=10)	Constrained (Value=3)
73	6	**Construction Dump**	8	342	I	50% laden (typically to GVWR), 50% unladen (Value=10)	Highly variable, but typically 150-250 miles per day (Value=10)	Centralized, at night (Value=1)	Somewhat constrained (Value=3)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
74	1.5	**Municipal Dump**	4-7	44	I	50% laden, 50% unladen, mixed light to heavy (Value=1)	Variable, 50 miles per day (Value=1)	Centralized, at night (Value=1)	Somewhat constrained (Value=3)
75	1.5	**Yard Tractor - Purpose Built (Warehouse/Rail)**	8	84	C or I	Heavy (65K - 85K lbs). Light-duty cycle. Load on/load off (Value=1)	<100 miles per day, <1 route (Predictable), 8-10 hours per day Accessory loads: high heating and cooling requirements, hydraulics to raise and lower 5th wheel	Centralized, at night and during the day (Value=1)	Constrained, for shorter wheelbase (Value=3)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
76	2	**Yard Tractor - Purpose Built (Port)**	8	21	C or I	Heavy (120K 0 140K lbs.). Load on/Load off (Value=1)	<200 miles per day, 1-2 mile routes (predictable), >10 hours per day Accessory loads: high heating and cooling requirements, hydraulics to raise and lower 5th wheel (Value=1)	Opportunity charging but port dependent. May need to remove from fleet for charging. Constrained for port applications due to hours of operation (Value=3)	Constrained for shorter wheelbase. (Value=3)
77	3.75	**Mobile Command Center**	4-7	27	I	Moderate heavy fixed load (Value=1)	Mostly short, unpredictable (mission dependent) (Value=1)	Generally centralized, may need to be charged while on mission; there may not be enough time for recharge between missions (Value=10)	Somewhat constrained (Value=3)
78	5.5	**H-D Van - Emergency**	2B-3	223	I	Heavy (Value=1)	50-150 miles per day, High route variability (Value=1)	Dispersed, or infrastructure dependent (Value=10)	Constrained (Value=10)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
79	5.5	**Ambulance**	4-7	128	I	Light (Value=1)	Mostly short, unpredictable (mission dependent) (Value=1)	Centralized, opportunity charging when possible; need to be fully charged and ready with no notice (e.g., conventional vehicles have quick disconnect air hoses to keep air brake tanks full, and similar would be required for electrical); there may not be enough time for recharge between missions	Constrained (due to equipment installation) (Value=10)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
80	8.25	**Fire Truck**	8	159	I	Start at high/max load, may diminish slightly throughout day (Value=3)	Mostly short, unpredictable (mission dependent). May be fueled by wet hose when operating continuously at a fire site. (Value=10)	Centralized, opportunity charging when possible; need to be fully charged and ready with no notice (e.g., conventional vehicles have quick disconnect air hoses to keep air brake tanks full, and similar would be required for electrical); there may not be enough time for recharge between missions (Value=10)	Constrained (due to equipment installation) (Value=10)
81	6	**Snow Plow**	8	92	I	Start at max load, diminish throughout day (Value=1)	varied, unpredictable (weather dependent) (Value=3)	Centralized, opportunity charging when possible; there may not be enough time for recharge between missions	Constrained (due to equipment installation) (Value=10)
82	1.5	**Crane**	4-7	100	I	Light (Value=1)	Average <70 miles per day (Value=1)	Centralized (Value=1)	Limited (Value=3)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
83	1.5	**Dump**	4-7	200	I	Variable (depends on use requirements) (Value=1)	Average <70 miles per day (Value=1)	Centralized (Value=1)	Limited (Value=3)
84	1.5	**Refuse/Recycling**	4-7	200	I	Start light, end day at max load (Value=1)	Average <70 miles per day (Value=1)	Centralized (Value=1)	Limited (Value=3)
85	1.5	**Shredder**	4-7	100	I	Start light, end day at max load (Value=1)	Average <70 miles per day (Value=1)	Centralized (Value=1)	Limited (Value=3)
86	3.75	**Pickup Truck - Personal Use**	2B-3	38000	C	Moderate Limited cargo carrying capacity to offset battery pack weights. Most people upgrade to the class 2b-3 pickup over a class 2a pickup for either load carrying or towing needs. (Value=1)	Variable; Towing will significantly shorten available EV range. (Value=3)	Centralized charging at residence/business (Value=1)	Constrained (Value=10)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
87	1.5	**H-D Van - Passenger**	2B-3	6198	C	Light (Value=1)	Variable (Value=1)	Centralized charging at residence/business (Value=1)	Constrained (Value=3)

Table E-2 - California Sales per Battery Electric Vehicle Suitability Score

Class	Score 1	1 < Score ≤ 2	3 < Score ≤ 4	4 < Score ≤ 5	5 < Score ≤ 10	All
2B-3	2,353	19,192	38,000	0	14,852	74,897
4-7	7,436	6,555	604	0	4,818	19,413
8	1,069	1,710	210	74	4,452	7,580
Total	10,858	27,457	38,814	74	24,122	101,890

2. Fuel Cell Electric Vehicle Suitability Table

Table E-3 - Fuel Cell Electric Vehicle Suitability Table

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Fueling Infrastructure	Vehicle Space Constraints
1	3.25	**Beverage Tractor**	8	123	I	Start at max load, diminish throughout day (Value=1)	Fixed, 100 miles per day (Value=1)	Centralized, at night (Value=1)	Constrained (Value=10)
2	1	**School Bus - Class C (Longer Rural Routes)**	4-7	87	C or I	Light (Value=1)	125 miles per day (Value=1)	Centralized, at night and during the day (Value=1)	Open (Value=1)
3	1	**School Bus - Class C (Shorter Urban Routes)**	4-7	608	C or I	Light (Value=1)	<75 miles per day (Value=1)	Centralized, at night and during the day (Value=1)	Open (Value=1)
4	1	**School Bus - Class C (Special Needs - ADA)**	4-7	87	C or I	Light (Value=1)	50-150 miles per day (Value=1)	Centralized, at night and during the day (Value=1)	Open (Value=1)
5	1	**School Bus - Class C (Long distance - Field Trip, special Events - just a bus)**	4-7	87	C or I	Light (Value=1)	125 miles per day Multiple uses, fixed and flexible routes (Value=1)	Centralized, at night and during the day (Value=1)	Open (Value=1)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
6	1	**School Bus - Class Rear Engine (Transit Style) All**	4-7	226	C or I	Light to medium. Higher capacity. (Value=1)	Varied Occassional use on long routes (Value=1)	Centralized, at night and during the day (Value=1)	Open (Value=1)
7	3.75	**Refuse, Automatic Side Loader (ASL), Residential Service**	8	400	I	Start light, end day at max load (Value=3)	Fixed, 75 miles per day (Value=1)	Centralized, at night (Value=1)	Constrained (Value=10)
8	3.75	**Refuse, Front Loader, Commercial or High Density Residential Service**	8	65	I	Start light, end day at max load (Value=3)	Fixed, 100 miles per day. Occasional long routes (Value=1)	Centralized, at night (Value=1)	Constrained (Value=10)
9	3.75	**Refuse, Rear Packer, Residential Service**	8	133	I	Start light, end day at max load (Value=3)	Fixed, 75 miles per day. Occasional long routes (Value=1)	Centralized, at night (Value=1)	Constrained (Value=10)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
10	2	**Refuse Hauler (roll on/roll off)**	8	65	I	50% laden, 50% unladen, highly variable from lightly loaded to grossed out. (Value=3)	Variable, up to 250 miles per day (Value=1)	Centralized, at night (Value=1)	Somewhat constrained (Value=3)
11	1	**Step Van - Parcel Delivery**	4-7	1985	I	Light (Value=1)	Fixed, 50 miles per day (Value=1)	Centralized, at night (Value=1)	Open (Value=1)
12	1	**Step Van - Municipal Fleet**	4-7	298	I	Can be heavy (like electrician or plumber) (Value=1)	Can be highly variable, local some days potentially to many sites around municipality in same day (Value=1)	Centralized, at night Can have a need for emergency service (e.g., storms) that force long drives and long hours away from charging (Value=1)	Open (Value=1)
13	1.5	**H-D Van - Parcel Delivery Class 2B-3)**	2B-3	951	I	Light (Value=1)	50-300 miles per day (Value=1)	Centralized, at night (Value=1)	Constrained (Value=3)
14	1.5	**H-D Van - Parcel Delivery (Class 4,5)**	4-7	1985	I	Light (Value=1)	50-300 miles per day (Value=1)	Centralized, at night (Value=1)	Constrained (Value=3)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
15	2	**H-D Van - Contractor**	2B-3	11854	C	Heavy (Value=1)	50-150 miles per day (Value=1)	Some central dispatch, many go with driver o/n (Value=3)	Constrained (Value=3)
16	1	**H-D Van - Shuttle**	2B-3	1116	I	Light (Value=1)	50-300 miles per day (Value=1)	Centralized, but 24/7 operation (Value=1)	Open (Value=1)
17	1.5	**H-D Van - Refrigerated**	2B-3	70	I	Heavy (Value=1)	200-300 miles per day. Refrigeration reduces range (Value=1)	Centralized, at night (Value=1)	Constrained (Value=3)
18	1	**H-D Van - School Bus**	2B-3	70	I	Light (Value=1)	65 miles per day (Value=1)	Centralized, at night (Value=1)	Open (Value=1)
19	3.75	**H-D Van - Motor Home**	2B-3	29	I	Heavy (Value=1)	300-450 miles per day (Value=1)	Dispersed, or infrastructure dependent (Value=10)	Constrained (Value=3)
20	1	**Box Truck - Pickup & Delivery (Fixed Light <100 Miles per Day)**	4-7	3075	I	Light (Value=1)	Variable <100 miles per day (Value=1)	Centralized (Value=1)	Open (Value=1)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
21	1.5	**Box Truck - Pickup & Delivery (Medium to Heavy Load >100 Miles per Day)**	4-7	1538	I	Medium to heavy (Value=3)	Variable >100 miles per day (Value=1)	Centralized (Value=1)	Open (Value=1)
22	3.75	**Box Truck - Pickup & Delivery (Medium to Heavy Load >200 Miles per Day)**	4-7	1538	I	Medium to heavy (Value=10)	Variable >200 miles per day (Value=1)	Centralized or remote (Value=3)	Open (Value=1)
23	1.5	**Box Truck - Leasing (Daily Rental)**	4-7	152	I	Light (Value=1)	Variable <100 miles per day (Value=1)	Centralized or remote (Value=3)	Open (Value=1)
24	1	**Box Truck - Leasing (Fixed Customer and Application)**	4-7	228	I	Light to medium (Value=1)	Variable <100 miles per day (Value=1)	Centralized (Value=1)	Open (Value=1)
25	1	**Box Truck - Leasing (Fixed Customer and Application)**	4-7	228	I	Medium to heavy (Value=1)	Variable <100 miles per day (Value=1)	Centralized (Value=1)	Open (Value=1)
26	1.5	**Box Truck - Leasing (Fixed Customer and Application)**	4-7	76	I	Medium to heavy (Value=3)	Variable >100 miles per day (Value=1)	Centralized (Value=1)	Open (Value=1)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
27	1.5	**Box Truck - Leasing (Fixed Customer and Application)**	4-7	76	I	Medium to heavy GVWR limited (Value=3)	Variable >200 miles per day (Value=1)	Centralized (Value=1)	Open (Value=1)
28	1	**Straight Truck Pickup & Delivery (Heavy Load >100 Miles per Day)**	8	1069	I	Heavy (Value=1)	Variable >100 miles per day (Value=1)	Centralized (Value=1)	Open (Value=1)
29	1.5	**Box Truck - Refrigerated**	4-7	390	I	Medium to heavy load (Value=1)	Variable <100 miles per day (Value=1)	Centralized (Value=1)	Constrained if equipped with diesel TRU (Value=3)
30	1	**Flatbed - Stake/Platform**	4-7	370	I	Variable (Value=1)	Variable (Value=1)	Centralized (Value=1)	Open (Value=1)
31	1.5	**Regional Tractor - Short Haul**	4-7	400	C	Variable, up to 80K GCW (Value=1)	Variable, <100 miles per day (Value=1)	Centralized, at night. Multiple shift operations impact charging times (Value=1)	Constrained - short wheelbase (Value=3)
32	1.5	**Regional Tractor - Short Haul**	8	400	C	Variable, up to 80K GCW (Value=1)	Variable, <100 miles per day (Value=1)	Centralized, at night. Multiple shift operations impact charging times (Value=1)	Constrained - short wheelbase (Value=3)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
33	1.5	**Regional Tractor - Medium Haul**	4-7	200	C	Variable, up to 80K GCW (Value=1)	Variable, 100-300 miles per day (Value=1)	Centralized, at night. Multiple shift operations impact charging times (Value=1)	Constrained, short wheelbase (Value=3)
34	1.5	**Regional Tractor - Medium Haul**	8	400	C	Variable, up to 80K GCW (Value=1)	Variable, 100-300 miles per day (Value=1)	Centralized, at night. Multiple shift operations impact charging times (Value=1)	Constrained, short wheelbase (Value=3)
35	6	**Regional Tractor - Long Haul**	4-7	100	C	Variable (Value=3)	Variable, >200 miles per day (Value=1)	Future retail charging network? Multiple shift operations impact charging times (Value=10)	Constrained - short wheelbase, fairings (Value=10)
36	6	**Regional Tractor - Long Haul**	8	300	C	Heavy (Value=3)	Variable, 200-500+ miles per day (Value=1)	Future retail charging network? Multiple shift operations impact charging times (Value=10)	Constrained (Value=10)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
37	2	**Port Drayage**	8	120	C	Heavy (Value=1)	Variable, 100-500 miles per day (Value=1)	Variable / Centralized, depending on owner. Multiple shift operations impact charging times (Value=3)	Constrained - short wheelbase (Value=3)
38	2	**Pickup Truck - Agriculture**	2B-3	500	C or I	Variable--dependent on type of agriculture. (Value=3)	Assume set routes, <100 miles per day, may have extended idling. Likely extended operation (Value=1)	Centralized (Value=1)	Constrained (Value=3)
39	3.75	**Pickup Truck - Contractor**	2B-3	5000	C or I	Moderate to heavy (Value=1)	Variable (Value=1)	Variable (Value=3)	Constrained (Value=10)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
40	3.75	**Pickup Truck - Towing**	2B-3	3000	C or I	Heavy (Value=1)	Variable--expect several will have long distance (~500 mile) routes. Towing will significantly shorten available EV range. (Value=1)	Variable (Value=3)	Constrained (Value=10)
41	5.5	**Pickup Truck - 4WD Off Road**	2B-3	5000	C or I	Light to moderate (Value=1)	Variable--expect some will have long distance routes. (Value=1)	Variable--off road usage will likely be away from EV grid. Off-highway usage and extended operation will make charging impossible for extended offroad operation. (Value=10)	Constrained (Value=10)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
42	3.75	**Pickup Truck - PTO Equipped**	2B-3	1500	C or I	Moderate to heavy (Value=1)	Assume set routes, <100 miles per day, may have extended idling. (Value=1)	Variable (Value=3)	Constrained (Value=10)
43	5.5	**Line Haul Tractor**	4-7	500	C	Heavy (Value=10)	Variable; 500+ mile days (Value=1)	Variable (Value=10)	Open (Value=1)
44	5.5	**Line Haul Tractor**	8	3000	C	Heavy (Value=10)	Variable; 500+ mile days (Value=1)	Variable (Value=10)	Open (Value=1)
45	7.75	**Logging**	8	5	C	Heavy (Value=10)	Variable (Value=1)	Variable, Long off-road travel (Value=10)	Constrained, ground clearance (Value=10)
46	5.5	**Concrete Mixer**	8	70	I	Typically 50% empty, 5-% grossed out (Value=10)	Highly variable (Value=1)	Centralized, at night (Value=1)	Highly constrained due to body equipment and weight (Value=10)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
47	7.75	**Concrete Pumper**	8	37	I	Due to weight of pumping equipment the vehicle is always heavily loaded (Value=10)	Highly variable (Value=1)	Vehicle may remain at construction site for multiple days (Value=10)	Highly constrained (Value=10)
48	4.25	**Mining Hauler**	8	15	I	Heavy (Value=10)	Fixed (Value=1)	Centralized; Long off-road travel (Value=3)	Constrained (Value=3)
49	2.5	**Mining Service**	8	15	C	Medium – fixed (Value=3)	Variable (Value=1)	Centralized; Long off-road travel (Value=3)	Constrained, due to body (Value=3)
50	5.5	**Heavy Equipment Transport**	8	110	C	Heavy (Value=10)	Variable (Value=1)	Variable (Value=10)	Open (Value=1)
51	1.5	**Utility/Lube Service**	4-7	76	I	Can be heavy (like electrician or plumber) (Value=1)	Can be highly variable, local some days potentially to many sites around municipality in same day (Value=1)	Centralized, at night Can have a need for emergency service (e.g., storms) (Value=3)	Open (Value=1)
52	7	**Oil Field Rig Mover**	8	14	C	Extremely high (Value=10)	Highly variable (Value=1)	May be enroute/onsite multiple days (Value=10)	

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
53	7.75	**Oil Field Well Servicing**	8	110	I	Always loaded at or near GVWR (Value=10)	Highly variable (Value=1)	Mixed locations, could need to charge during peak times Many of these vehicles are for off-road use only. (Value=10)	Constrained (Value=10)
54	1.5	**Tow/Wrecker**	4-7	250	I	Variable (Value=1)	Variable, <100 miles per day (Value=1)	Centralized when not in use (Value=1)	Constrained. Need space for bed/hoist and hydraulic mechanisms between the frame rails where batteries would be installed (Value=3)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
55	1	**Farm Service - Truck**	2B-3	119	I	Heavy (almost like a dump truck) May be restricted on weight due to heavy produce and need to operate in ag fields (Value=1)	Fixed, but can be long distance from farm to city (Value=1)	Centralized but in rural area at night (Value=1)	Open (Value=1)
56	5.5	**Farm Service - Tractor**	8	90	C	Heavy (almost like a dump truck) May be restricted on weight due to heavy produce and need to operate in ag fields (Value=10)	Fixed, but can be long distance from farm to city (Value=1)	Centralized but in rural area at night (Value=1)	Constrained (short wheelbase) (Value=10)
57	3.75	**Tanker Truck - Liquids or Gases**	8	44	I	Start at max load, may diminish throughout day (Value=3)	Fixed, but can be long distance from depot to destination (Value=1)	Centralized, at night (Value=1)	Constrained due to effort to maximize payload (Value=10)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
58	6	**Car Carrier - Class 8**	8	123	I	High (Value=10)	Variable (Value=1)	Variable (Value=10)	Constrained (Value=3)
59	2	**Car Carrier - Class 6/7 (Roll Back)**	4-7	150	I	Variable (Value=1)	Variable, local (Value=1)	Centralized Variable origin and destination pairs (Value=3)	Constrained (Value=3)
60	3.75	**Utility Service - Private (Class 8)**	8	87	I				
61	3.75	**Utility Service - Private (Class 6-7)**	4-7	143	I	High (Value=1)	Variable (Value=1)	Variable + remote Extended operation off road (Value=10)	Constrained (Value=3)
62	3.75	**Utility Service - Private Trouble Truck (Class 4-5)**	4-7	277	I	Medium to heavy (Value=1)	Variable (Value=1)	Variable + remote Extended remote operation (Value=10)	Constrained (Value=3)
63	2	**Utility Service - Public (Class 8)**	8	87	I				
64	2	**Utility Service - Public (Class 6-7)**	4-7	143	I	High (Value=1)	Variable (Value=1)	Variable Extended operation off road (Value=3)	Constrained (Value=3)
65	2	**Utility Service - Public (Class 4-5)**	4-7	277	I	Medium to heavy (Value=1)	Variable (Value=1)	Variable Extended remote operation (Value=3)	Constrained (Value=3)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
66	3.75	**Recreational Vehicle**	4-7	2500	I	Variable (Value=3)	Expected long distance routes (Value=1)	Non-centralized (Value=10)	Open (Value=1)
67	1	**Airport Service**	2B-3	1167	I	Light (Value=1)	Set routes, <100 miles per day (Value=1)	Centralized, Close proximity to charging infrastructure (Value=1)	Open (Value=1)
68	3.25	**Rail Service**	2B-3	100	I	Light (Value=1)	Expected long distance routes (Value=1)	Centralized (Value=1)	Constrained. Need physical space to mount rail wheels, lift mechanism, and upfitter body. (Value=10)
69	1	**Shuttle Bus**	4-7	331	I	Variable, light (Value=1)	Fixed <100 miles per day (Value=1)	Centralized (Value=1)	Open (Value=1)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
70	1.5	**Armored Car**	4-7	100	I	Variable (depends on drop-off or pick-up work) (Value=1)	Variable, <100 miles per day (Value=1)	Centralized, at night (Value=1)	Constrained. Armor plating and security defenses would take up underbody battery storage opportunities (Value=3)
71	3.25	**Mobile Laboratory**	4-7	81	I	Variable (depends on use requirements) (Value=1)	Variable, <100 miles per day (Value=1)	No central charging available when in use Occasional use on long routes and dependent on deployment needs (Value=10)	Open (Value=1)
72	6	**Digger Derrick**	4-7	52	I	High (Value=10)	Variable (Value=1)	Extended operation off road (Value=10)	Constrained (Value=3)
73	3.75	**Construction Dump**	8	342	I	50% laden (typically to GVWR), 50% unladen (Value=10)	Highly variable, but typically 150-250 miles per day (Value=1)	Centralized, at night (Value=1)	Somewhat constrained (Value=3)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
74	1.5	**Municipal Dump**	4-7	44	I	50% laden, 50% unladen, mixed light to heavy (Value=1)	Variable, 50 miles per day (Value=1)	Centralized, at night (Value=1)	Somewhat constrained (Value=3)
75	1.5	**Yard Tractor - Purpose Built (Warehouse/Rail)**	8	84	C or I	Heavy (65K - 85K lbs). Light-duty cycle. Load on/load off (Value=1)	<100 miles per day, <1 route (Predictable), 8-10 hours per day (Value=1)	Centralized, at night and during the day (Value=1)	Constrained, for shorter wheelbase (Value=3)
76	3.25	**Yard Tractor - Purpose Built (Port)**	8	21	C or I	Heavy (120K 0 140K lbs.). Load on/Load off (Value=1)	<200 miles per day, 1-2 mile routes (predictable), >10 hours per day (Value=1)	Opportunity charging but port dependent. May need to remove from fleet for charging Constrained for port applications due to hours of operation (Value=1)	Constrained for shorter wheelbase. Constrained for port applications due to hours of operation (Value=3)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
77	1.5	**Mobile Command Center**	4-7	27	I	Moderate heavy fixed load (Value=1)	Mostly short, unpredictable (mission dependent) (Value=1)	Generally centralized, may need to be charged while on mission; there may not be enough time for recharge between missions (Value=1)	Somewhat constrained (Value=3)
78	3.75	**H-D Van - Emergency**	2B-3	223	I	Heavy (Value=1)	50-150 miles per day (Value=1)	Dispersed, or infrastructure dependent (Value=3)	Constrained (Value=10)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
79	3.25	**Ambulance**	4-7	128	I	Light (Value=1)	Mostly short, unpredictable (mission dependent) (Value=1)	Centralized, opportunity charging when possible; need to be fully charged and ready with no notice (e.g., conventional vehicles have quick disconnect air hoses to keep air brake tanks full, and similar would be required for electrical); there may not be enough time for recharge between missions (Value=1)	Constrained (due to equipment installation) (Value=10)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
81	3.25	**Snow Plow**	8	92	I	Start at max load, diminish throughout day (Value=1)	varied, unpredictable (weather dependent) (Value=1)	Centralized, opportunity charging when possible; there may not be enough time for recharge between missions (Value=1)	Constrained (due to equipment installation) (Value=10)
82	1.5	**Crane**	4-7	100	I	Light (Value=1)	Average <70 miles per day (Value=1)	Centralized (Value=1)	Limited (Value=3)
83	1.5	**Dump**	4-7	200	I	Variable (depends on use requirements) (Value=1)	Average <70 miles per day (Value=1)	Centralized (Value=1)	Limited (Value=3)
84	1.5	**Refuse/Recycling**	4-7	200	I	Start light, end day at max load (Value=1)	Average <70 miles per day (Value=1)	Centralized (Value=1)	Limited (Value=3)
85	1.5	**Shredder**	4-7	100	I	Start light, end day at max load (Value=1)	Average <70 miles per day (Value=1)	Centralized (Value=1)	Limited (Value=3)

Index	Quantitative Suitability Score	Market Segment	Class	Annual CA Sales	Complete/ Incomplete	Loading	Routes/Range	Infrastructure/ Charging	Battery Space Constraints
86	3.75	**Pickup Truck - Personal Use**	2B-3	38000	C	Moderate Limited cargo carrying capacity to offset battery pack weights. Most people upgrade to the class 2b-3 pickup over a class 2a pickup for either load carrying or towing needs. (Value=1)	Variable; Towing will significantly shorten available EV range. (Value=1)	Centralized charging at residence/business (Value=3)	Constrained (Value=10)
87	1.5	**H-D Van - Passenger**	2B-3	6198	C	Light (Value=1)	Variable (Value=1)	Centralized charging at residence/business (Value=1)	Constrained (Value=3)

Table E-4 - California Sales per Battery Fuel Cell Electric Vehicle Suitability Score

Class	Score 1	1 < Score ≤ 2	3 < Score ≤ 4	4 < Score ≤ 5	5 < Score ≤ 10	All
2B-3	2,472	19,573	47,852	0	5000	74,897
4-7	7,610	6,484	4,667	0	652	19,413
8	1,069	1,156	1,466	15	3859	7,580
Total	11,151	27,213	53,985	15	9,511	101,890

F. Reference List

The following documents are the technical, theoretical, or empirical studies, reports, or similar documents relied upon in proposing these regulatory amendments, identified as required by Government Code, section 11346.2, subdivision (b)(3). Additionally, each appendix references the documents upon which it relies, as required by Government Code, section 11346.2, subdivision (b)(3).

1. California Air Resources Board. ACT Market Analysis. February 22, 2019. https://ww2.arb.ca.gov/index.php/sites/default/files/2019-02/190225actmarketanalysis.xlsx
2. California Legislature. Assembly Bill No. 2061 Chapter 580. (web link: https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB2061)
3. U.S. Census Bureau. 2002 Economic Census Vehicle Inventory and Use Survey Geographic Area Series. (web link: https://www2.census.gov/library/publications/economic-census/2002/vehicle-inventory and-use-survey/ec02tv-us.pdf)

State of California
AIR RESOURCES BOARD

Advanced Clean Trucks Regulation

Standardized Regulatory Impact Assessment (SRIA)

DATE OF RELEASE: August 8, 2019

Air Resources Board
1001 I Street
Sacramento, California 95814

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Table of Contents

LIST OF ACRONYMS AND ABBREVIATIONS

AB	Assembly Bill
ACC	Advanced Clean Car
ACT	Advanced Clean Truck
ASB	Airport Shuttle Bus
ATM	Advanced Technology Multiplier
BAU	Business-As-Usual
BEV	Battery-Electric Vehicle
CAAQS	California Ambient Air Quality Standards
CARB	California Air Resources Board
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CPI	Consumer Price Index
DMV	Department of Motor Vehicles
EER	Energy Efficiency Ratio
EIA	Energy Information Administration
EMFAC	Emission Factor Inventory Model
EPA	Environmental Protection Agency
ER	Emergency Room
EVSE	Electrical Vehicle Supply Equipment
FCEV	Fuel Cell Electric Vehicle
FY	Fiscal Year
GHG	Greenhouse Gas
GO-Biz	Governor's Office of Business and Economic Development
GSP	Gross State Product
GVWR	Gross Vehicle Weight Rating
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
ICCT	International Council on Clean Transportation
ICE	Internal Combustion Engine
ICT	Innovative Clean Transit
IPCC	Intergovernmental Panel on Climate Change
ISOR	Initial Statement of Reasons
IWG	Interagency Working Group
kWh	Kilowatt-Hour
LCFS	Low Carbon Fuel Standard
LHD	Light Heavy-Duty
LTL	Less-than-Truckload
MMT	Million Metric Tons
MY	Model Year
NHTSA	National Highway Traffic Safety Administration
NOx	Oxides of Nitrogen
PHEV	Plug-In Hybrid Electric Vehicle
PM	Particulate Matter

SB	Senate Bill
SC-CO_2	Social Cost of Carbon
SRIA	Standardized Regulatory Impact Assessment
State SIP Strategy	State Strategy for the State Implementation Plan
TCO	Total Cost of Ownership
tpd	Tons per Day
TTW	Tank-to-Wheel
WTW	Well-to-Wheel
ZE	Zero-Emission
ZEB	Zero-Emission Bus
ZEP	Zero-Emission Powertrain
ZEV	Zero-Emission Vehicle

A. Introduction

Mobile sources are the greatest contributor to emissions of criteria pollutants and greenhouse gases (GHG) in California, accounting for about 80 percent of ozone precursor emissions and approximately 50 percent of statewide GHG emissions when upstream emissions are included. Zero-emission vehicles (ZEVs) have no tailpipe emissions and help protect public health, reduce petroleum use, meet sustainability objectives, and reduce direct exposure to diesel emissions in local communities.

The proposed Advanced Clean Trucks (ACT) regulation (Proposed ACT Regulation) aims to accelerate adoption of medium and heavy duty ZEVs with a gross vehicle weight rating (GVWR) greater than 8,500 lbs. as part of California's strategy to reduce emissions from transportation. The Proposed ACT Regulation has two main elements:

- Manufacturers would be required to produce and sell medium and heavy duty ZEVs at an increasing percentage of California sales, and
- Large employers like retailers, manufacturers, government agencies and fleet owners would be required to report information that can be used to develop future strategies to further accelerate the use of ZEVs.

The proposed manufacturer ZEV sales requirement will meet several objectives and recommendations included in the Sustainable Freight Action Plan, Mobile Source Strategy[1] and ZEV Action Plan. The Proposed ACT Regulation will also complement recently approved regulations that require transit agencies and airport shuttle service providers to begin purchasing zero-emission buses, and to meet the zero-emission (ZE) truck purchase requirements in Assembly Bill 769 (AB 769) for state government fleets. The proposed manufacturer ZEV sales requirement also complements the federally and California-adopted Phase 2 GHG (CA Phase 2 GHG) regulation, because ZEVs can be used to meet these existing requirements. Finally, the Proposed ACT Regulation, including the proposed reporting requirement, establishes a foundation for meeting executive orders, plans, and directives issued by the Governor as described in the next section.

1. Regulatory History

In March 2017, CARB adopted the Revised Proposed 2016 State Strategies document as part of the State Implementation Plan (SIP) which identified several sectors that are key to launching heavy-duty zero-emission technology in the on-road heavy-duty sector: transit buses, delivery trucks, and airport shuttles.[2] The Proposed ACT Regulation continues implementation of these strategies to increase the first wave of heavy-duty ZEV deployments. The SIP includes the "Last Mile Delivery" measure which focuses on deploying zero-emission vehicles and equipment in well-suited applications. Based on continued assessment of

[1] California Air Resources Board, 2016 Mobile Source Strategy, May 2016, (web link: https://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf, last accessed June 2019).
[2] California Air Resources Board, Revised Proposed 2016 State Strategy for the State Implementation Plan, released on March 7, 2017 (web link: https://www.arb.ca.gov/planning/sip/2016sip/rev2016statesip.pdf, last accessed June 2019).

technological readiness, the Proposed ACT Regulation includes last mile delivery vehicles and expands to include a wider range of vehicles in well-suited applications. The experience gained by operating these early ZEVs are expected to benefit other heavy-duty vehicle markets and increase the commercialization, and acceptance, of clean transportation technologies in a wide range of applications.

The Sustainable Freight Action Plan established the strategy of using zero-emission technology where feasible, and “near-zero” with renewable fuels everywhere else, to meet California’s long-term air quality goals.[3] The Proposed ACT Regulation requires ZEV production and sales, while allowing for partial compliance with “near-zero” plug-in hybrid electric vehicle (PHEV) technology, closely matches with the Sustainable Freight strategy.

Several California executive orders and policies provide additional background for the Proposed ACT Regulation. In March 2012, Governor Edmund G. Brown issued Executive Order B-16-2012[4] directing California agencies to establish benchmarks for key milestones to help support and facilitate the ZEV market in California. One of those milestones include deploying over 1.5 million ZEVs and PHEVs on the road by 2025. As a result of this order, multiple state agencies, including the California Air Resources Board (CARB), worked to develop and release the 2013 ZEV Action Plan (2013 Plan).[5] The 2013 Plan identified over 100 strategies to meet the milestones of the Executive Order and included four broad goals to advance the overall ZEV market:

- Complete needed ZEV infrastructure and planning;
- Expand consumer awareness and demand of ZEVs;
- Transform fleets; and
- Grow jobs and investment in the private sector.

In January 2018, Governor Brown issued Executive Order B-48-18 building on past efforts to increase ZEVs by increasing California’s goal to 5 million ZEVs on the road by 2030, and setting a target of 250,000 chargers by 2025.[6] Also in 2018, Governor Brown issued executive order B-55-18, which sets a target to achieve carbon neutrality in California no later than 2045, and achieve and maintain net negative emissions thereafter.[7] The Proposed ACT Regulation

[3] Governor’s Office, Sustainable Freight Action Plan, released on July 2016 (web link: http://dot.ca.gov/hq/tpp/offices/ogm/cs_freight_action_plan/Documents/CSFAP_Main%20Document_FINAL_07272016.pdf, last accessed June 2019).
[4] Executive Order B-16-2012. State of California Executive Order signed by Governor Edmund G. (Jerry) Brown Jr. March 23, 2012 (web link: https://www.gov.ca.gov/2012/02/15/news17445/, last accessed June 14, 2019).
[5] Governor’s Interagency Working Group on Zero-Emission Vehicles, 2013. 2013 ZEV Action Plan: A roadmap toward 1.5 million zero-emission vehicles on California roadways by 2025 (web link: http://opr.ca.gov/docs/Governors_Office_ZEV_Action_Plan_(02-13).pdf, last accessed June, 2019).
[6] Executive Order B-48-18. State of California Executive Order signed by Governor Edmund G. (Jerry) Brown Jr. January 26, 2018 (web link: http://business.ca.gov/Portals/0/ZEV/2018-ZEV-Action-Plan-Priorities-Update.pdf, last accessed June 2019).
[7] Executive Order B-55-18. State of California Executive Order signed by Governor Edmund G. (Jerry) Brown Jr. To Achieve Carbon Neutrality, Executive Department: State of California, Office of the Governor, September 10, 2018. (web link: https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf, last accessed June 2019).

will support these goals by ensuring large scale production by manufacturers and is estimated to place 56,000 medium- and heavy-duty ZEV's in California by 2030.

In August 2018, Governor Brown sent a letter to Chair Nichols of CARB directing CARB to pursue conversion of public and private fleets to zero-emission vehicles in categories including large employers, delivery vehicles, and transportation service fleets.[8] In response, staff proposed adding a reporting requirement to the Proposed ACT Regulation, to collect additional information from large employers, retailers, brokers and fleets. The information would inform future rules to require the use of ZEVs that would further expand the ZEV market, and to complement the proposed manufacturer ZEV sales requirements, and other policies.

The Proposed ACT Regulation would complement other regulations recently adopted by the Board that require zero-emission airport shuttle and transit bus purchases. It also supports AB 739 that requires state fleets to purchase ZE trucks. The Innovative Clean Transit (ICT) regulation applies to buses with a GVWR greater than 14,000 lbs. It requires transit agencies to begin purchasing zero-emission buses (ZEBs) in 2023, and is phased-in so that 100 percent of bus purchases must be ZEBs beginning in 2029. Similarly, the Airport Shuttle Bus (ASB) regulation requires the purchase of zero-emission shuttle buses with a GVWR greater than 8,500 lbs. with a complete transition to zero-emission shuttles by 2035. Finally, AB 739 requires California state owned fleets of vehicles at or over 19,000 lbs. GVWR to purchase 15 percent ZEVs [9] starting in 2026, ramping up to 30 percent by 2030. Manufacturers can earn credit in the Proposed ACT Regulation for ZEVs sold to fleets affected by these other requirements. However, staff are excluding the cost and benefits of the ZEV purchases that are already required by the ICT regulation, ASB regulation, and AB739 from the Proposed ACT Regulation as they are already expected and attributed to other regulations.

The Proposed ACT Regulation also complements other regulations approved by CARB and the United States Environmental Protection Agency (US EPA) to reduce GHG emissions from medium- and heavy-duty vehicles. The U.S. EPA Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2 (Federal Phase 2 GHG) is structured to provide a range of options to manufacturers to reduce the fuel consumption of medium- and heavy-duty vehicles through use of a range of technologies including aerodynamics, more efficient engines, ZEVs and other technologies.[10] California adopted this federal program with minor changes. The California Greenhouse Gas Emissions Standards for Medium- and Heavy-duty Engines and Vehicles, and the Amendments to the Tractor-Trailer GHG Regulation (CA Phase 2 GHG) were adopted by the Board in February 2018.[11] There are some synergies in costs and emissions benefits between CA Phase 2 GHG

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[8] Governor's letter to Chair Nichols. Signed by Edmund G. (Jerry) Brown Jr. August 1, 2018. (web link: https://www.arb.ca.gov/msprog/zero_emission_fleet_letter_080118.pdf, last accessed June 2019).
[9] California State Legislature, Assembly Bill 739, signed into law October 10, 2017 (web link: https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB739, last accessed June 2019).
[10] United States Environmental Protection Agency (U.S. EPA) (2016). Final Rule for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2. Final Rule. October 25, 2016. (web link: https://www.gpo.gov/fdsys/pkg/FR-2016-10-25/pdf/2016-21203.pdf, last accessed June 2019).
[11] California Air Resources Board, Staff Report: Initial Statement of Reasons for Proposed Rulemaking Proposed California Greenhouse Gas Emission Standards for Medium- and Heavy-Duty Engines and Vehicles and

and the Proposed ACT Regulation, because ZEVs can be used to comply with both regulations. Since the Phase 2 GHG regulation is already in effect, no new GHG emissions reductions are attributed to the Proposed ACT Regulation unless the number of ZEVs sold exceeds what is required to comply with the Phase 2 GHG regulation. The impact on cost estimates is described in the baseline discussion in Section 5.

The Advanced Clean Cars (ACC) ZEV regulation requires manufacturers of Class 1 and 2A vehicles to produce and sell ZEVs in California as a percentage of total annual sales.[12] The ACC ZEV regulation does not require manufacturers to produce and sell Class 2B and 3 ZEVs, but it does provide an optional credit provision for Class 2B and 3 ZEVs. The Proposed ACT Regulation interacts with this optional credit provision for Class 2B and 3 ZEVs. However, the Proposed ACT Regulation avoids double counting with the ACC ZEV regulation by specifying that manufacturers may not use credits from the same Class 2B and 3 vehicles in both rules.

Zero-Emission Powertrain (ZEP) Certification was approved by the Board earlier this year as optional certification procedures for medium and heavy-duty electric and fuel-cell vehicles or zero-emission powertrains. ZEP certification supports future zero-emission measures by helping ensure fleet purchasers are provided with consistent and reliable information about zero-emission technology and the vehicles that use it, and that heavy-duty electric and fuel-cell vehicles are well supported once deployed.[13] ZEP certification will help ensure that zero-emission powertrains, along with the heavy-duty vehicles they are designed for, are reliable in their intended applications. The Proposed ACT Regulation will make ZEP certification required for manufacturers to earn credits needed to comply.

The cost analysis includes the value of Low Carbon Fuel Standard program (LCFS) credits as part of the analysis to show the potential impacts on the state economy. The LCFS is a regulation designed to reduce GHG emissions associated with the lifecycle of transportation fuels used in California.[14] A fleet owner that opts into the LCFS program can receive credits for consuming electricity or producing an alternative fuel (e.g., hydrogen) onsite. The credits can be sold to regulated parties in the LCFS credit market, thereby reducing operating costs for fleet owners. These credits will have a monetary value when sold to regulated parties who must offset deficits created by their supply of fuels with Carbon Indexing that exceed the LCFS standards. According to the LCFS staff report, regulations are needed to encourage the adoption of zero-emission vehicles, and the generation of LCFS credits can assist that effort.[15]

Proposed Amendments to the Tractor-Trailer GHG Regulation, December 19, 2017 (web link: https://www.arb.ca.gov/regact/2018/phase2/isor.pdf, last accessed June 2019).

[12] Zero-Emission Vehicle Standards for 2018 and Subsequent Model Year Passenger Cars, Light-Duty Trucks, and Medium-Duty Vehicles, California Code of Regulations Section 1962.2, January 1 2016, (web link: https://www.arb.ca.gov/msprog/zevprog/zevregs/1962.2_Clean.pdf, last accessed June 2019).

[13] Staff Report: Initial Statement of Reasons - Proposed Alternative Certification Requirements and Test Procedures for Heavy Duty Electric and Fuel-Cell Vehicles And Proposed Standards and Test Procedures For Zero Emission Powertrains (Zero-Emission Powertrain Certification Regulation), December 31, 2018 (web link: https://www.arb.ca.gov/regact/2019/zepcert/isor.pdf, last accessed June 2019).

[14] Subarticle 7: Low Carbon Fuel Standard, California Code of Regulations § 95480-95503, January 4, 2019 (web link: https://www.arb.ca.gov/fuels/lcfs/fro_oal_approved_clean_unofficial_010919.pdf, last accessed June 2019).

[15] California Air Resources Board, Public Hearing to Consider Proposed Amendments to the Low Carbon Fuel Standard Regulation and to the Regulation on Commercialization of Alternative Diesel Fuels. Staff Report: Initial Statement of Reasons (web link: https://www.arb.ca.gov/regact/2018/lcfs18/isor.pdf, last accessed June 2019).

To isolate the effects of switching to lower carbon fuels of the same type vs switching to new vehicle technologies the LCFS program does not count GHG benefits that are resultant from regulations that require switching to different vehicle technologies that influence carbon intensities of transportation fuels. Therefore, all of the GHG emissions benefits of deploying ZEVs will be counted as part of the Proposed ACT Regulation except if the ZEVs are already required to be purchased from existing regulations or legislation.

Additionally, Assembly Bill 2061 (AB 2061) is a complementary piece of legislation that mitigates vehicle weight concerns for ZEVs required by the Proposed ACT Regulation. AB 2061, to the extent expressly authorized by federal law, authorizes a near-zero-emission vehicle or a zero-emission vehicle, to exceed the weight limits on the power unit by up to 2,000 pounds.[16] AB 2061 factors into staff's assessment because it improves the suitability of ZEVs and reduces concerns about the potential for reduced payload and loss in revenue for vehicles that operate at their weight limits.

2. Proposed Advanced Clean Trucks (ACT) Regulation

The overall strategy of the Proposed ACT Regulation is to develop a self-sustaining ZE truck market through increasing sales of ZE trucks in California by truck manufacturers. The Proposed ACT Regulation includes two primary elements. First, it requires a percentage of truck and bus sales to be zero-emissions. Second, it requires large organizations including retailers, manufacturers, government agencies, and large truck fleets to report information about services they contract for that require the use of trucks and shuttles.

The primary objectives of the Proposed ACT Regulation include the following:

- Accelerate first wave of zero-emission truck deployments in best suited applications
- Enable a large-scale transition to zero-emission technology
- Maximize the total number of ZEVs deployed
- Provide environmental benefits, targeting disadvantaged communities
- Ensure requirements are technologically feasible and cost effective
- Foster a self-sustaining zero-emission truck market

a. *ZEV Sales Requirement*

The proposed manufacturer ZEV sales requirement applies to all manufacturers that certify incomplete chassis or complete vehicles with combustion engines in weight Classes 2B through 8 (GVWR greater than 8,500 lbs.). Manufacturers with 500 or more total annual California sales would be required to sell zero-emission vehicles as a percentage of annual California vehicle sales including incomplete vehicles, and complete vehicles. Manufacturers with less than 500 annual California sales are exempt from staff's proposal because they will incur similar investment costs to comply with the rule as larger manufacturers, but would not be likely to recoup their investments over their smaller production volumes.

The sales percentage requirements would begin with the 2024 MY to give manufacturers lead time to develop product lines. The requirements increase annually until the 2030 MY, and are

[16] California State Legislature, Assembly Bill 2061, signed into law September 20, 2018 (web link: https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201720180AB2061, last accessed June 2019).

detailed in Table A-1. The proposed ZEV sales percentages were developed based on analysis of ZE technology suitability to date, and current market developments. Staff subdivided vehicles into three categories reflecting differences in available ZEV technologies, and vehicle characteristics. The Class 4 through 8 straight trucks and shuttles are highly suited to electrification due to low average range needs, lower weight and payload concerns, and typically return to a base of operations enabling centralized fueling, thereby justifying the significant ramp up of the vehicle category requirements sooner than the others categories.

Table A-1. ZEV Sales Percentage Schedule

Model Year (MY)	Class 2B-3*	Class 4-8**	Class 7-8 Tractors
2024	3%	7%	0%
2025	5%	9%	0%
2026	7%	11%	0%
2027	9%	13%	9%
2028	11%	24%	11%
2029	13%	37%	13%
2030 and beyond	15%	50%	15%

*Excludes pickups until 2027 MY
**Excludes Class 7-8 Tractors

Class 7 and 8 tractors would be excluded until the 2027 MY because many vehicles in this category are more challenging to electrify due to longer range needs and higher payload needs. Today, only one Class 8 tractor is available for purchase and there is no publicly accessible infrastructure network to charge or fuel ZE trucks. Pickup truck sales are excluded from Class 2B-3 ZEV sales requirement until the 2027 model year due to concerns raised by stakeholders about highly variable towing needs and associated impacts on range.

Transit buses, double-decker buses, 60-foot articulated buses, and motor coach buses are excluded from the annual sales requirement because ZE buses are already required to be purchased by the Innovative Clean Transit (ICT)[17] and Zero-Emission Airport Shuttle Bus (ASB)[18] regulations, bus manufacturers have less than 500 annual sales in California, and several buses are already commercially available. However, there are some vehicles that are typically manufactured as cutaway or cab-and-chassis incomplete vehicles with a transit or shuttle body added after initial manufacture and sale that may be sold as ZEVs needed to comply with the ICT and ASB regulations. Similarly, ZEVs that are sold to state agencies to meet the requirements of AB 739 are already expected to be purchased. To simplify reporting and compliance tracking, staff are proposing to give credit for the sale of all ZEVs that are subject to the regulation, but will exclude projected sales of ZEV cutaway and cab-and-chassis sales that are already required from the existing ICT and ASB regulations and ZEV trucks required by AB739 from the inventory when estimating the cost and benefits of the Proposed ACT Regulation, and in the alternatives analysis discussed later in this document.

[17] California Air Resources Board, Innovative Clean Transit (web link: https://ww2.arb.ca.gov/our-work/programs/innovative-clean-transit, Last accessed June, 2019)
[18] California Air Resources Board, Zero-Emission Airport Shuttle (web link: https://ww2.arb.ca.gov/our-work/programs/zero-emission-airport-shuttle, Last accessed June, 2019)

Staff are proposing that credits can begin being generated starting with the 2021 MY, to incentivize early deployments, early development of ZE technologies and supply chains, and early action to result in achieving economies of scale sooner than the Proposed ACT Regulation would require.

b. ***ZEV Sales Flexibility***

The Proposed ACT Regulation, is structured to use a credit and deficit system for required ZEV sales to provide flexibility to the manufacturer. The method accounts for the fact that larger vehicles have higher emissions per mile than lighter vehicles and allows manufactures to exceed ZEV sales requirements in one category to offset required ZEV sales in another category without significantly impacting expected emissions benefits. For the cost analysis, staff assumed manufacturers would meet the specified ZEV requirement in each vehicle category and did not assume reduced costs from flexibility.

c. ***Plug-in Hybrid Electric Vehicles***

Staff are proposing plug-in hybrid electric vehicles (PHEVs) be allowed to earn partial credits based on their battery size and to use PHEV credits to meet part of their compliance obligation. It is unclear whether manufacturers are likely to utilize this option. Most manufacturers have already announced plans for full ZEVs and have stated that they are not planning to make additional models available as PHEVS; therefore, staff did not model costs differently for PHEVs.

d. ***ZEP Certification***

The Proposed ACT Regulation would make ZEP Certification mandatory starting with the 2024 model year for medium and heavy duty ZEVs, and includes the costs associated with mandatory ZEP certification requirements in the cost analysis.

e. ***Manufacturer Reporting***

Manufacturers that are subject to the ZEV sales requirement and those who sell ZEVs and want to earn credits must report annually to CARB. Manufacturers of ICE and ZEV chassis and complete vehicles must report to CARB annually to demonstrate compliance. Any manufacturers that sell ZEVs in California and elect to earn ZEV credits must report vehicle or chassis sales annually to earn credits. Manufacturers must report details of credit trade transactions so CARB can determine and track compliance.

f. ***Large Entity Reporting Requirement***

Under the Proposed ACT Regulation, a large entity would be required to report information about contracting practices for services that require the use of shuttles or trucks and these large entities would also be required to report information about how their existing trucks and buses are used. Reporting would be done once, in early 2021. This information is needed to build a knowledge base of typical fleet operations and contracting practices to help develop future rules that would increase the use of ZEVs in California starting in 2024, with a goal of complementing the Proposed ACT Regulation. A large entity is defined as a public or private organization that did business in California and met one of the following in calendar year 2019:

- Received more than $50M in total annual gross revenue
- Owned or dispatched 100 or more Class 2B and larger vehicles

Large entity reporting applies to a wide range of large businesses and government agencies whether or not they own trucks and buses. Large entities include, retailers, manufacturers, refiners, accounting firms, hotels, drayage terminal operators, utility providers, refuse companies, federal, state, and local government agencies and other types of large employers. The information that large entities would be required to submit about the type of service, frequency of deliveries, type of facility, approximate location, and other summary information about any of the following that might apply:

- Contracts to move freight/materials by truck or van
- Contract for regular pick-up or delivery services
- Contract for shuttle or bus service
- Contracts for vocational truck service
- Vehicle usage characteristics if they own/lease trucks vans or buses
- For-hire truck or bus transportation services they provide
- Characteristics of facilities they operate that receive deliveries.

Vehicle owners would need to provide individual vehicle characteristics, operation data and usage data, and location information. Many fleets already provide some vehicle characteristics to CARB in the TRUCRS reporting system, but more would need to report and would need to include additional information about vehicle usage characteristics and terminal or yard locations. These data would then be used to identify opportunities for ZEV adoption and to inform decisions on what regulatory mechanism is most appropriate to ensure ZEV purchases are made and that ZEVs would be placed in uses that are suitable to meet individual fleet needs. Staff believes that collecting this level of detailed information from large organizations will provide sufficient information about fleet types and businesses in California to support and focus future rulemaking efforts that would require the use of ZEVs in California. Affected entities would need to spend time to understand the data request, would take staff time to gather all relevant information or to export data to submit. The estimated staff time to collect and report the information is a cost associated with the Proposed ACT Regulation.

3. Statement of the Need of the Proposed ACT Regulation

The Proposed ACT Regulation will contribute to achieve the state's criteria pollutant and GHG reduction goals and cleaner technology targets. The California 2016 Mobile Source Strategy states that mobile sources and the fossil fuels that power them are the largest contributors to the formation of ozone, GHG emissions, fine particulate matter (PM2.5), and toxic diesel particulate matter[19]. In California, the transportation sector alone accounts for 41 percent of

[19] California Air Resources Board, 2016 Mobile Source Strategy (web link: https://ww3.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf, last accessed June 2019)

total GHG emissions (50% when upstream emissions from fuel is included)[20] and is a major contributor to oxides of nitrogen (NOx) and particulate matter (PM) emissions.

The Proposed ACT Regulation is needed to accelerate the transition to zero-emissions in the medium-and heavy- duty vehicle sector. The Proposed ACT Regulation is identified as the “Last Mile Delivery” measure in the SIP and 2017 Climate Change Scoping Plan[21] as a necessary component for California to achieve established near- and long-term air quality and climate mitigation targets. In addition, the deployment of ZEVs meets goals identified in the 2016 ZEV Action Plan that supports the governor’s Executive Order B-16-12 and Executive Order B-48-18, which calls for 1.5 million ZEVs in California by 2025 and establishes several milestones on the pathway toward this target.

Currently, regulations including Phase 2 GHG provide an incentive to build more fuel efficient, lower GHG vehicles, but these regulations have no specific requirement for medium- and heavy-duty manufacturers to build ZEVs. Phase 2 GHG includes a temporary credit multiplier for ZEVs through 2027. The Proposed ACT Regulation is needed to provide certainty and to ensure that manufacturers will invest into ZEV technology.

4. Major Regulation Determination

The Proposed ACT Regulation has been determined to be a major regulation because the economic impact of the regulation in California is estimated to exceed $50 million in multiple years of the regulatory timeline extending from 2020 to 2040. The economic impact is estimated as a result of direct cost and cost-savings to the manufacturer as passed on to California businesses. Cost increases are associated with the higher cost of producing ZEVs and savings for the manufacturers are the result of reduced costs of compliance with the Phase 2 GHG regulation while the ZEV multiplier is in effect prior to 2028. The temporary ZEV multiplier results in making ZEVs a lower cost option for manufacturers to meet Phase 2 GHG requirements for a few years than if assuming compliance would be achieved without producing ZEVs as originally assumed in the Phase 2 GHG rulemakings. More detail on this is in the next section.

5. Baseline Information

For the SRIA, the economic and emissions impacts of the Proposed ACT Regulation are evaluated against the business-as-usual (BAU) scenario each year for the analysis period from 2020 to 2040. The BAU case for the economic and emissions analysis for the Proposed ACT Regulation is referred to as the “baseline” and uses the same vehicle inventory for both analyses. The baseline vehicle inventory includes the same vehicle sales and population growth assumptions reflected in CARB’s EMFAC emissions inventory for weight Class 2B and

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[20] California Air Resources Board, California Greenhouse Gas Emission Inventory (web link: https://www.arb.ca.gov/cc/inventory/data/data.htm, last accessed June 2019)
[21] California Air Resources Board, California’s 2017 Climate Change Scoping Plan, released in November 2017 (web link: https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf, last accessed June 2019)

larger vehicles for all fuel types[22]. EMFAC emissions inventory includes assumptions reflecting Phase 2 GHG, and LCFS program compliance.

ZEVs required by the Proposed ACT Regulation can also be used to comply with the CA Phase 2 GHG regulation and the U.S. EPA Phase 2 GHG regulation, and results in potential overlapping emissions and costs. In the Federal Phase 2 GHG rulemaking, EPA stated that they "do not project fully electric vocational vehicles to be widely commercially available in the time frame of the final Phase 2 rules. For this reason, [EPA and NHTSA] have not based the Phase 2 standards on adoption of full-electric vocational vehicles."[23] California adopted the U.S. EPA Phase 2 GHG regulation and similarly did not model ZEV deployments due to the CA Phase 2 GHG regulation.

Even though Phase 2 GHG gives an Advanced Technology Multiplier (ATM) that may make ZEVs a temporarily more cost effective compliance option until the end of the 2027 MY, staff does not believe the Phase 2 GHG regulation incentivizes ZEVs enough to ensure their production. Manufacturers bear risks in building and selling ZEVs due to the large upfront investments and uncertainty in future growth and may not be the lower cost option to comply with the Phase 2 GHG regulation post 2027.

For purposes of evaluating GHG emissions staff assumes no new GHG emissions benefits as a result of the Proposed ACT Regulation up to the total benefits anticipated from the CA Phase 2 GHG requirements. Staff does count GHG emissions benefits after any CA Phase 2 GHG anticipated benefits are exceeded. The interactions between CA Phase 2 GHG and the Proposed ACT Regulation are also factored into the cost analysis later in this document.

The ZEVs that are already required to be purchased by the existing ICT and ASB regulations and AB 739 are also excluded from the from the costs and emissions analysis of the Proposed ACT Regulation and any alternatives analysis to avoid double counting.

This analysis of the Proposed ACT Regulation counts ZEVs sold starting with the 2021 model year, but will not include those sold in prior years because incentive funding programs are already offsetting most, if not all of the incremental costs. Staff does not assume ZEV sales will continue without incentive or other policies to promote them. For example, some industry market projections forecast ZEV adoption, but these include assumptions about availability of incentives and government policies to increase ZEV sales. ACT Research, a major freight movement analytics firm, released an August 2018 report titled "Commercial Vehicle Electrification: To Charge or Not To Charge[24]", which predicted that ZEVs will be adopted in increasing numbers due to incentives and government policies, among other factors. Another reason that ZEVs are not included in the baseline inventory is that medium and heavy duty ZEV deployments were assumed in the SIP and only actions that are enforceable can be included in the SIP. The Proposed ACT Regulation would make ZEV sales enforceable.

[22] California Air Resources Board, EMFAC 2017 Database (web link: https://www.arb.ca.gov/emfac/2017/, last accessed June 2019)
[23] United States Environmental Protection Agency, Final Rule for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2: Regulatory Impact Analysis, 2016. https://nepis.epa.gov/Exe/ZyPDF.cgi/P100P7NS.PDF?Dockey=P100P7NS.PDF. Last accessed June 17, 2019.
[24] Advanced Clean Transportation Research, Commercial Vehicle Electrification: To Charge or Not To Charge (https://www.actresearch.net/cv-electrification-study/, last accessed June 2019)

6. Public Outreach and Input

For the Proposed ACT Regulation, CARB created a technical workgroup that comprises interested stakeholders including manufacturers, fleets, environmental groups, utilities, technology providers, and fuel providers. In addition to public workgroup meetings, CARB staff has conducted more than 100 individual meetings with more than 50 stakeholders. Some of these key stakeholders include but are not limited to Truck and Engine Manufacturers Association members (EMA), the California Electric Transportation Coalition (CalETC) and electric vehicle manufacturers, several fleet representatives, and nonprofit organizations.

Since 2016, CARB staff held six workshops, and five workgroup meetings to provide information to the public and solicit feedback. CARB staff posted information regarding these events and any associated materials on the ACT website and distributed notice of these meetings through two public list serves; actruck and zevfleet that include 2,662 and 948 recipients. The majority of the meetings were available by webcast and teleconference. At the meetings, CARB staff solicited stakeholder feedback on the Proposed ACT Regulation and overall regulatory process.[25] In addition to continued efforts to solicit feedback from stakeholders about the Proposed ACT Regulation, CARB staff solicited for alternatives during the May 31, 2018 workshop.[26]

Staff has reached out to the proposed regulated parties throughout the regulatory development. In the April 2017 workshop, staff asked fleets to submit answers to a draft fleet survey questionnaire in an effort to gather detailed information about everyday operations of local fleets. Staff also mailed notice letters to the 11,000 large entities and fleets that would be required to report under the Proposed ACT Regulation. Further, staff has met with the proposed ten regulated manufacturers (Daimler, FCA, Ford, GM, Isuzu, Navistar, Nissan, PACCAR, Hino/Toyota, and Volvo) on a group and individual basis throughout the regulatory development process. CARB staff has held two joint meetings with California Governor's Office of Business and Economic Development (GO-Biz) in which fleets, manufacturers, and utilities discussed medium-and heavy-duty electrification. Additionally, staff has engaged in frequent discussions with ZEV technology providers, electric utilities, fuel providers, and non-governmental environmental organizations during various outreach events such as technology symposiums and expositions.

Staff has produced two discussion documents that were made available to the public for comment on the ACT website; Total Cost of Ownership (TCO) and Energy Efficiency Ratio (EER) papers.[27,28] The TCO paper assessed the costs of owning and operating zero-emission vehicles. The EER paper analyzed of the efficiency of heavy-duty electric vehicles compared to conventional ICE vehicles of the same type and use; this analysis supported LCFS

[25] California Air Resources Board, Advanced Clean Truck meetings and workshops (https://ww2.arb.ca.gov/our-work/programs/advanced-clean-truck/act-meetings-workshops, last accessed June 2019).
[26] California Air Resources Board, Meeting notice of public workshop to discuss the proposed Advanced Clean Truck rule (web link: https://www.arb.ca.gov/msprog/mailouts/msc1811/msc1811.pdf, last accessed June 2019).
[27] California Air Resources Board, Advanced Clean Trucks Total Cost of Ownership Discussion Document – Draft(web link: https://ww2.arb.ca.gov/sites/default/files/2019-02/190225tco_0.pdf, last accessed June 2019).
[28] California Air Resources Board, Battery Electric Truck and Bus Efficiency Compared to Diesel Vehicles (web link: https://ww2.arb.ca.gov/sites/default/files/2018-11/180124hdbevefficiency.pdf, last accessed June 2019).

regulation amendments which increased the EER for heavy-duty battery-electric vehicles, resulting in nearly doubling the amount of credits earned for using electricity as a transportation fuel. In addition, CARB staff posted an updated version of a TCO calculator, on the ACT website, which allows stakeholders to calculate and compare the TCO between diesel, battery-electric, and hydrogen fuel-cell vehicles.

B. Benefits

The 2016 State SIP Strategy identifies that "electrification and progress toward zero emission is critical to address the remaining (from renewable fuels) localized risk of cancer and other adverse effects from major freight hubs, and (electrification) must play a growing role in reducing GHG emissions and petroleum use."[29] The Proposed ACT Regulation supports the goals of the SIP and reduces pollutants linked to multiple adverse health effects identified by the California Ambient Air Quality Standards (CAAQS).[30] These pollutants are nitrogen oxides (NOx), key ingredients in the formation of several airborne toxic substances[31], and particulate matter of diameter less than 2.5 microns ($PM_{2.5}$), which may deposit deep inside the lung. Long-term exposure to PM2.5 has been linked to premature death, particularly in people who have chronic heart or lung diseases, and reduced lung function growth in children.[32] The Proposed ACT Regulation also reduces GHG emissions, petroleum use, and provides the certainty needed to establish a long term medium- and heavy-duty ZEV market.

1. Benefits to Typical Businesses

a. Truck and Bus Owners

Individual businesses that have operations that are well suited for using ZEVs may be able to lower their total cost of ownership by taking advantage of the operational cost savings of battery-electric vehicles. ZE truck owners that own their charging or hydrogen fueling stations can lower fuel costs by taking advantage of Low Carbon Fuel Standard (LCFS) program.

b. Utility Providers

The Proposed ACT Regulation will increase the number of ZEVs deployed which in turn will increase the amount of electricity supplied by utility providers

The Proposed ACT Regulation also helps the state's investor-owned utilities meet the goals of SB350. SB350 requires the state's investor-owned utilities to develop programs "to accelerate widespread transportation electrification." Pacific Gas and Electric and Southern California Edison have both developed and been approved to set up programs to install electric

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[29] California Air Resources Board, 2016 Mobile Source Strategy, May 2016, pg. 77-79 (web link: https://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf, last accessed June 2019).
[30] California Air Resources Board, California Ambient Air Quality Standards (web link: https://ww2.arb.ca.gov/resources/california-ambient-air-quality-standards, last accessed June 2019).
[31] California Air Resources Board, Nitrogen Dioxide and Health (web link: https://ww2.arb.ca.gov/resources/nitrogen-dioxide-and-health, last accessed June 2019).
[32] California Air Resources Board, Inhalable Particulate Matter (PM 2.5 and PM10) (web link: https://ww3.arb.ca.gov/research/aaqs/common-pollutants/pm/pm.htm, last accessed June 2019).

infrastructure on the customer's site up to the charger and would offer a voucher for the charger itself. San Diego Gas and Electric has proposed a similar program that is currently awaiting CPUC decision. All three utilities are either developing or have been approved to establish new electricity rates for commercial ZEV deployments. By ensuring that vehicles will be available to make use of these utility investments and rates, the Proposed ACT Regulation supports the utilities' programs and the goals of SB350.

c. Other California Businesses

The Proposed ACT Regulation may result in benefits to zero-emissions truck component suppliers, electrical vehicle supply equipment (EVSE) suppliers and installers, and hydrogen fuel station suppliers. Due to higher demand for ZEVs from the Proposed ACT Regulation, production of ZEVs in California would likely increase leading to increases in manufacturing and related jobs throughout the state. The increase in the production and usage of ZEVs could also benefit various businesses related to the ZEV component supply chain, including those involved in battery, fuel cell, and electric drivetrain businesses.

The Proposed ACT Regulation may also benefit EVSE suppliers who may see an increase in charging equipment installation as a result of increased medium and heavy duty ZEV purchases. Most of these installations are expected to be located in central depots or yards where trucks are parked overnight. Increased installation of charging infrastructure will benefit the EVSE suppliers, equipment installers, and electricians. All of the installations will be in California, and some of the EVSE equipment may be manufactured in California. Increased purchase of ZEVs under the Proposed ACT Regulation could also benefit various California businesses related to installing hydrogen fueling stations, supplying hydrogen and associated maintenance.

2. Benefits to Small Businesses

The Proposed ACT Regulation may result in benefits to small business due to higher demand for ZEVs, and would likely lead to increases in manufacturing, distribution, infrastructure installation and maintenance and other related jobs for small businesses throughout the state. Electricians, construction companies, including infrastructure installers, existing ZEV manufacturers, fuel cell and electric drivetrain parts and components businesses may fall into the small business category. Increased installation of charging infrastructure will benefit EVSE suppliers, equipment installers, and electricians that are small business. All of the installations will be in California, and some of the EVSE equipment may be manufactured in California. Increased purchase of ZEVs under the Proposed ACT Regulation could also benefit various California small businesses related to installing hydrogen fueling stations, supplying hydrogen and associated maintenance.

3. Benefits to Individuals

The Proposed ACT Regulation will benefit California residents mainly from reductions in NOx, PM, and from improvements in California air quality and reduced impact on adverse health impacts. The reduction of GHG emissions, while being a global pollutant, will also benefit California residents.

a. *Criteria Pollutant Emissions Benefits*

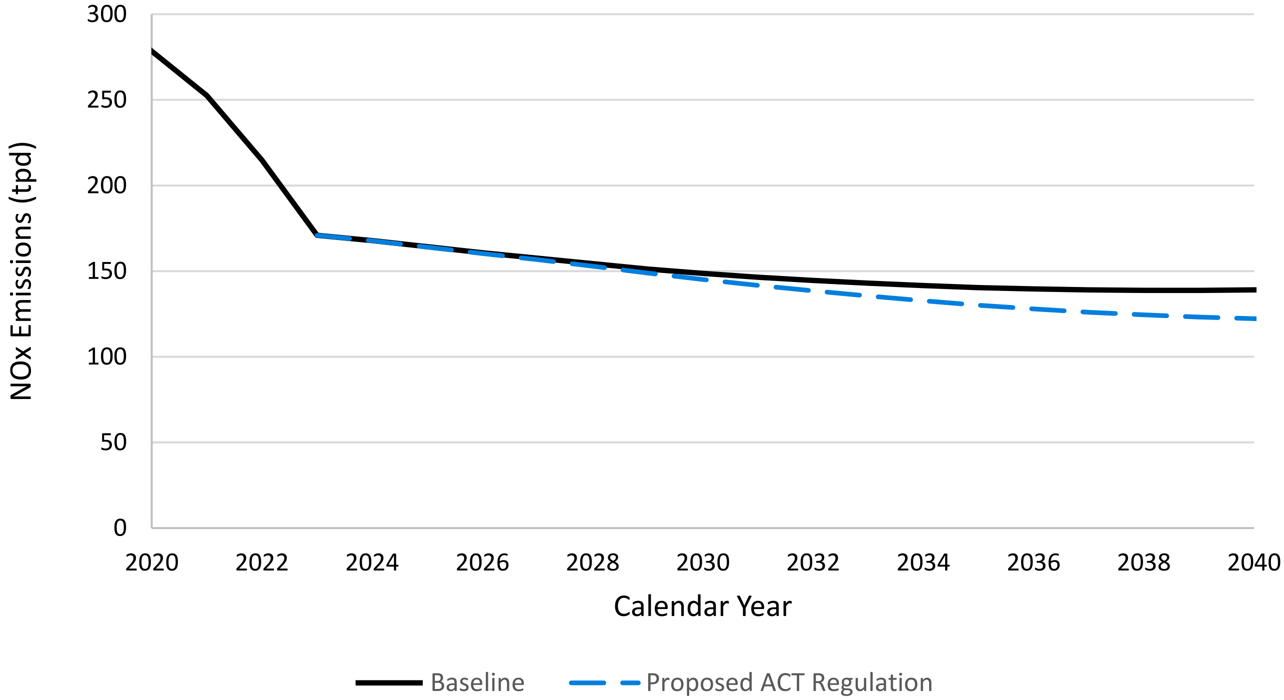
The projected benefits of the proposed Advanced Clean Trucks regulation are identified in Table B-1 with respect to NOx, $PM_{2.5}$, and GHG. Emissions benefits are projected by assuming zero tailpipe emissions for the forecasted number of ZEVS sold in California assuming no change in VMT and California sales compared to the baseline. In addition, staff is including an estimated 50% brake wear reduction for electric vehicles compared to conventional due to the effects of regenerative braking. These sales projections are further discussed in Section C. Emission benefits continue to grow as the ZEV sales requirement continues to be in effect past 2030 and the population of ZEV continue to grow. The cumulative total emission reductions from 2020 to 2040 is estimated to result in 125,830 tons reduction in NOx and a 3,382 tons reduction in $PM_{2.5}$ relative to baseline. The emissions presented below for GHG are solely tank-to-wheel (TTW) meaning upstream emission reductions are not included. Staff is in the process of developing and updating upstream emission factors and will include WTW emissions in the Initial Statement of Reasons. Once these are included, they are expected to show greater GHG emissions reductions due to the lower upstream emissions of electricity and hydrogen compared to gasoline and diesel. Table B-1 shows the benefits of the Proposed ACT Regulation in 2031 and 2040.

Table B-1. Proposed ACT Regulation NOx, $PM_{2.5}$, and TTW GHG Benefits Relative to Baseline

Calendar Year	NOx (tpd)	$PM_{2.5}$ (tpd)	CO_2 (MMT/yr)
2031	4.77	0.16	0.34
2040	16.84	0.46	1.27

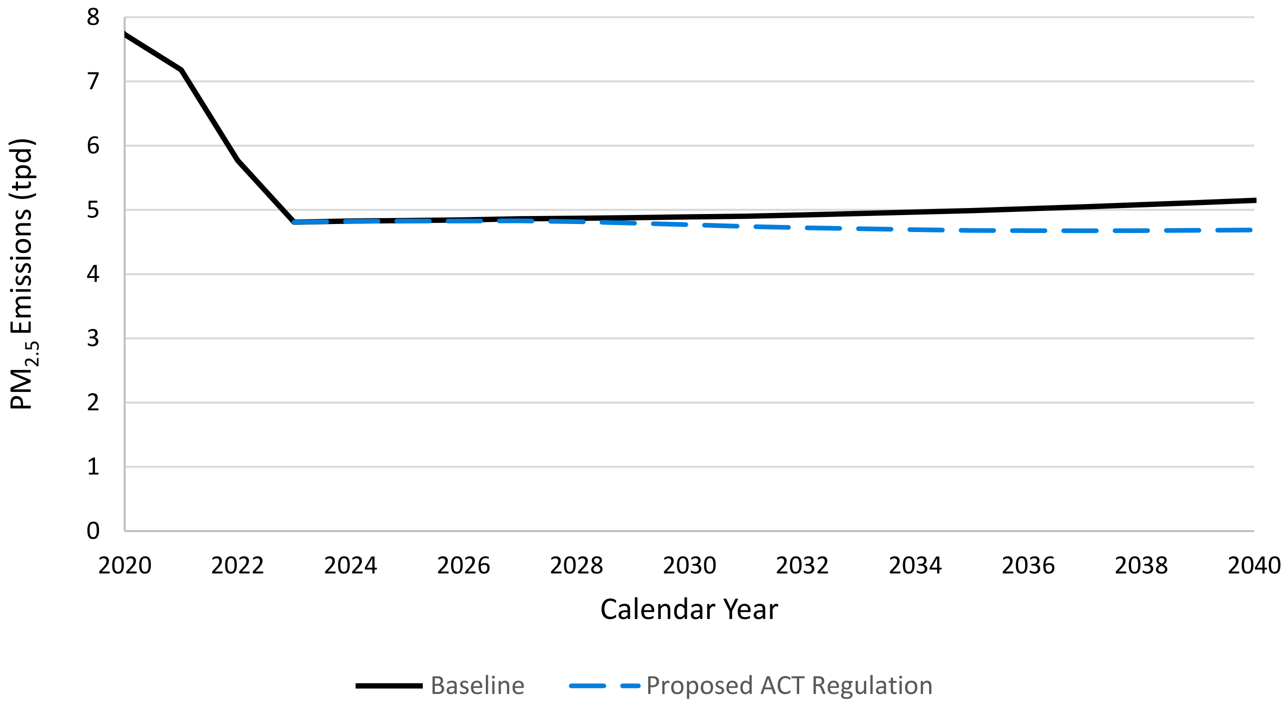
The NO_x and $PM_{2.5}$ emissions impact of the Proposed ACT Regulation are presented relative to the baseline in Figure B-1 and Figure B-2 respectively and are shown in short tons per day (tpd). In the baseline, projected NOx emissions decrease sharply until 2023 when the Truck and Bus regulation achieves its goal of upgrading most diesel vehicles to 2010 MY and newer engines. The Truck and Bus regulation applies to trucks and buses with a GVWR greater than 14,000 lbs.

Figure B-1. Projected TTW NO_x Emissions, Baseline and Proposed ACT Regulation



Past 2023, NOx emissions are expected to decrease in the baseline scenario in EMFAC even as miles travelled continues to grow. This occurs because of continued NOx reduction through natural attrition to cleaner engines for vehicles that are not subject to the Truck and Bus Regulation. Medium- and heavy-duty vehicles that are not subject to the Truck and Bus regulation include, public fleet vehicles, Solid Waste Collection Vehicles with pre-2007 MY engines, vehicles with a GVWR less than 14,001 lbs and other vehicles that do not use diesel fuel.

Figure B-2. Projected $PM_{2.5}$ Emissions, Baseline and Proposed ACT Regulation



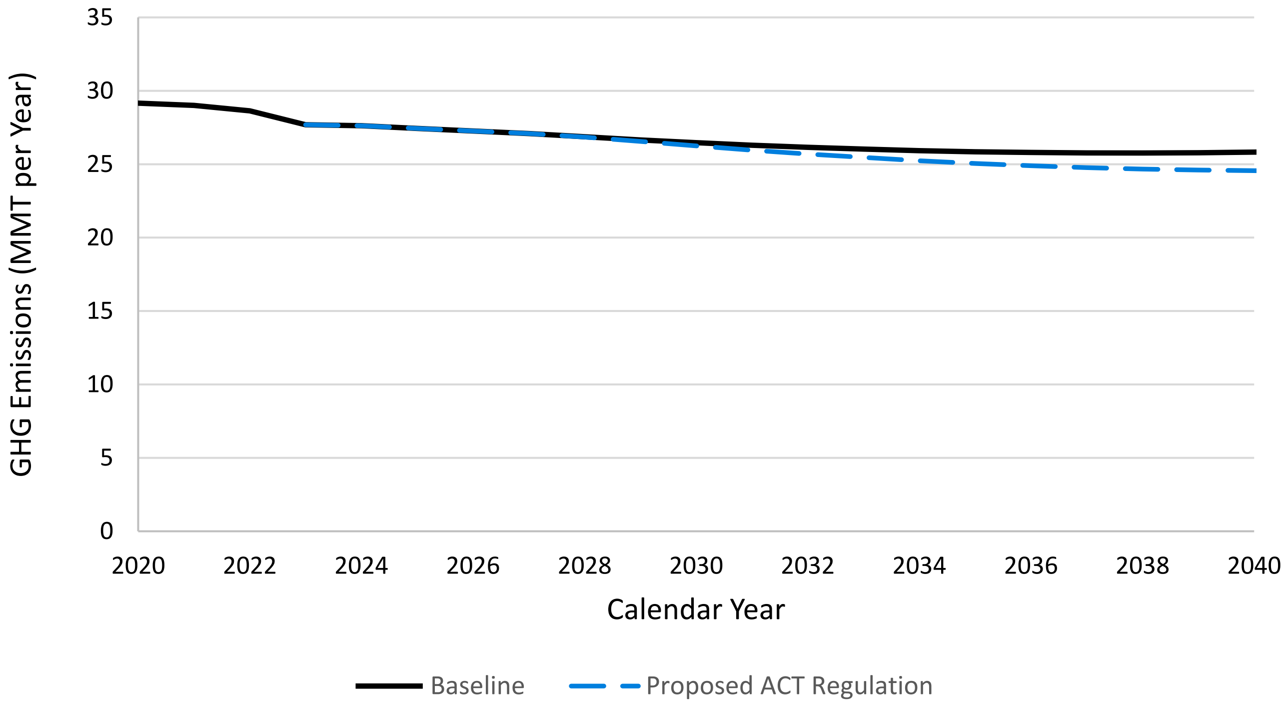
Similarly, $PM_{2.5}$ emissions decrease sharply in the baseline scenario until 2023 but level off for several years before beginning to rise in later years. By 2023, nearly all diesel trucks with a GVWR greater than 14,000 lbs will have PM filters due to the Truck and Bus Regulation. Beginning 2024, $PM_{2.5}$ emissions begin to increase slightly as vehicle miles travelled in EMFAC continue to grow, but the increase is partially offset from some $PM_{2.5}$ emissions reductions from lighter vehicles that continue to be replaced through normal attrition. These vehicles, with a GVWR less than 14,000 lbs, are not subject to in-use requirements to be retrofitted or replaced. For these lighter vehicles, when the pre-2007 diesel engines that do not have $PM_{2.5}$ are replaced, the PM emissions from this segment of the truck population continues to go down until all diesel vehicles have PM filters.

b. ***GHG Emissions Benefits***

The Proposed ACT Regulation accounts for GHG benefits in terms of carbon dioxide (CO_2). Figure B-3 summarizes the estimated TTW GHG emissions reductions with the Proposed ACT Regulation compared to the baseline in million metric tons per year (MMT per Year). The emissions presented below for GHG are solely tank-to-wheel (TTW) meaning upstream emission reductions are not included. Staff is in the process of developing and updating upstream emission factors and will include WTW emissions in the Initial Statement of Reasons. Once these are included, they are expected to show greater GHG emissions reductions due to the lower upstream emissions of electricity and hydrogen compared to gasoline and diesel. Staff expects the Proposed ACT Regulation to reduce cumulative TTW GHG emissions by an estimated 10.1 Million Metric Tons (MMT) of CO_2 relative to the baseline from 2020 to 2040. The benefits for this rule do not include any ZEVs which may be used to comply with the California Phase 2 GHG regulation. Only ZEVs sold in excess of the

California Phase 2 GHG regulation's requirements are included in GHG calculations to avoid double-counting.

Figure B-3. Projected TTW GHG Emissions under the Baseline and Proposed ACT Regulation



The benefit of these GHG reductions can be estimated using the Social Cost of Carbon (SC-CO_2), which provides a dollar valuation of the damages caused by one ton of carbon pollution and represents the monetary benefit today of reducing carbon emissions in the future.

In this analysis, CARB utilizes the current Interagency Working Group (IWG) supported SC-CO_2 values to consider the social costs of actions taken to reduce GHG emissions. This is consistent with the approach presented in the Revised 2017 Climate Change Scoping Plan [33] and is in line with Executive Orders including 12866 and the OMB Circular A-4 of September 17, 2003, and reflects the best available science in the estimation of the socio-economic impacts of carbon.[34]

The IWG describes the social costs of carbon as follows:

> *The social cost of carbon (SC-CO_2) for a given year is an estimate, in dollars, of the present discounted value of the future damage caused by a 1-metric ton increase in carbon dioxide (CO_2) emissions into the atmosphere in that year, or equivalently, the*

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[33]California Air Resources Board, California's 2017 Climate Change Scoping Plan, released in November 2017 (web link: https://www.arb.ca.gov/cc/scopingplan/scoping_plan_2017.pdf, last accessed June 2019).
[34] Office of Management and Budgets, Circular A-4 (web link: https://www.transportation.gov/sites/dot.gov/files/docs/OMB%20Circular%20No.%20A-4.pdf, last accessed June 2019).

benefits of reducing CO_2 emissions by the same amount in that year. The SC-CO_2 is intended to provide a comprehensive measure of the net damages – that is, the monetized value of the net impacts- from global climate change that result from an additional ton of CO_2.

These damages include, but are not limited to, changes in net agricultural productivity, energy use, human health, property damage from increased flood risk, as well as nonmarket damages, such as the services that natural ecosystems provide to society. Many of these damages from CO_2 emissions today will affect economic outcomes throughout the next several centuries.[35]

The SC-CO_2 is year specific, and is highly sensitive to the discount rate used to discount the value of the damages in the future due to CO_2. The SC-CO_2 increases over time as systems become more stressed from the aggregate impacts of climate change and future emissions cause incrementally larger damages. This discount rate accounts for the preference for current costs and benefits over future costs and benefits, and a higher discount rate decreases the value today of future environmental damages. While the Proposed ACT Regulation cost analysis does not account for any discount rate, this social cost analysis uses the IWG standardized range of discount rates from 2.5 to 5 percent to represent varying valuation of future damages. Table B-2 shows the range of IWG SC-CO_2 values used in California's regulatory assessments.[36]

Table B-2. SC-CO_2, 2012-2050 (in 2007$ per Metric Ton)

Year	5 Percent Discount Rate	3 Percent Discount Rate	2.5 Percent Discount Rate
2020	$12	$42	$62
2025	$14	$46	$68
2030	$16	$50	$73
2035	$18	$55	$78
2040	$21	$60	$84
2045	$23	$64	$89
2050	$26	$69	$95

If all TTW GHG reductions under the Proposed ACT Regulation are assumed to be carbon reductions, the avoided SC-CO2 from 2020 to 2040 is the sum of the annual TTW GHG emissions reductions multiplied by the SC-CO2 in each year. The cumulative TTW GHG emission reductions along with the estimated benefits from the Proposed ACT Regulation are shown in Table B-3. These benefits range from about $239 million to $1.01 billion through 2040, depending on the chosen discount rate.

[35] National Academies of Sciences, Engineering, Medicine, Valuing Climate Damages: Updating Estimation of Carbon Dioxide (web link: http://www.nap.edu/24651, last accessed June 2019.

[36] Interagency Working Group on the Social Cost of Carbon, Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis -Under Executive Order 12866 (web link: https://obamawhitehouse.archives.gov/sites/default/files/omb/inforeg/scc-tsd-final-july-2015.pdf, last accessed June 2019).

Table B-3. Avoided Social Cost of CO_2

Year	GHG emission reductions (MMT)	Avoided SC-CO_2 (Million 2018$)		
		5% discount rate	3% discount rate	2.5% discount rate
2024	0.0	$0.0	$0.0	$0.0
2025	0.0	$0.0	$0.0	$0.0
2026	0.0	$0.0	$0.0	$0.0
2027	0.0	$0.0	$0.1	$0.1
2028	0.0	$0.4	$1.5	$2.1
2029	0.1	$2.0	$6.6	$9.7
2030	0.2	$5.0	$15.6	$22.8
2031	0.4	$7.8	$25.0	$36.3
2032	0.5	$11.3	$34.7	$50.0
2033	0.7	$14.3	$44.5	$63.8
2034	0.8	$18.1	$54.4	$77.5
2035	0.9	$21.0	$64.2	$91.0
2036	1.1	$25.1	$73.9	$104.2
2037	1.2	$27.8	$83.5	$118.6
2038	1.3	$32.1	$93.0	$131.5
2039	1.4	$34.7	$102.4	$144.0
2040	1.5	$39.1	$111.6	$156.3
Total	**10.1**	**$238.8**	**$710.8**	**$1,007.9**

It is important to note that the SC-CO_2, while intended to be a comprehensive estimate of the damage caused by carbon globally, does not represent the cumulative cost of climate change and air pollution to society. There are additional costs to society outside of the SC-CO_2, including costs associated with changes in co-pollutants, the social cost of other GHGs including methane and nitrous oxide, and costs that cannot be included due to modeling and data limitations. The Intergovernmental Panel on Climate Change (IPCC) has stated that the IWG SC-CO_2 estimates are likely underestimated due to the omission of significant impacts that cannot be accurately monetized, including important physical, ecological, and economic impacts.

c. *Health Benefits*

The Proposed ACT Regulation reduces NOx and $PM_{2.5}$ emissions, resulting in health benefits for individuals in California. The value of these health benefits are due to fewer instances of premature mortality, fewer hospital and emergency room visits, and fewer lost days of work. As part of setting the National Ambient Air Quality Standard for PM, the U.S. EPA quantifies the health risk from exposure to PM and CARB relies on the same health studies for this evaluation.[37] The evaluation method used in this analysis is the same as the one used for

[37] United States Environmental Protection Agency, Health and Environmental Effects of Particulate Matter (web link: https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm, last accessed June 2019)

CARB proposed Low Carbon Fuel Standard 2018 Amendments, and Heavy-Duty Vehicle Inspection Program and Periodic Smoke Inspection Program.

CARB analyzed the value associated with five health outcomes in the BAU, proposed amendments, and alternatives: Cardiopulmonary[38] mortality, hospitalizations for cardiovascular[39] illness, hospitalizations for respiratory[40] illness, emergency room (ER) visits for respiratory illness, and ER visits for asthma.

These health outcomes were selected because US EPA has identified these as having a *causal* or *likely causal* relationship with exposure to $PM_{2.5}$.[41] The US EPA examined other health endpoints such as cancer, reproductive and developmental effects, but determined there was only *suggestive* evidence for a relationship between these outcomes and PM exposure, and insufficient data to include these endpoints in the national health assessment analyses routinely performed by U.S. EPA.

The U.S. EPA has determined that both long-term and short-term exposure to $PM_{2.5}$ plays a *causal* role in premature mortality, meaning that a substantial body of scientific evidence shows a relationship between $PM_{2.5}$ exposure and increased risk of death. This relationship persists when other risk factors such as smoking rates, poverty and other factors are taken into account.[42] While other mortality endpoints could be analyzed, the strongest evidence exists for cardiopulmonary mortality.[43] The greater scientific certainty for this effect, along with the greater specificity of the endpoint, leads to an effect estimate for cardiopulmonary deaths that is both higher and more precise than that for all-cause mortality.[44]

The US EPA has also determined a *causal* relationship between non-mortality cardiovascular effects and short and long-term exposure to PM2.5, and a *likely causal* relationship between non-mortality respiratory effects (including worsening asthma) and short and long-term $PM_{2.5}$ exposure.[45] These outcomes lead to hospitalizations and ER visits, and are included in this analysis.

[38] Outcomes related to the heart or lungs
[39] Outcomes related to the heart or blood vessels
[40] Respiratory illness such as chronic obstructive pulmonary disease, and respiratory infections
[41] U.S. EPA, 2010. Quantitative Health Risk Assessment for Particulate Matter (Final Report). https://www3.epa.gov/ttn/naaqs/standards/pm/data/PM_RA_FINAL_June_2010.pdf
[42] U.S. EPA. Integrated Science Assessment (ISA) for Particulate Matter (Final Report, Dec 2009). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-08/139F, 2009. http://ofmpub.epa.gov/eims/eimscomm.getfile?p_download_id=494959
[43] U.S. EPA. Integrated Science Assessment (ISA) for Particulate Matter (Final Report, Dec 2009). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-08/139F, 2009. http://ofmpub.epa.gov/eims/eimscomm.getfile?p_download_id=494959
[44] Air Resources Board (ARB), 2010. Estimate of Premature Deaths Associated with Fine Particle Pollution (PM2.5) in California Using a U.S. Environmental Protection Agency Methodology. https://www.arb.ca.gov/research/health/pm-mort/pm-report_2010.pdf
[45] U.S. EPA. Integrated Science Assessment (ISA) for Particulate Matter (Final Report, Dec 2009). U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-08/139F, 2009. http://ofmpub.epa.gov/eims/eimscomm.getfile?p_download_id=494959

In general, health studies have shown that populations with low socioeconomic standings are more susceptible to health problems from exposure to air pollution.[46,47] However, the models currently used by U.S. EPA and CARB do not have the granularity to account for this impact. The location and magnitude of projected emission reductions resulting from many proposed regulations are not known with sufficient accuracy to account for socioeconomic impacts, and an attempt to do so would produce uncertainty ranges so large as to make conclusions difficult. CARB acknowledges this limitation.

A detailed summary of the health modeling methodology is included in Health Benefits Appendix of this SRIA.

i. Results

Table B-4 shows the estimated avoided premature mortality, hospitalizations, and emergency room visits because of the Proposed ACT Regulation for 2020 through 2040 by California air basin, relative to the baseline. Only the regions with values of one or higher are shown, and regions with zero or insignificant impacts are not shown. Values in parenthesis represent the 95 percent confidence intervals of the central estimate. As detailed in the previous section, the Proposed ACT Regulation is estimated to reduce overall emissions of $PM_{2.5}$ and NOx in most years, and lead to net reduction in adverse health outcomes statewide, relative to the baseline.

The Proposed ACT Regulation may decrease the occupational exposure to air pollution of California truck operators and other employees who work around truck traffic. CARB staff cannot quantify the potential effect on occupational exposure due to lack of data on the typical occupational exposure for these types of workers.

Table B-4. Regional and Statewide Avoided Mortality and Morbidity Incidents from 2020 to 2040 under the Proposed ACT Regulation*

Air Basin	Avoided Premature Deaths	Avoided Hospitalizations for cardiovascular illness	Avoided Hospitalizations for respiratory illness	Avoided ER visits
Great Basin Valleys	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Lake County	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Lake Tahoe	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Mojave Desert	4 (3 - 4)	1 (0 - 1)	1 (0 - 1)	1 (1 - 2)
Mountain Counties	4 (3 - 4)	0 (0 - 1)	0 (0 - 1)	1 (1 - 2)
North Central Coast	3 (2 - 3)	0 (0 - 1)	1 (0 - 1)	2 (1 - 2)
North Coast	1 (1 - 1)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Northeast Plateau	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Sacramento Valley	24 (19 - 29)	3 (0 - 6)	3 (1 - 6)	9 (6 - 12)
Salton Sea	3 (2 - 4)	0 (0 - 1)	0 (0 - 1)	1 (1 - 2)

[46] Krewski et al. (2009) Extended Follow-Up and Spatial Analysis of the American Cancer Society Study Linking Particulate Air Pollution and Mortality. Health Effects Institute Research Report 140. https://ephtracking.cdc.gov/docs/RR140-Krewski.pdf.
[47] Gwynn RC, Thurston GD. (2001) The burden of air pollution: impacts among racial minorities. Environ Health Perspectives;109(4):501–6. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1240572/

San Diego County	27 (21 - 33)	4 (0 - 7)	5 (1 - 8)	11 (7 - 15)
San Francisco Bay	54 (42 - 66)	9 (0 - 17)	10 (2 - 18)	30 (19 - 41)
San Joaquin Valley	70 (55 - 86)	8 (0 - 17)	10 (2 - 18)	26 (16 - 35)
South Central Coast	10 (8 - 12)	2 (0 - 3)	2 (0 - 3)	4 (3 - 6)
South Coast	387 (303 - 473)	65 (0 - 128)	78 (18 - 137)	198 (124 - 271)
Statewide	587 (459 - 718)	92 (0 - 181)	110 (26 - 194)	283 (178 - 388)

*Values in parenthesis represent the 95% confidence interval. Totals may not add due to rounding.

In accordance with U.S. EPA practice, health outcomes are monetized by multiplying each incident by a standard value derived from the economic studies.[48] The value per incident is shown in Table B-5. The value for avoided premature mortality is based on willingness to pay,[49] which is a statistical construct based on the aggregated dollar amount that a large group of people would be willing to pay for a reduction in their individual risks of dying in a year. While the cost-savings associated with premature mortality is important to account for in the analysis, the valuation of avoided premature mortality does not correspond to changes in expenditures, and is not included in the macroeconomic modeling (Section E). As avoided hospitalizations and ER visits correspond to reductions in household expenditures on health care, these values are included in the macroeconomic modeling.

Unlike mortality valuation, the cost-savings for avoided hospitalizations and ER visits are based on a combination of typical costs associated with hospitalization and the willingness of surveyed individuals to pay to avoid adverse outcomes that occur when hospitalized. These include hospital charges, post-hospitalization medical care, out-of-pocket expenses, and lost earnings or both individuals and family members, lost recreation value, and lost household production (e.g., valuation of time-losses from inability to maintain the household or provide childcare).[50] These monetized benefits from avoided hospitalizations and ER visits are included in macroeconomic modeling (Section E).

Table B-5. Valuation per Incident for Avoided Health Outcomes

Outcome	Value per incident (2018$)
Avoided Premature Mortality	$9,419,320
Avoided Cardiovascular Hospitalizations	$56,588
Avoided Acute Respiratory Hospitalizations	$49,359
Avoided Emergency Room Visits	$810

Statewide valuation of health benefits were calculated by multiplying the value per incident by the statewide total number of incidents for 2020-2040 as shown in Table B-6. The estimated

[48] U.S. EPA, Appendix B: Mortality Risk Valuation Estimates, Guidelines for Preparing Economic Analyses (240-R-10-001, released December 2010) (web link: http://yosemite.epa.gov/ee/epa/eerm.nsf/vwAN/EE-0568-22.pdf/$file/EE-0568-22.pdf
[49] U.S. EPA, An SAB Report on EPA's White Paper Valuing the Benefits of Fatal Cancer Risk Reduction (EPA-SAB-EEAC-00-013, released July 27, 2000) (web link: https://yosemite.epa.gov/sab%5CSABPRODUCT.NSF/41334524148BCCD6852571A700516498/$File/eeacf013.pdf
[50] Chestnut, L. G., Thayer, M. A., Lazo, J. K. and Van Den Eeden, S. K. (2006), The Economic Value Of Preventing Respiratory And Cardiovascular Hospitalizations, Contemporary Economic Policy, 24: 127– 143. doi: 10.1093/cep/byj007

total statewide health benefits derived from criteria emission reductions is estimated to be $5.5 billion, with $5.2 billion resulting from reduced premature mortality and $0.34 billion resulting from reduced hospitalizations and emergency room visits. The spatial distribution of these benefits across the state follows the distribution of the health impacts by air basin as described in Table B-4.

Table B-6 Statewide Valuation from Avoided Health Outcomes

Outcome	Avoided Incidents	Valuation (Million 2018$)
Avoided Premature Mortality	587	$5,528.9
Avoided Cardiovascular Hospitalizations	92	$5.2
Avoided Acute Respiratory Hospitalizations	110	$5.4
Avoided Emergency Room Visits	283	$0.2
Total		**$5,540**

d. *Other Benefits to Individuals*

In addition to emission reductions, ZEVs offer a number of other benefits to truck operators when compared to gasoline and diesel vehicles. ZEVs are quiet and have a smoother ride than ICE vehicles, and reduces noise at the worksite as well as in the community the vehicle is operating.

C. Direct Costs

The Proposed ACT Regulation will require manufacturers to produce and sell vehicles that have a higher upfront cost than in the baseline. Manufacturers bear the risk associated with the incremental costs associated with producing and selling ZEVs, but producing and selling these ZEVs will simultaneously decrease the manufacturers' cost of comply with the Phase 2 GHG regulation. Staff assumes the costs to California includes the higher upfront capital costs, infrastructure upgrades and lower operating expenses. This approach shows the full estimated cost to California for deploying the same number of ZEVs required by the regulation.

1. Direct Cost Inputs

The estimated direct costs from the Proposed ACT Regulation and the baseline scenario include: upfront capital costs of the vehicles, infrastructure, and ongoing operating costs which include fueling and maintenance. Compared to gasoline or diesel vehicles, ZEVs generally have higher upfront capital costs but lower operating costs, which result in an overall savings in staff's analysis over the useful life of the vehicles. Currently there are a number of rebate and voucher programs in California that offset some or all of the incremental costs for ZEVs and supporting infrastructure; however, none of these incentives are included in the cost analysis. LCFS credits are a form of incentive, but it is a market-based mechanism that increases the use of low carbon transportation fuels in California that has been established by California regulations. The assumptions underlying the direct costs are detailed in the following sections.

a. ***Vehicle Population and Annual Mileage***

Staff divided the affected vehicle population into five vehicle groups to match the requirements of the Proposed ACT Regulation. Note that Class 6-7 and Class 8 excludes Class 7-8 tractors because there is a separate category for those vehicles.

- Class 2B-3 – Vehicles with a GVWR from 8,501 to 14,000 lb.
- Class 4-5 – Vehicles with a GVWR from 14,001 to 19,500 lb.
- Class 6-7 – Vehicles with a GVWR from 19,500 to 33,000 lb. (excluding Class 7 tractors)
- Class 8 – Vehicles with a GVWR above 33,001 lb. (excluding Class 8 tractors)
- Class 7-8 Tractors – Tractors with a GVWR above 26,001 lb.

In this analysis, all estimates for annual California sales come from CARB's Emission Factor (EMFAC) inventory model.[51] The EMFAC model is developed and used by CARB to assess emissions from on-road vehicles including cars, trucks, and buses in California, and to support CARB's regulatory and air quality planning efforts to meet the Federal Highway Administration's transportation planning requirements. U.S. EPA approves EMFAC for use in State Implementation Plan and transportation conformity analyses. It includes vehicle population growth, mileage accrual rates over time, vehicle fuel usage and associated emission factors, and vehicle attrition over time. The vehicle categories in EMFAC were matched to the Proposed ACT Regulation's vehicle groups as shown in Table C-1:

Table C-1. Vehicle Groups and EMFAC categories

Vehicle Group	EMFAC Categories
Class 2B-3	Light Heavy-Duty 1 and Light Heavy-Duty 2
Class 4-5 & Class 6-7	T6 Small (Class 4-6 Vehicles), T6 Heavy (Class 7) excluding tractors, School Bus, All Other Buses
Class 8	T7 (Class 8) excluding tractors
Class 7-8 Tractor	T6 Heavy Tractors, T7 Tractors

EMFAC groups Class 4-5 and Class 6-7 into the same category called T6. However, because staff needed to match population categories with the proposed rule to more accurately model the resulting changes in vehicle populations for this analysis, the T6 category was split into Class 4-5 and Class 6-7. Staff assumes a 49% Class 4-5 to 51% Class 6-7 split based on DMV data.[52]

Because the Proposed ACT Regulation only affects vehicles sold into California, the total sales numbers were adjusted downward using California DMV data to remove out-of-state sales. The estimated number of California sales from 2024-2030 model years for each category are shown in Table C-2. Truck sales are forecasted by EMFAC to grow at about 1 percent per year.[53]

[51] California Air Resources Board, EMFAC2017 Web Database (web link: https://www.arb.ca.gov/emfac/2017/, last accessed June 2019).
[52] California Department of Motor Vehicles, DMV Data, 2018. (Last accessed June 2019).
[53] California Air Resources Board, EMFAC2017: Volume III – Technical Documentation (web link: https://ww3.arb.ca.gov/msei/downloads/emfac2017-volume-iii-technical-documentation.pdf, last accessed June 2019).

Table C-2. Estimated Number of Annual Sales per Vehicle Group

Model Year	Class 2B-3	Class 4-5	Class 6-7	Class 8	Class 7-8 Tractor	Total Sales
2024	53,761	6,856	7,136	1,119	4,686	73,559
2025	54,217	6,957	7,241	1,137	4,769	74,321
2026	54,753	7,083	7,372	1,177	4,918	75,302
2027	55,152	7,228	7,523	1,194	4,993	76,091
2028	55,765	7,354	7,654	1,216	5,075	77,064
2029	56,371	7,482	7,788	1,239	5,161	78,041
2030	56,968	7,613	7,924	1,264	5,263	79,032

Vehicle manufacturers sell trucks powered by a variety of fuels – most commonly gasoline or diesel, but also including compressed and liquid natural gas, propane, E85, and other fuels. In staff's assumed baseline conditions, for simplification, Class 2B-3 vehicles are split between gasoline- and diesel-powered assuming a 43 percent gasoline to 57 percent diesel ratio based on available EMFAC data.[54] Staff assumes Class 4-8 vehicles are solely diesel-powered to simplify the analysis. Based on EMFAC data, roughly 10 percent of Class 4-8 vehicles use a fuel other than diesel.

Under the Proposed ACT Regulation, manufacturers can comply with a combination of battery-electric, fuel-cell electric, and plug-in hybrid electric technologies. It is difficult to predict manufacturers' future plans for complying with the Proposed ACT Regulation, especially as battery and fuel-cell technologies improve and costs continue to decline. Based on manufacturers' publicly announced plans, staff assumed manufacturers will comply with the Proposed ACT Regulation requirements for Class 2B-3 and Class 4-8 vocational trucks by building battery-electric vehicles. Staff assumed no FCEVs in these two categories because no manufacturers that would be regulated have announced plans to commercially produce FCEVs. Cummins is a powertrain manufacturer that has announced plans to offer a plug-in hybrid powertrain to vehicle manufacturers that allows for full-electric, series hybrid, and parallel hybrid functionality.[55] At this time it is unclear if PHEVs will result in lower costs for regulated manufacturers because the vehicles would have two propulsion systems, and would earn fewer PHEV credits than an equivalent ZEV meaning that more PHEVs would need to be sold to meet the same credit requirement. The reduced PHEV credit also ensures that total emission benefits remain about the same. Although PHEVs are expected to have lower cost per vehicle than full ZEVs, they still require charging infrastructure and will not have as significant operational cost savings as battery-electric vehicles. At workgroup meetings, multiple manufacturers have stated they would not produce both PHEVs and ZEV models if still required to produce ZEVs to comply. For all of these reasons, staff are not including PHEVs in the cost analysis.

For Class 7-8 tractors, staff assumes 90% of the required vehicles will be sold as battery-electric and 10% will be sold as fuel-cell electric. While there is interest from numerous manufacturers in fuel-cell tractor technology, most manufacturers are currently investing in

[54] California Air Resources Board, EMFAC2017 Web Database (web link: https://www.arb.ca.gov/emfac/2017/, last accessed June 2019).
[55] Cummins, Powerdrive for Electric Trucks (web link: https://www.cummins.com/electrification/powerdrive-for-electric-trucks, last accessed June 2019).

battery-electric tractor technology. The proposed percentage requirements are not stringent enough to require electrification of the long haul sector meaning manufacturers can focus their deployments in short-haul tractor applications. Battery-electric technology is well suited for short-haul applications and offers potential fuel savings. Long-haul applications are where fuel cell electric trucks offer the greatest advantage over battery-electric tractors due to their rapid refueling and lower weight.

Table C-3 outlines the assumptions for each vehicle group in the baseline and proposal scenarios.

Table C-3. Vehicle Groups and Technologies

Vehicle Group	Baseline Scenario	Proposal Scenario
Class 2B-3	Gasoline (43%) Diesel (57%)	Battery-electric (All normal range)
Class 4-5	Diesel	Battery-electric (50% long range after 2030)
Class 6-7	Diesel	Battery-electric (50% long range after 2030)
Class 8	Diesel	Battery-electric (50% long range after 2030)
Class 7-8 Tractor	Diesel	Battery-electric (90%) Fuel Cell Electric (10%)

The percentage schedules shown below in Table C-4 are applied to the annual sales numbers to calculate the annual number of zero-emission trucks required by the regulation.

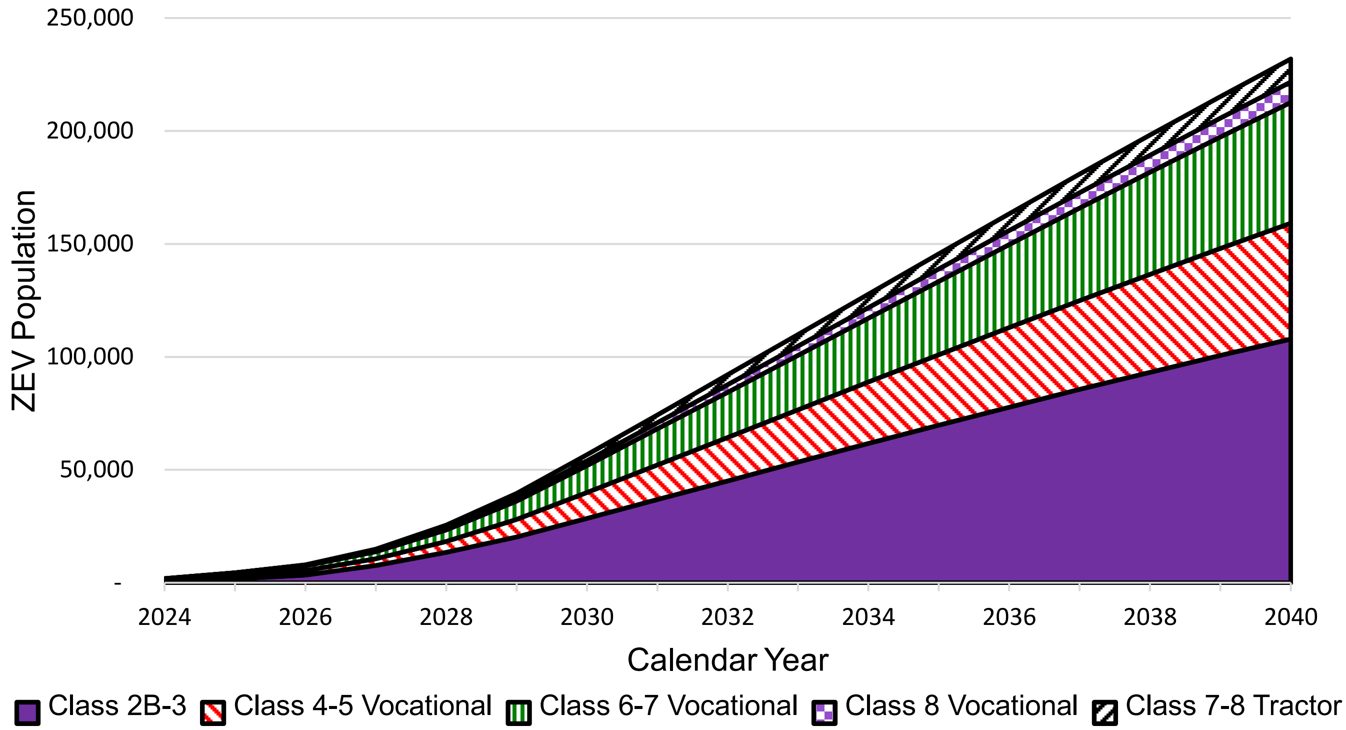
Table C-4. Advanced Clean Trucks ZEV Sales Percentage Schedule

Model Year	Baseline	Class 2B-3*	Class 4-8**	Class 7-8 Tractor
2024	0%	3%	7%	0%
2025	0%	5%	9%	0%
2026	0%	7%	11%	0%
2027	0%	9%	13%	9%
2028	0%	11%	24%	11%
2029	0%	13%	37%	13%
2030 and beyond	0%	15%	50%	15%

*Pickup trucks are excluded from Class 2B-3 requirements until 2027
**Excluding Class 7-8 tractors

These percentages are applied to the annual California sales numbers to estimate the number of zero-emission trucks that will be sold in California as shown in Figure C-1. The population growth rate increases to 2030 as the ZEV sales percentage requirement ramps up, and starts to slow down afterwards as ZEV sales begin to replace ZEVs that retire out of the fleet.

Figure C-1. ZEV Population Forecast over Time (>8,500 lb. GVWR)



Staff are not anticipating any pre-buy situation where manufacturers increase sales of their vehicles before the Proposed ACT Regulation and decrease sales after implementation begins. Fleets, not manufacturers, decide when to purchase vehicles and this regulation would not encourage them to delay their purchases.

Annual mileage factors into a number of costs in this analysis including fuel costs, maintenance, and LCFS revenue. All annual mileage are based on EMFAC inventory estimates of mileage accrual rates over a vehicles life. For most vehicle categories, annual mileage is the highest early for low age vehicles and drops over time as the vehicle ages. EMFAC categories are matched to vehicle groupings as follows:

- Class 2B-3 annual mileage is the population weighted average of the following EMFAC categories: Light Heavy-Duty 1 and 2
- Class 4-5 and Class 6-7 vehicles are not separated in EMFAC and are lumped together into a Class 4-7 grouping. Based on data available from the 2002 US Vehicle Inventory and Use Survey and the 2018 California Vehicle Inventory and Use Survey, the annual miles for Class 4-5 and Class 6-7 trucks are fairly similar.[56, 57] The Class 4-7 vocational truck annual mileage is the population weighted average of the following EMFAC categories: T6 Public, T6 Instate, T6 Instate – Construction, T6 Utility, T6 gasoline powered trucks, School Buses, and All Other Buses.

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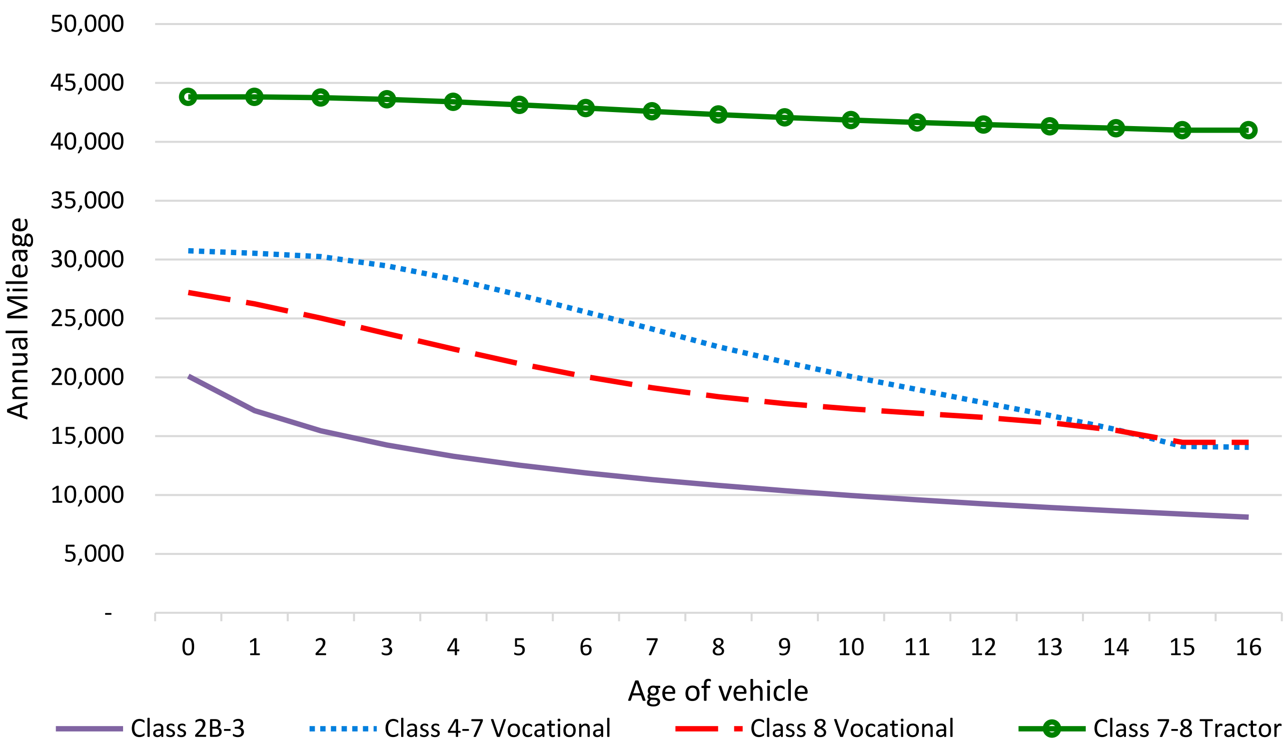
[56] United States Census, 2002 Vehicle Inventory and Use Survey (web link: https://www.census.gov/library/publications/2002/econ/census/vehicle-inventory-and-use-survey.html , last accessed June 2019).

[57] California Department of Transportation, CalTrans Truck Survey, 2018. (Summarized data available here: http://www.scag.ca.gov/committees/CommitteeDocLibrary/mtf012319_CAVIUS.pdf, Last accessed June 2019).

- Class 8 truck annual mileage is the population weighted average of the following EMFAC categories: T7 Public, T7 Single Unit, T7 Single Unit – Construction, T7 Solid Waste Collection Vehicle, and T7 Utility.
- Class 7-8 tractor annual mileage is the population weighted average on the three EMFAC drayage categories: Port of Los Angeles, Port of Oakland, and All Other Ports. We are currently assuming that all required sales zero-emission tractors will be used in drayage service or similar shorter-haul operation.

Figure C-2 illustrates the average mileage assumption for each vehicle group over the life of the vehicle from EMFAC. Staff are assuming ZEVs will travel the same miles as conventional ICE vehicles in their typical operation. Even today, commercially available ZEVs have the range to meet the majority of trucking needs and the lower operating cost of BEVs incentivizes higher mileage duty cycles. Over time as technology advances and more models become available, range should become less of an issue.

Figure C-2. Annual Mileage Accrual Rates by Vehicle and Age



The California International Registration Plan and Out of State categories are not included in these calculations as these categories represent trucks that regularly travel in interstate operation. Due to their high annual miles and variable infrastructure needs, these categories are not assumed to be representative of a zero-emission duty cycle. In addition, many of these trucks are not sold into California despite operating within the state, so these sales would not be regulated under the proposed ACT rule.

b. ***Costs to Manufacturers***

Manufacturers are the regulated party in the Proposed ACT Regulation and would be responsible for selling zero-emission vehicles in California. The Proposed ACT Regulation requires that manufacturers must build and sell more expensive zero-emission trucks, certify their powertrain using the optional ZEP Certification procedure, and report information to CARB as part of their regulatory requirements. Manufacturers have the option to use the required zero-emission truck sales to help meet their Phase 2 GHG compliance obligation. Therefore, the incremental costs of producing ZEVs above the expected costs of compliance with the Phase 2 GHG without ZEVs are attributable to the Proposed ACT Regulation.

i. Vehicle Price

This section covers the cost to the manufacturer of building and selling a baseline ICE vehicle or a ZEV. Today and for the foreseeable future, battery-electric and fuel cell electric trucks will cost more than their diesel or gasoline counterparts. Declining battery and component costs in addition to economies of scale are expected to lower the incremental costs of zero-emission vehicles as the market expands. For this subsection, we are assuming the full incremental price of the vehicle when compared to the baseline is treated as a cost to the manufacturer. Vehicle prices are not amortized as the manufacturer would see the full cost in the year it is built and sold.

Gasoline and diesel vehicle prices are based on averages of prices taken from manufacturers' websites and other related websites. [58,59,60,61,62] For the Class 4-5, Class 6-7, and Class 8 vehicles, the cost is meant to represent a vehicle with a basic body such as a box or stake-bed and not a vehicle with an expensive specialty body such a boom truck or refuse truck.

Staff estimated the cost of zero-emission vehicles for battery-electric and fuel cell powered vehicles by adding electric components costs, fuel cell component costs, and energy storage costs to a conventional glider vehicle. The final retail price of the zero-emission vehicle is the sum of the total component costs adjusted by an additional 10 percent for other upfront costs such as research, development, retooling, and overhead. The calculated prices for battery electric vehicles are comparable to battery electric trucks and vans that are available through the HVIP program today

The cost of battery storage is the largest contributing factor associated with the price of battery-electric truck. Battery pack costs have dropped over 80 percent since 2010 and are projected to continue declining. The CARB discussion document "Battery Cost for Heavy-Duty Vehicles" was a literature review published in 2016 using data sources from 2013 and 2014 to assess battery costs for buses and heavy duty vehicles.[63] Battery pack cost for heavy duty applications are higher than for light cars due to smaller volumes and differing packaging requirements even though many use the same cells. However, this report is somewhat dated and does not reflect the current state of the battery market. At the December 4th, 2018

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[58] Daimler, Mercedes-Benz Vans (web link: https://www.mbvans.com/sprinter/home , last accessed June 2019).
[59] FCA, Ram Commercial (web link: https://www.ramtrucks.com/ram-commercial/index.html, last accessed June 2019).
[60] Ford, Ford Fleet (web link: https://www.fleet.ford.com/ , last accessed June 2019).
[61] General Motors, General Motors Fleet (web link: https://www.gmfleet.com/, last accessed June 2019).
[62] TruckPaper, TruckPaper (web link: https://www.truckpaper.com/ , last accessed June 2019).
[63] California Air Resources Board, Battery Cost for Heavy-Duty Electric Vehicles (Discussion Draft) (web link: https://www.arb.ca.gov/msprog/bus/battery_cost.pdf, last access June 2019).

Advanced Clean Trucks workgroup meeting, a number of manufacturers suggested we use light-duty battery prices with a five-year delay to reflect battery-price projections that are applicable to heavy duty vehicles.

The battery-electric vehicle costs in this analysis are calculated using electric vehicle component costs from the International Council on Clean Transportation whitepaper (ICCT), "Transitioning to Zero-Emission Heavy-Duty Freight Vehicles" and battery costs will use the Bloomberg light-duty battery prices with a five-year delay.[64,65] Hydrogen fuel cell component costs are from a variety of sources. Electrical component costs and hydrogen tank costs are calculated using the same ICCT source and battery costs are estimated using the same Bloomberg light-duty battery prices with a five year delay. Hydrogen system component costs are calculated using a presentation from Strategic Analysis titled "Fuel Cell Systems Analysis" which estimated fuel cell system costs for medium- and heavy-duty trucks.[66] This presentation analyzed fuel cell system costs on a component level basis for multiple weight classes of vehicle and provided temporal and volume-based cost projections.

Staff are not forecasting that this rule will affect commercial battery prices and ZEV technology significantly. The Proposed ACT Regulation affects a portion of California's heavy-duty trucking fleet, which is very small compared to the worldwide market for batteries in consumer electronics, light-duty vehicles, battery-storage, and other applications. To the extent that this rule increases economies of scale for general ZEV components, infrastructure, and battery production, there may be lower component prices as a result of the rule, but these effects are less certain and are not modelled. The Proposed ACT Regulation may cause the cost for components specifically designed for medium- and heavy-duty ZEVs to decrease as economies of scale start to emerge in this new market.

The battery-electric vehicle is modelled using motors and electrical components in line with an existing diesel counterpart's power needs, and battery storage capacity based on the Age 0 daily mileage, the energy economy of the electric vehicle, and a 35% buffer to account for battery degradation and some operational variability. The hydrogen fuel cell tractor cost assumes the battery is 10 kWh, 40 kg. of hydrogen storage, and the fuel cell stack's power output is half the vehicle's peak power needs.

In the proposal and some alternatives, a long-range battery-electric vehicle is modelled, which assumes a 50% larger battery. For tractors, longer range needs are assumed to be met with fuel cell electric tractors. Table C-5 lists the specifications of the battery-electric vehicles.

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[64] International Council on Clean Transportation, Transitioning to Zero-Emission Heavy-Duty Freight Vehicles (web link: https://www.theicct.org/sites/default/files/publications/Zero-emission-freight-trucks_ICCT-white-paper_26092017_vF.pdf, last accessed June 2019).
[65] Bloomberg, Better Batteries (web link: https://www.bloomberg.com/quicktake/batteries, last accessed June 2019).
[66] Strategic Analysis, Fuel Cell Systems Analysis. (web link: https://www.hydrogen.energy.gov/pdfs/review18/fc163_james_2018_o.pdf, last accessed June 2019).

Table C-5. Battery Size Calculation

Vehicle Group	Age 0 Daily Mileage	Efficiency (kWh/mi)	Normal Range Battery Size (kWh)	Long Range Battery Size (kWh)
Class 2B-3	65	0.6	55	80
Class 4-5 Vocational	100	1.0	135	200
Class 6-7 Vocational	100	1.5	200	300
Class 8 Vocational	90	2.0	240	360
Class 7-8 Tractors	140	2.1	400	N/A

The assumed vehicle prices for gasoline and diesel vehicles are shown in Table C-6, and the battery-electric and fuel cell electric price forecasts are shown Table C-7.

Table C-6. Baseline Vehicle Prices

Vehicle Group	Vehicle Price
Class 2B-3 - Gasoline	$45,000
Class 2B-3 - Diesel	$50,000
Class 4-5	$55,000
Class 6-7	$85,000
Class 8	$120,000
Class 7-8 Tractors	$130,000

Table C-7. ZEV Price Forecast

Vehicle Group	2024 MY	2025 MY	2026 MY	2027 MY	2028 MY	2029 MY	2030+ MY
Class 2B-3 – Electric Normal Range	$64,896	$63,635	$62,599	$61,684	$60,829	$60,035	$59,241
Class 2B-3 – Electric Long Range	$69,241	$67,568	$66,201	$65,011	$63,909	$62,895	$61,881
Class 4-5– Electric Normal Range	$80,127	$77,616	$75,585	$73,852	$72,267	$70,830	$69,394
Class 4-5– Electric Long Range	$91,424	$87,841	$84,952	$82,503	$80,275	$78,266	$76,258
Class 6-7– Electric Normal Range	$116,174	$112,591	$109,702	$107,253	$105,025	$103,016	$101,008
Class 6-7– Electric Long Range	$133,554	$128,321	$124,112	$120,563	$117,345	$114,456	$111,568
Class 8– Electric Normal Range	$154,799	$150,486	$147,007	$144,057	$141,371	$138,949	$136,527
Class 8– Electric Long Range	$175,655	$169,362	$164,299	$160,029	$156,155	$152,677	$149,199
Class 7-8 Tractor - Electric	$201,351	$194,134	$188,312	$183,371	$178,870	$174,809	$170,748
Class 7-8 Tractor - Fuel Cell	$216,931	$212,353	$207,885	$203,439	$199,004	$194,579	$190,155

Table G-8 outlines the incremental cost difference between a ZEV and its diesel equivalent.

Table G-8. Incremental ZEV versus Diesel Price Forecast

Vehicle Group	2024 MY	2025 MY	2026 MY	2027 MY	2028 MY	2029 MY	2030+ MY
Class 2B-3 – Electric Normal Range	$14,896	$13,635	$12,599	$11,684	$10,829	$10,035	$9,241
Class 2B-3 – Electric Long Range	$19,241	$17,568	$16,201	$15,011	$13,909	$12,895	$11,881
Class 4-5– Electric Normal Range	$25,127	$22,616	$20,585	$18,852	$17,267	$15,830	$14,394
Class 4-5– Electric Long Range	$36,424	$32,841	$29,952	$27,503	$25,275	$23,266	$21,258
Class 6-7– Electric Normal Range	$31,174	$27,591	$24,702	$22,253	$20,025	$18,016	$16,008
Class 6-7– Electric Long Range	$48,554	$43,321	$39,112	$35,563	$32,345	$29,456	$26,568
Class 8– Electric Normal Range	$34,799	$30,486	$27,007	$24,057	$21,371	$18,949	$16,527
Class 8– Electric Long Range	$55,655	$49,362	$44,299	$40,029	$36,155	$32,677	$29,199
Class 7-8 Tractor - Electric	$71,351	$64,134	$58,312	$53,371	$48,870	$44,809	$40,748
Class 7-8 Tractor - Fuel Cell	$86,931	$82,353	$77,885	$73,439	$69,004	$64,579	$60,155

Though the cost for manufacturers to comply is estimated in detail as described above, it is not straightforward to predict how these costs and cost-savings would be passed on to consumers. Vehicle pricing is complex, and different manufacturers could use different strategies to pass on these costs. It is possible that manufacturers may pass on incremental ZEV costs through the ZEVs themselves, through the rest of their ICE fleet, or some combination thereof.

ii. Zero-Emission Powertrain Certification Costs

The Proposed ACT Regulation requires manufacturers starting 2024 MY to certify their vehicles using the Zero-emission Powertrain (ZEP) Certification procedure in order to earn ZEV credits. This requirement would only apply to vehicles affected by ZEP certification – complete vehicles above 14,000 lb. GVWR and incomplete vehicles above 10,000 lb. GVWR. Based on our current knowledge, there are roughly ten manufacturers who are regulated by the Proposed ACT Regulation and would sell ZEVs that be required to follow the ZEP certification procedure.

The Initial Statement of Reasons (ISOR) for the ZEP Certification rulemaking estimated the cost of certification would be $9,200 per powertrain.[67] For this rulemaking and analysis, we are estimating that each regulated manufacturer affected would certify two powertrains in 2024 model year and afterwards would certify an additional two new powertrains every 5 years afterwards.

The ISOR for ZEP certification included a $25 cost per vehicle for labelling costs and a $100 cost per vehicle family for ZEP vehicle family certification. We are not modelling this cost in for the Proposed ACT Regulation because this assumption does not take into account for avoided costs from not having to meet more rigorous ICE labelling requirements or ICE vehicle family certifications for the same number of vehicles, nor does it assume any potential reductions in ICE certification costs as the ZEV sales percentage requirement ramps up.

Manufacturers who are not regulated under the Proposed ACT Regulation would need to follow the ZEP certification to generate credits in this proposal. Manufacturers who are not required to meet ZEP certification may still do so if 1) they wish to earn credits in this rule to be sold to other manufacturers, or 2) a different program such as HVIP requires it. Because neither of these are costs attributable to the Proposed ACT Regulation, we are not modelling any ZEP certification costs to unregulated manufacturers. This assumes regulated manufactures would only buy credits if the credits reduce their overall compliance costs which already included ZEP certification costs.

[67] California Air Resources Board, Proposed Alternative Certification Requirements and Test Procedures for Heavy-Duty Electric and Fuel Cell Electric Vehicles and Proposed Standards and Test Procedures for Zero-Emission Powertrains – Staff Report: Initial Statement of Reasons (web link: https://www.arb.ca.gov/regact/2019/zepcert/isor.pdf, last accessed June 2019).

iii. Phase 2 GHG Compliance Costs

The federal and California Phase 2 GHG regulations require manufacturers to build trucks that are more fuel efficient and have lower GHG emissions. These requirements start in 2021 model year and ramp up through the 2027 model year. EPA estimated the cost per vehicle to comply with the regulation shown in Table C-9.[68]

Table C-9. U.S. EPA Phase 2 GHG Incremental Compliance Costs

Phase 2 Category	2021-2023 MY	2024-2026 MY	2027+ MY
Class 2B-3 Pickup/Van	$524	$963	$1,364
Vocational Vehicles	$1,110	$2,022	$2,662
Tractors	$6,484	$10,101	$12,442

Manufacturers can meet the Phase 2 standards through a variety of technologies including improved aerodynamics, low rolling resistance tires, engine and accessory optimization, weight reduction, idle reduction systems, hybridization, powertrain electrification, and more. The Proposed ACT Regulation requires the sale of zero-emission vehicles that can also be used to comply with Phase 2 GHG. The costs of producing ZEVs are assumed to be higher than other compliance options, but would also reduce the amount of upgrades the manufacturers would need to make for their remaining ICE sales. While it is possible for a manufacturer to meet their entire compliance obligation with electric trucks, the U.S. EPA assumed this compliance pathway is a higher cost option than building cleaner combustion vehicles. In the Federal Phase 2 GHG rulemaking, EPA stated that they "…do not project fully electric vocational vehicles to be widely commercially available in the time frame of the final Phase 2 rules. For this reason, [EPA and NHTSA] have not based the Phase 2 standards on adoption of full-electric vocational vehicles."[69]

The cost difference between Phase 2 GHG compliance costs in the baseline scenario and the Proposed ACT Regulation represents the potential cost savings to the manufacturer. Manufacturers can build ZEVs and comply with the Proposed ACT regulation and the Phase 2 GHG regulations simultaneously which will reduce the number of ICE vehicles that need to be upgraded to meet Phase 2 standards. In the baseline scenario, the cost to comply with the California Phase 2 GHG regulation is the number of vehicles sold multiplied by the cost per vehicle as outlined in Table C-9.

In the Proposed ACT Regulation scenario, as the ZEV sales percentage requirement ramps up, the number of ICE trucks that must be upgraded to the Phase 2 GHG standards decreases. This is because, per the Phase 2 GHG regulation, electric vehicles do not produce tailpipe GHG emissions and therefore can offset compliance requirements for the rest of the

[68] United States Environmental Protection Agency, Final Rule for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2 (web link: https://www.govinfo.gov/content/pkg/FR-2016-10-25/pdf/2016-21203.pdf, last accessed June 2019).

[69] United States Environmental Protection Agency, Final Rule for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2: Regulatory Impact Analysis, pg. 73704 (web link: https://nepis.epa.gov/Exe/ZyPDF.cgi/P100P7NS.PDF?Dockey=P100P7NS.PDF, last accessed June 2019).

manufacturer's fleet. The lower costs of complying with the Phase 2 GHG regulation in the Proposal ACT Regulation scenario are modelled using the following formula:

$$GHG\ Phase\ 2\ Annual\ Cost\ Savings\ to\ Manufacturer\ Due\ to\ Proposed\ ACT\ Regulation = \frac{Vehicles\ Sold}{Year} x \frac{Phase\ 2\ GHG\ Cost}{Vehicle\ Sold} x \frac{ZEV\ Sales\ \% * ATM}{Phase\ 2\ Reduction\ \%}$$

Where:

- "ZEV Sales %" is the annual ZEV Sales percentage requirement each year
- "ATM" is the Phase 2 GHG Advanced Technology Multiplier which gives extra credit to PHEV, BEV, and FCEV vehicles until the end of the 2027 MY. This multiplier is 3.5, 4.5, and 5.5, respectively.
- "Phase 2 Reduction %" is the percentage of GHG reduction that the Phase 2 GHG regulation requires per year. By 2027, the standards are roughly 17-20% more stringent than the 2018 Phase 2 GHG baseline.

This formula calculates the potential avoided costs to upgrade ICE vehicles to comply with the Phase 2 GHG regulation.

The Phase 2 GHG compliance costs offset by the Proposed ACT Regulation are derived primarily from the federal regulation. If these compliance cost savings are passed through to fleets it would likely be a nationwide effect. Therefore, staff make a conservative assumption that percent savings passed through to California fleets is proportional to California's share of the national truck population estimated at 10% as to not overestimate the cost-savings.[70] Table C-10 displays the nationwide and California portion of reduced Phase 2 GHG compliance costs relative to the compliance costs relative to the baseline.

Table C-10. Cumulative Nationwide and California Phase 2 GHG Cost Savings Relative to the Baseline (million 2018$)

Calendar Year	Nationwide	California Portion
2031	-$1,539	-$154
2040	-$3,737	-$375

iv. Manufacturer Reporting Costs

The Proposed ACT Regulation will require information from manufacturers regarding their total sales of combustion powered vehicles, ZEV sales, and PHEV sales starting in the 2021 model year. This information will be used to determine which manufacturers are regulated and their annual credit and deficit generation.

Manufacturers are already required to report information to CARB as a requirement of the California Phase 2 GHG regulation including sales per model year of every powertrain and vehicle family. Because manufacturers are already collecting and reporting this information to CARB, we are not modelling any significant additional reporting costs to manufacturers as a result of the Proposed ACT Regulation. Similarly, no reporting costs are attributed to

[70] Energy Information Administration, Annual Energy Outlook 2018 (web link: https://www.eia.gov/outlooks/aeo/data/browser/#/?id=3-AEO2018&cases=ref2018&sourcekey=0, last accessed June 2019).

unregulated ZEV manufacturers that may optionally report information for purposes of earning and trading credits to other manufacturers because credits are assumed to be purchased if regulated manufacturers can reduce their overall compliance costs.

c. *Costs to California Businesses*

The Proposed ACT Regulation regulates vehicle manufacturers that primarily manufacture vehicles outside of California. Most of regulatory requirements associated with the Proposed ACT Regulation applies to these manufacturers. The only requirement on California businesses in the Proposed ACT Regulation is the large entity reporting requirement which is proposed as a one-time requirement. However, for purposes of demonstrating the potential economic impacts on the state's overall economy, all of the costs from deploying the number of ZEVs required by the Proposed ACT Regulation are assumed to be borne in California. Therefore, in the statewide cost analysis, all costs including the incremental vehicle costs, infrastructure upgrades, fueling, maintenance, and other costs are assumed to be the direct costs of the regulation in California despite the lack of a specific fleet purchase requirement. For this analysis, vehicle and infrastructure costs are amortized over a five and twenty year period, respectively, to reflect typical purchasing patterns.

i. Large Entity Reporting

Under the Proposed ACT Regulation, large fleet owners and large companies that contract out for transportation related services will be required to report information to CARB regarding what vehicles they own and how they operate, as well as company-wide information about their California locations and how they and their contractors move freight and perform other services.

Staff are estimating that roughly 12,000 companies or entities will be affected by this reporting requirement consisting of 11,000 large companies or trucking fleets and 1,000 public entities, utility fleet, and refuse fleets. Companies that do not own trucks will need to report summary information about the types of product they move and services they hire. Most large companies that own trucks or buses will have fleet software or other data management systems to pull information about their fleet and company quickly. Staff are estimating it will take on average two hours to retrieve, review, and report company-specific information, and an additional two hours to retrieve, review, and report vehicle information resulting in four hours of reporting per company. This may be higher or lower from company to company. These averages assume that some large entities will not have information to report other than to respond that they do not contract directly for any transportation services. The hourly cost is assumed to be $50 per hour for staffing and lost revenue from the employee assigned to pull the information.[71]

[71] California Air Resources Board, Technical Support Document: Proposed Regulation for In-Use Road Diesel Vehicles (web link: https://www.arb.ca.gov/regact/2008/truckbus08/tsd.pdf, last accessed June 2019).

ii. Sales Tax and Federal Excise Tax

Taxes are additional costs levied on the purchase of a vehicle. Because they are based on the purchase price of the vehicle, they are higher for zero-emission vehicles due to their higher upfront costs.

Vehicles purchased in California must pay a sales tax on top of the vehicle's purchase price. The sales tax varies across the state from a minimum of 7.25% up to 10.25% in some municipalities; a value of 8.5% was used for staff's analysis based on a statewide population weighted average.[72] This results in higher costs for fleets and higher revenue for state and local governments. Class 8 vehicles are subject to an additional Federal Excise Tax which adds 12% to their purchase price.

iii. Gasoline, Diesel, Electricity, and Hydrogen Fuel Cost

Fuel costs are calculated using total fuel used per year and the cost of fuel per unit. The total fuel used per year is based on the vehicle population per calendar year, the annual mileage of these vehicles, and the fuel economy of the vehicles. Population and mileage assumptions are discussed on Vehicle Population and Annual Mileage subsection on page 24. In general, ZEVs are 2 to 5 times as efficient as similar vehicles with internal combustion engines technologies and significantly reduce petroleum and other fossil fuel use and use less total energy.[73]

Fuel economy is measured in miles per gallon for gasoline and diesel, miles per kilowatt-hour for battery-electric, and miles per kilogram for fuel cell electric trucks. Gasoline and diesel fuel economy is derived from EMFAC inventory projections for each gasoline and diesel vehicle group. These projections incorporate the effects of Phase 2 GHG which will increase gasoline and diesel fuel economies over the next decade. Battery-electric vehicle fuel economy is derived from in-use data collected from a variety of vehicles. For fuel cell efficiency, we are applying the LCFS program's Energy Efficiency Ratio (EER) of 1.9 to the diesel fuel economy to estimate the fuel cell fuel economy as we are not aware of any data available measuring the fuel efficiency of fuel cell electric tractors.

Staff modeled that for both battery-electric and fuel cell electric vehicles, the efficiency will improve at the same rate as for gasoline and diesel powered vehicles. This may be a conservative estimate as both of these technologies are less developed than ICE powertrains and reports have shown improvements in the technology recently.

Table C-11 outlines the fuel economy assumptions for each vehicle group and technology type over the course of the regulation.

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[72] California's basic sales tax rate is 7.25 percent with 3.94 percent going to the State and the rest to local authorities. In addition to the basic sales tax, districts levy special taxes that differ amongst districts.
[73] California Air Resources Board, Battery Electric Truck and Bus Efficiency Compared to Diesel Vehicles (web link: https://ww2.arb.ca.gov/sites/default/files/2018-11/180124hdbevefficiency.pdf, last accessed June 2019).

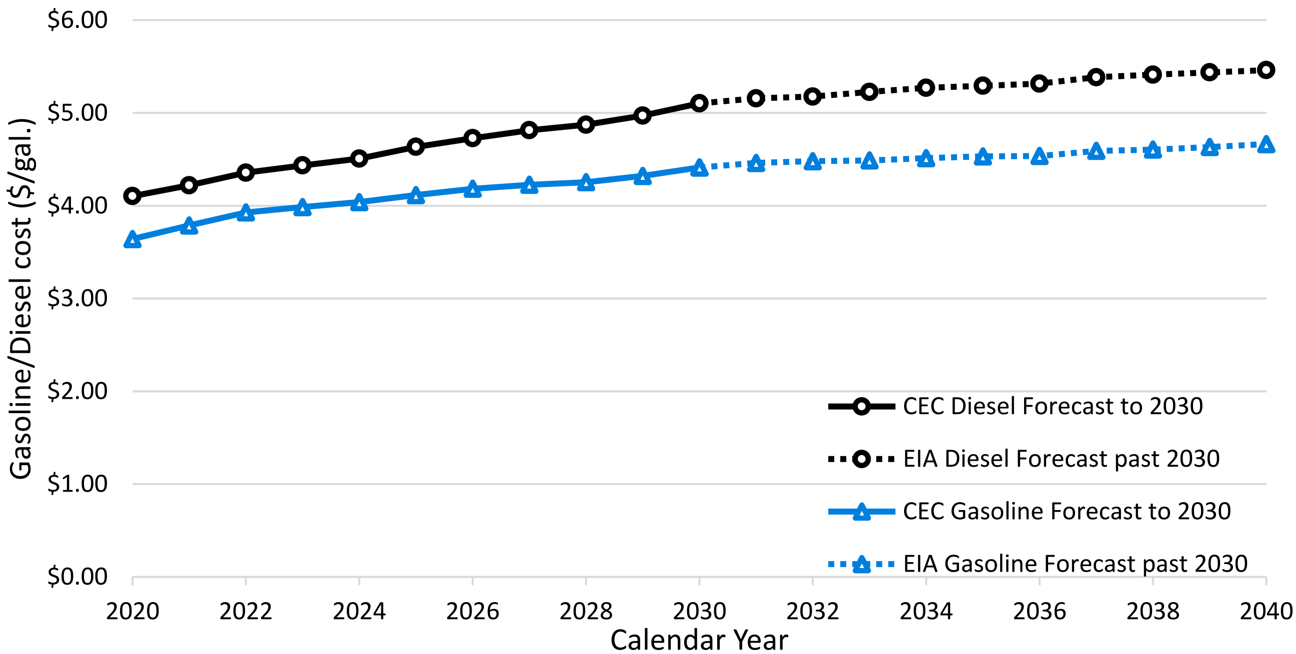
Table C-11. Fuel Economy for Each Vehicle Group and Technology

Vehicle Group	Technology	Fuel Economy 2024-2026 MY	Fuel Economy 2027 MY and beyond	Units
Class 2B-3	Gasoline	10.89	11.74	mpg
	Diesel	23.03	24.83	mpg
	Battery-Electric	1.98	2.13	mi./kWh
Class 4-5	Diesel	13.75	14.28	mpg
	Battery-electric	1.26	1.30	mi./kWh
Class 6-7	Diesel	9.55	9.91	mpg
	Battery-electric	0.80	0.83	mi./kWh
Class 8	Diesel	7.72	8.08	mpg
	Battery-electric	0.62	0.65	mi./kWh
Class 7-8 Tractor	Diesel	8.75	9.22	mpg
	Battery-electric	0.61	0.64	mi./kWh
	Fuel Cell Electric	16.63	17.53	mi./kg

Gasoline and diesel fuel prices to 2030 are taken from the California Energy Commission's (CEC) "Revised Transportation Energy Demand Forecast, 2018-2030", adjusted to 2018 dollars using California CPI.[74] Fuel prices past 2030 are calculated using the Energy Information Administration's (EIA) 2018 Annual Energy Outlook for the Pacific region.[75,76] The annual percentage change in EIA gasoline and diesel fuel prices past 2030 is applied to the 2030 CEC gasoline and diesel prices to estimate price changes past 2030. Figure C-3 shows the projected prices of gasoline and diesel out to 2040.

[74] California Department of Finance, Consumer Price Forecast (web link: http://www.dof.ca.gov/Forecasting/Economics/Eco_Forecasts_Us_Ca/index.html , last accessed June 2019)
[75] California Energy Commission, Revised Transportation Energy Demand Forecast 2018-2030 (web link: https://efiling.energy.ca.gov/getdocument.aspx?tn=223241, last accessed June 2019).
[76] Energy Information Administration, Annual Energy Outlook 2018 (web link: https://www.eia.gov/outlooks/aeo/data/browser/#/?id=3-AEO2018&cases=ref2018&sourcekey=0, last accessed June 2019).

Figure C-3. Gasoline and Diesel Price Forecasts



Battery-electric fuel prices depend on how they are charged and include energy costs, fixed fees and demand fees. Vehicles charged at high power or during peak periods will have higher electricity costs than if charging overnight over an extended period. Electricity prices are calculated using CARB's Battery-Electric Truck and Bus Charging Calculator and assumes a fleet of 20 vehicles will be depot charged overnight on a separate utility meter using a managed charging strategy with the applicable rate schedule. Additionally, charger efficiency losses and local electricity taxes are incorporated into these numbers. The energy, demand, fixed costs, efficiency losses and local taxes and fees are all calculated using the Charging Calculator.[77] The cost per kWh is calculated separately for each utility and a weighted average is used to determine the cost per kWh per vehicle in 2018. Table C-12 shows the electricity price per kWh for each vehicle group and major utility region as well as the weighted statewide average. In general, electricity costs are lower for larger vehicles because larger vehicles tend to use more electricity which decreases the fixed costs per kWh and allows the use of lower cost rate schedules for larger utility customers.

Table C-12. Electricity Cost Calculation for 2018 (2018$/kWh)

Utility Area	Class 2B-3	Class 4-5	Class 6-7	Class 8	Class 7-8 Tractor
Los Angeles Department of Water and Power	$0.11	$0.10	$0.10	$0.11	$0.10
Pacific Gas and Electric (PG&E)*	$0.23	$0.20	$0.20	$0.20	$0.18
Sacramento Municipal Utility District	$0.15	$0.14	$0.11	$0.11	$0.10
San Diego Gas and Electric	$0.24	$0.19	$0.19	$0.22	$0.19
Southern California Edison (SCE)**	$0.19	$0.15	$0.15	$0.14	$0.13

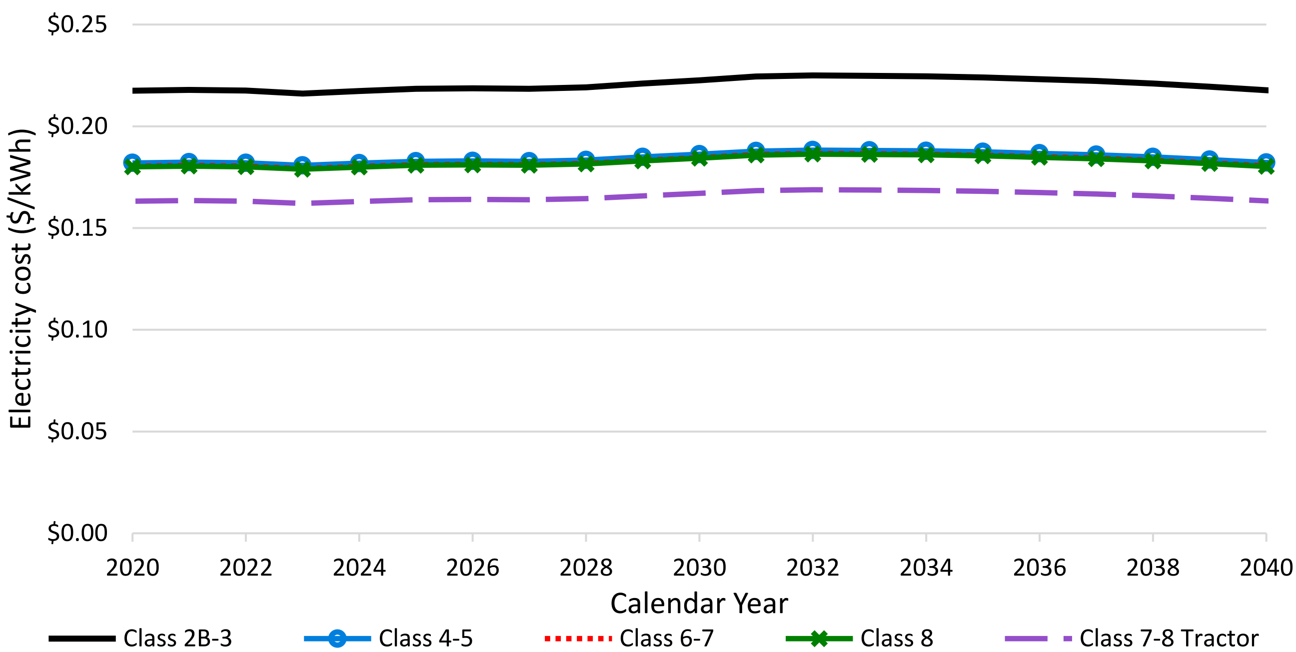
[77] California Air Resources Board, Battery-Electric Truck and Bus Charging Calculator (web link: https://ww2.arb.ca.gov/resources/documents/battery-electric-truck-and-bus-charging-cost-calculator, last accessed June 2019).

Utility Area	Class 2B-3	Class 4-5	Class 6-7	Class 8	Class 7-8 Tractor
Weighted Statewide Average	$0.21	$0.18	$0.18	$0.18	$0.16

*PG&E has proposed two new electricity rates for commercial ZEVs, CEV-S and CEV-L, which are currently under CPUC review with a decision expected in August/September 2019. If approved, these rates will decrease electricity rates to commercial fleets to roughly $0.13-$0.15/kWh in PG&E territory.
**SCE's newly introduced electric vehicle rates, EV-8 and EV-9, have no demand fees from 2019 to 2023 and phase them back over the following five years, with demand fees being fully reintroduced in 2029. This analysis is based on an SCE estimate for what the electricity rate will look like in 2029 once demand fees are fully reintroduced.[78]

Electricity price changes over time are modelled using the CEC's "Revised Transportation Energy Demand Forecast, 2018-2030", adjusted to 2018 dollars using California CPI. Fuel prices past 2030 are calculated using the EIA 2018 Annual Energy Outlook for the Pacific region. The annual percentage change in EIA gasoline and diesel fuel prices past 2030 is applied to the 2030 CEC gasoline and diesel prices to estimate future price changes. Results per vehicle type are shown in Figure C-4. The electricity costs for Class 4-5, Class 6-7, and Class 8 are fairly similar resulting in them overlapping on the graph.

Figure C-4. Electricity Price Forecasts

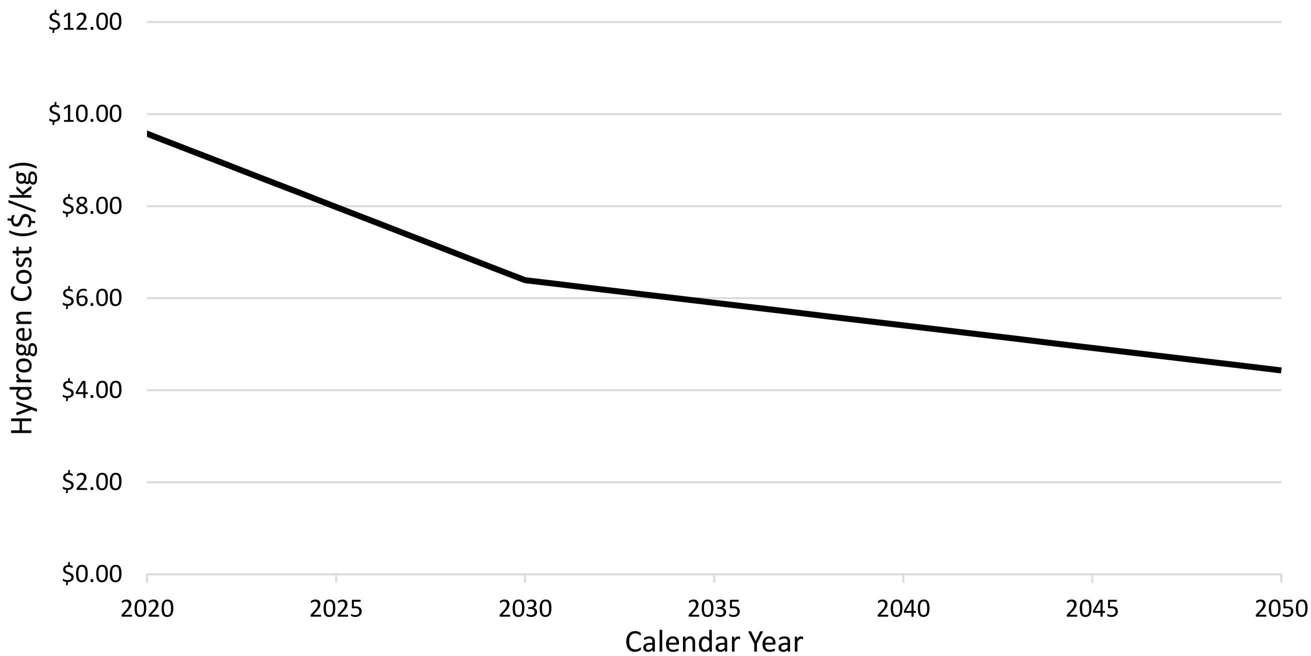


For this analysis, hydrogen stations were assumed to be available at strategic locations around ports or major distribution hubs where the infrastructure costs are included in the hydrogen fuel price rather than reflecting costs for stations installed in a depot. This model is currently used for light-duty hydrogen stations and heavy-duty diesel sales and based on stakeholder feedback appears most appropriate near term estimate for heavy-duty hydrogen fueling. Hydrogen fuel costs are based on communication with Trillium CNG who estimated the cost of

[78] Southern California Edison, Communication via email with Alexander Echele in April 2019.

hydrogen at low, intermediate, and high volumes using different production methods.[79] This report uses the liquid hydrogen delivery numbers based on what Trillium presented as being most feasible for production at scale. The low volume cost will be used in 2018, the intermediate volume in 2030, and the high volume in 2050 with intermediate years being interpolated. These assumptions are based on expecting low volume production today, intermediate volume by 2030 when we would see some moderate sized deployments but no complete conversions yet, and continuing price reductions out to 2050. Hydrogen costs over time are shown in Figure C-5.

Figure C-5. Hydrogen Price Forecasts



The cost of fuel displayed above includes fuel taxes. State and local taxes on fuel are listed below in Table C-13.

Table C-13. Local and State Taxes on Fuel

Fuel Type	Local Tax	State Tax
Gasoline	2.25% sales tax	$0.493/gal excise tax
Diesel	4.5% sales tax	8.5% sales tax + $0.38/gal excise tax
Electricity	3.53% utility user tax*	$0.0003/kWh
Hydrogen	0	0

*Statewide population-weighted average

iv. Low Carbon Fuel Standard Revenue

The Low Carbon Fuel Standard (LCFS) is a California regulation that creates a market mechanism that incentivizes low carbon fuels. The LCFS regulation was amended in 2018. These amendments 1) increased the Energy Efficiency Ratio for Class 4-8 trucks from 2.7 to 5.0, 2) reduced the carbon intensity target to 20% reduction by 2030, and 3) clarified how

[79] Trillium CNG, Email communication with Ryan Erickson in November 2018.

hydrogen station operators can receive credits. The regulation now requires the carbon intensity of California's transportation fuels to decrease by 20% through the 2030 timeframe and maintains the standard afterwards. Electricity and hydrogen are eligible to earn LCFS credits which can be sold and used to offset the costs of these fuels. Fossil gasoline and diesel are generally not eligible for LCFS credits.

Fleets who own and operate their infrastructure generate credits based on the amount of fuel or energy they dispense. Credit values for different fuel types are calculated using the LCFS Credit Price Calculator.[80] The following credit values assume a credit price of $125 as estimated by LCFS program staff in the staff report for the 2018 rulemaking.[81] The average credit price for May 2019 was $185 has been above $180 since December 2018. Thus, the actual cost for fleets could be lower with higher LCFS credit value. An electric Class 2B-3 vehicle will earn $0.073/kWh in 2024 using grid electricity while an electric Class 4-8 vehicle will earn roughly $0.124/kWh in 2024. For hydrogen, we are assuming the hydrogen is produced from 33% renewable feedstock as required by SB 1505 (2006). This results in Class 4-8 vehicles earning $1.037/kg in 2024. LCFS credit revenue for a given fuel drops slightly over time as the program standards tighten and maintains upward pressure on the credit price.

v. Vehicle Maintenance Costs

Maintenance costs reflects the cost of labor and parts for routine maintenance, preventative maintenance, and repairing broken components. Maintenance costs for electric vehicles are generally assumed to be lower than for diesel in part due to their simpler design and fewer moving components. There is very little data available on hydrogen fuel cell vehicles currently, but available data appears to show maintenance costs that are comparable with diesel.

Maintenance costs for ICE Class 2B-3 vehicles are based on four sources from three reports.[82] [83] Maintenance costs for ICE vocational vehicles are based on the American Truck Research Institute study, "An Analysis of the Operational Costs of Trucking: 2017 Update" cost for straight truck maintenance per mile.[84] Maintenance costs for ICE tractors are based on the American Truck Research Institute study, "An Analysis of the Operational Costs of Trucking: 2018 Update" cost for less-than-truckload (LTL) maintenance cost per mile.[85] The LTL cost was used because the slower speed, frequent stops of LTL service match most closely to the

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[80] California Air Resources Board, LCFS Credit Price Calculator (web link: https://www.arb.ca.gov/fuels/lcfs/dashboard/creditpricecalculator.xlsx, last accessed June 2018).

[81] California Air Resources Board, Public Hearing to Consider Proposed Amendments to the Low Carbon Fuel Standard Regulation and to the Regulation on Commercialization of Alternative Diesel Fuels. Staff Report: Initial Statement of Reasons (web link: https://www.arb.ca.gov/regact/2018/lcfs18/isor.pdf, last accessed June 2019).

[82] Access LA, Access LA Fleet Design (web link: https://www.sacog.org/sites/main/files/file-attachments/access_la_life_cycle.pdf, last accessed June 2019).

[83] Utilimarc, Report: ½ Ton Pickup Truck Data (web link: https://utilimarc.com/report-12-ton-pickup-truck-data/, last accessed June 27, 2019).

[84] American Trucking Research Institute, An Analysis of the Operational Costs of Trucking: 2017 Update (web link: https://atri-online.org/wp-content/uploads/2017/10/ATRI-Operational-Costs-of-Trucking-2017-10-2017.pdf, last accessed June 2019).

[85] American Trucking Research Institute, An Analysis of the Operational Costs of Trucking: 2018 Update (web link: https://atri-online.org/wp-content/uploads/2018/10/ATRI-Operational-Costs-of-Trucking-2018.pdf, last accessed June 2019).

duty cycle of drayage or short-haul tractors that are more likely to become ZEVs prior to 2030. Table C-14 shows the maintenance cost assumptions used in this analysis. Battery-electric vehicles are assumed to have 25 percent lower vehicle maintenance costs compared to gasoline and diesel based on an aggregation of sources and data.[86, 87, 88, 89] Fuel cell electric vehicles are assumed to have similar maintenance costs to ICE vehicles; Ballard recommends estimating a fuel cell bus's maintenance costs as the same as a battery-electric bus plus $0.20/mi. for fuel cell maintenance. This adjustment will put a fuel cell bus's maintenance costs in line with a diesel or CNG bus.[90]

Table C-14. Maintenance Cost per Mile per Vehicle Group

Vehicle Group	Gasoline/Diesel ($/mi.)	Battery-Electric ($/mi.)	Fuel Cell Electric ($/mi.)
Class 2B-3	$0.17	$0.128	$0.17
Class 4-5 Vocational	$0.31	$0.233	$0.31
Class 6-7 Vocational	$0.31	$0.233	$0.31
Class 8 Vocational	$0.31	$0.233	$0.31
Class 7-8 Tractor	$0.19	$0.142	$0.19

vi. Maintenance Bay Upgrades

Maintenance bays are facilities used to service vehicles. Services performed can include inspections, routine maintenance, preventative maintenance, repairs, overhauls and more. Servicing electric vehicles requires separate safety equipment, diagnostic tools, and equipment which will incur costs to the facility.

Based on transit agency data, upgrading a fifteen bus maintenance bay to handle battery-electric buses would cost $25,000, and upgrading to handle fuel cell electric buses would cost $750,000. For this analysis, we are assuming the cost per maintenance bay is the same and a fifteen bus maintenance bay could accommodate 25 trucks due to their smaller size. The amount of maintenance bay upgrades each year is based on the increase in ZEV population per year to avoid double-counting in situations where a ZEV is replaced by a ZEV.

vii. Midlife Costs

Midlife costs are the cost of rebuilding or replacing major propulsion components due to wear or deterioration. For diesel vehicles, this would be a midlife rebuild, for battery-electric vehicles

[86] California Air Resources Board, Literature Review on Transit Bus Maintenance Cost (web link: https://www.arb.ca.gov/msprog/bus/maintenance_cost.pdf, last accessed June 2019).
[87] Electrification Coalition, State of the Plug-in Electric Vehicle Market (web link: https://www.pwc.com/gx/en/automotive/industry-publications-and-thought-leadership/assets/pwc-ec-state-of-pev-market-final.pdf, last accessed June 2019).
[88] Propfe, B. et.al. Cost analysis of Plug-in Hybrid Electric Vehicles including Maintenance & Repair Costs and Resale Values (web link: http://www.mdpi.com/2032-6653/5/4/886, last accessed June 2019).
[89] Taefi, T. et.al. Comparative Analysis of European examples of Freight Electric Vehicle Schemes. http://nrl.northumbria.ac.uk/15185/1/Bremen_final_paperShoter.pdf, last accessed June 2019).
[90] Ballard, Fuel Cell Electric Buses: Proven Performance and the Way Forward (web link: https://info.ballard.com/fuel-cell-electric-buses-proven-performance-white-paper?hsCtaTracking=ab0058ba-1240-4ab6-a4e6-0032faf329b7%7Cd0616627-31ce-416a-bbe8-d036529a4d75, last accessed June 2019).

this would be a battery replacement, and for a hydrogen fuel-cell vehicle this would be a fuel cell stack refurbishment. The frequency and cost of a midlife rebuild vary from technology to technology.

The frequency of a diesel engine rebuild varies based on the vehicle's weight class. Table C-15 shows the anticipated diesel engine useful life based on years or miles. The cost of an engine rebuild is estimated to be one quarter of the total vehicle price.

Table C-15. Useful life of diesel engines

Vehicle/Engine Category	Useful Life (Years/Miles)
Class 4-5 (Light-Heavy Duty)	18/350,000
Class 6-7 (Medium-Heavy Duty)	18/450,000
Class 8 (Heavy-Heavy Duty)	18/850,000

Data is limited for battery-electric vehicles, but today zero-emission manufacturers are offering vehicles with warranties of eight or more years and up to 300,000 miles on their products. Information on battery degradation trends from light-duty Tesla vehicles was used to estimate when batteries for trucks would need to be replaced. [91,92,93,94] Staff estimate that the battery will be replaced every 300,000 miles. The cost of the battery replacement is assumed to be the size of the battery in kWh multiplied by the price per kWh at the time of the replacement.

For fuel cell electric vehicles, the consulting firm Ricardo has estimated that a fuel cell stack refurbishment is necessary every seven years and costs one third the cost of a new fuel cell stack at the time of refurbishment. [95]

Based on the above assumptions, Table C-16 shows when vehicles are assumed to incur midlife costs.

Table C-16. Frequency of Midlife Rebuilds

Vehicle Group	Technology	Midlife Occurrence (yr)
Class 2B-3	Gasoline	Not necessary
	Diesel	Not necessary
	Battery-Electric	Not necessary
Class 4-5	Diesel	13
	Battery-electric	10
Class 6-7	Diesel	17
	Battery-electric	10

[91] BYD, The BYD K9 (web link: https://en.byd.com/wp-content/uploads/2019/07/4504-byd-transit-cut-sheets_k9-40_lr.pdf, last accessed June 2019).
[92] New Flyer, Xcelsior Charge (web link: https://www.newflyer.com/site-content/uploads/2019/06/Xcelsior-CHARGE-web.pdf, last accessed June 2019).
[93] Steinbuch, Tesla Model S Degradation Data (web link: https://steinbuch.wordpress.com/2015/01/24/tesla-model-s-battery-degradation-data/, last accessed June 2019).
[94] Proterra, Catalyst: 40 Foot Bus – Performance Specifications (web link: https://mk0proterra6iwx7rkkj.kinstacdn.com/wp-content/uploads/2019/06/Proterra-Catalyst-40-ft-Spec-Sheet.pdf, last accessed June 2019).
[95] Ricardo, Economics of Truck TCO and Hydrogen Refueling Stations, 2016.

Vehicle Group	Technology	Midlife Occurrence (yr)
Class 8	Diesel	18
	Battery-electric	14
Class 7-8 Tractor	Diesel	18
	Battery-electric	5, 13, 20
	Fuel Cell Electric	7, 14, 21

viii. Fueling Infrastructure Installation and Maintenance

Infrastructure is necessary to refuel or recharge vehicles. All vehicles need either dedicated refueling infrastructure onsite or publicly available retail stations in order to operate. There are numerous ways infrastructure expenses can be accounted for which will affect the cost to California businesses in different ways. Infrastructure expenses are generally an upfront capital investment needed prior to vehicles being deployed, but infrastructure can last multiple vehicle lifetimes and generally is amortized over its life.

In the baseline scenario, we are assuming that the fleet is either using existing gasoline or diesel infrastructure or publicly accessible stations and the infrastructure cost is already incorporated into the fuel cost. As a result, diesel infrastructure costs are not separately modeled.

In the proposal scenario, we are assuming that fleets using battery-electric will be setting up private, behind-the-fence infrastructure to recharge their vehicles and will not depend on publically available charging networks. There are two main cost components of installing charging infrastructure: the cost of the charger itself and the cost of upgrading the site to deliver power to the charger. The latter can include trenching, cabling, laying conduit, potential transformer upgrades and more.

Charger and infrastructure cost estimates for Class 2B-3 and Class 4-5 vocational vehicles are derived from Pacific Gas and Electric and Southern California Edison cost estimates as part of their SB 350 applications. Costs for Class 8 vocational and Class 7-8 tractors are taken from the ICT ISOR and comes from electric transit bus deployment data. Class 6-7 trucks are assumed to use the same infrastructure as a heavier truck but would be able to share the charger with another Class 6-7 truck; as a result, their infrastructure costs are half that of a Class 8 truck. Table C-17 outlines the assumptions for charger power, charger cost, and infrastructure upgrade costs.

Table C-17. Charger Power Ratings and Infrastructure Costs

Vehicle Group	Charger Power (kW)	Charger Cost	Infrastructure Upgrade Cost
Class 2B-3	19	$5,000	$20,000
Class 4-5	19	$5,000	$20,000
Class 6-7	40	$25,000	$27,500
Class 8	80	$50,000	$55,000
Class 7-8 Tractor	80	$50,000	$55,000

Fleets are assumed to amortize their infrastructure costs over a 20 year period with an interest rate of five percent. The amount of chargers installations and infrastructure upgrades each year is based on the increase in ZEV population per year to avoid double-counting infrastructure costs in situations where a ZEV is replaced by a ZEV.

Hydrogen infrastructure costs are incorporated into the hydrogen fuel costs identified by Trillium and are not included here.

Depot and on-route chargers for zero-emission vehicles require regular maintenance. The maintenance costs of depot chargers are estimated by considering costs for replacing charger heads, connectors, and other components, as well as labor costs for regular inspections.[96] The information about on-route chargers is based on data from Foothill Transit who has experience with Proterra on-route chargers.[97] Charger maintenance costs are estimated at $500/yr/charger. We assume that the maintenance cost for other fueling infrastructures are reflected in the fuel price.

ix. Transitional Costs and Workforce Development

Transitioning to a new technology has inherent costs associated with its deployment, including shifts in operational and maintenance practices. These recurring costs include operator and technician trainings, purchasing and upgrading of software, securing additional spare parts, and others.

Limited information is available for this type of transitional cost, but discussions occurred on this topic during the development of the Innovative Clean Transit rule. Based on discussions with transit agencies, Staff assumed that these “other costs” associated with ZE bus deployments are equivalent to 2.5 percent of bus prices for all powertrains and discussed that the costs should go down over time for ZEBs as they become more common. This method is based on the assumption that the Cost Subgroup used to reflect estimated soft costs for conventional internal combustion engine bus.[98]

In the cost analysis for the Proposed ACT Regulation, staff are making similar assumptions and that the workforce training and transitional costs are equal to 2.5% of the incremental cost difference between a baseline ICE vehicle and a ZEV. These costs continue until 2030 at which point the technology will have developed to a point where these transitional costs become business as usual for trucking fleets.

x. Registration Fees

Vehicles operating and registered in California must pay an annual registration fee. The registration fee varies based on the vehicle’s cost, age, and weight. These calculations are different for ICE vehicles and ZEVs.

[96] Personal communications with Tesla and Clipper Creek in October 2016
[97] Foothill Transit, Email communication with Andrew Papson, Electric Bus Program Manager, in March 2017
[98] Transit Agency Subcommittee-Lifecycle Cost Modeling Subgroup (2017). Report of Findings, April 2017.

ICE and ZEV's are subject to the following fixed fees based on the DMV online calculator.[99] These are constant annual fees for every vehicle and are shown in Table C-18.

Table C-18. Fixed Registration Fees for Diesel Vehicles and ZEVs

Diesel Fee Name	Amount	ZEV Fee Name	Amount
Current Registration	$58	Current Registration	$58
CVRA Registration Fee	$122	Current California Highway Patrol	$25
CVRA Service Authority for Freeway Emergencies Fee	$3	CVRA Service Authority for Freeway Emergencies Fee	$1
CVRA Fingerprint ID Fee	$3	CVRA Fingerprint ID Fee	$1
CVRA Abandoned Vehicle Fee	$3	CVRA Abandoned Vehicle Fee	$1
CVRA California Highway Patrol Fee	$41	Current Air Quality Management District	$6
Current Air Quality Management District	$6	Alt Fuel/Tech Registration Fee	$3
Current Cargo Theft Interdiction Program Fee	$3	CVRA Auto Theft Deterrence/DUI Fee	$2
CVRA Weight Decal Fee	$3	Reflectorized License Plate Fee	$1
Alt Fuel/Tech Registration Fee	$3	Road Improvement Fee	$100
CVRA Auto Theft Deterrence/DUI Fee	$4		
Reflectorized License Plate Fee	$1		
Total	$250	Total	$198

All vehicles registered in California must pay a Transportation Improvement Fee based on the price of the vehicle. For vehicles priced between $35,000 and $60,000, the fee is $150, and for vehicles priced above $60,000, the fee is $175.

All registered vehicles are assessed a Vehicle License Fee which is equal to the vehicle price multiplied by 0.65% and a separate percentage schedule. This separate schedule is shown in Table C-19.

Table C-19. Vehicle License Fee Decline over Time

Year	1	2	3	4	5	6	7	8	9	10	11+
Percentage	100%	90%	80%	70%	60%	50%	40%	30%	25%	20%	15%

For commercial ICE vehicles, vehicle owners are assessed an annual weight fee based on the vehicle's potential maximum loaded weight. For electric vehicles, the weight fee is based on its unladen weight. The estimated weight fees are shown in Table C-20.

Table C-20. Weight Fees for ICE Vehicles and ZEVS

Diesel Fee Name	Diesel Weight Fee	ZEV Weight Fee
Class 2B-3	$210	$266
Class 4-5	$447	$358
Class 6-7	$546	$358
Class 8	$1,270	$358
Class 7-8 Tractor	$2,064	$358

[99] California Department of Motor Vehicles, California New Vehicle Fees (web link: https://www.dmv.ca.gov/portal/dmv/detail/portal/feecalculatorweb, last accessed June 2019).

Overall, ZEV's pay lower registration fees over the vehicles life although it may be higher in the initial years of registration. This difference is greater for heavier vehicles due to the large difference in annual weight fees.

xi. Battery Recycling, Repurposing, and Disposal

The energy capacity of the batteries used in ZEVs will naturally degrade over their useful life and require battery replacements. When battery capacity is not sufficient for meeting daily range needs for a truck or bus, it is expected that there will be a second life for the batteries. The used battery at the end of its vehicle useful can be repurposed into other applications such as stationary storage, then at the end of the battery life it can be recycled and non-recyclable materials can be disposed.

The cost for battery recycling at the end of battery life is not included here, because this cost could be offset by the residual value of the battery at the end of its useful life in a truck or bus. The end of life may be a revenue source depending on whether the battery can be recycled and repurposed, or could become a cost if it must be disposed of. Today, light-duty vehicle batteries are already being repurposed for second life applications including stationary storage.[100,101] Even today, some lithium-ion battery manufacturers provide an attractive residual value to customers upon the retirement of a battery. Therefore, staff believes that the residual value will offset the recycling cost and become a revenue source, but does not include a residual battery value in the economic analysis.

d. *Total Costs*

The Proposed ACT Regulation would increase the number of ZEVs sold in California relative to the baseline. These ZEVs have higher upfront capital costs for the vehicle and infrastructure investments, but lower operating costs over time resulting in lower overall costs for truck transportation in California. The cost to truck transportation in California assuming all vehicle manufacturer costs and 10 percent of the Phase 2 GHG savings are passed on is -$4.8 billion between 2020 and 2040 compared to the baseline scenario. Figure C-6 and Table C-22 illustrates the difference in cost between the Proposed ACT Regulation and the baseline scenario. In Figure C-6, the cost components are grouped as shown in Table C-21.

Table C-21. Summarized Cost Items

Cost Category	Components
Manufacturer Cost	ZEV Price, ICE Phase 2 GHG (cost avoided), ZEP Certification
Fuel Cost	Gasoline, Diesel, Electricity, Hydrogen Fuel Cost
LCFS Revenue	LCFS Revenue
Infrastructure	Charger Costs, Infrastructure Upgrades, Charger Maintenance
Maintenance	Vehicle Maintenance Costs, Maintenance Bay Upgrades

[100] Nissan Motor Corporation, Nissan LEAF batteries to light up Japanese town. (web link: https://newsroom.nissan-global.com/releases/180322-01-e?lang=en-US&la=1&downloadUrl=%2Freleases%2F180322-01-e%2Fdownload, last accessed June 2019).
[101] BMW Group, BMW Group, Northvolt and Umicore join forces to develop sustainable life cycle loop for batteries (web link: https://www.press.bmwgroup.com/global/article/detail/T0285924EN/bmw-group-northvolt-and-umicore-join-forces-to-develop-sustainable-life-cycle-loop-for-batteries, last accessed June 2019).

Cost Category	Components
Midlife	Midlife Costs
Other	Sales Tax, Federal Excise Tax, Registration Fees, Large Entity Reporting, Transitional Costs and Workforce Development

Based on the cost analysis, deploying ZEVs will decrease costs to the California economy primarily due to lower fuel costs. Manufacturers would see increased costs past 2024 MY in California as the cost to build ZEVs would be a higher cost pathway to comply with Phase 2 GHG than using other technologies. However, the Proposed ACT Regulation is estimated to reduce costs of compliance with the Phase 2 GHG regulation when factoring in nationwide savings due to the Advanced Technology Multiplier that expires at the end of 2027 MY.

Despite these potential short term cost savings, large manufacturers have hesitated to invest significant amounts of capital into ZE products because of uncertainty in the longer term market and estimated higher costs after 2027. Transitioning from conventional ICE powertrains to battery-electric and fuel cell electric technology represents a major paradigm shift for both manufacturers and fleets, and it is difficult to forecast how the technology may grow without established government policy. There are other non-monetary risks associated with ZEV development that need to be managed such as infrastructure availability, range anxiety, weight concerns. Studies from University of California, Davis and the North American Council on Fuel Efficiency show some hesitancy from the trucking industry despite the potential for cost savings.[102, 103]

Additionally, manufacturers bear additional risks by building electric vehicles when compared to compliance strategies that depend on modest improvements in existing conventional truck technologies. Developing a ZE product line requires initial research and development expenses, new or heavily modified assembly lines, agreements with new suppliers, and more. While this analysis does show a cost saving while the Advanced Technology Multiplier is in effect, on a longer timeframe past 2027 MY, ZEVs are a more expensive vehicle to build. Demand for ZEVs is dependent on many factors outside the manufacturer’s control including fuel price swings, battery and other component prices, shifting fleet behavior, and others. So while this cost analysis shows that ZEVs overall have potential to decrease costs to manufacturers for complying with Phase 2 GHG regulation prior to 2028, staff believe the manufacturers may not commercially produce ZEVs in a BAU scenario without certainty from a regulation.

[102] Miller, Marshal; Wang, Qian; Fulton, Lew; Truck Choice Modeling: Understanding California's Transition to Zero-Emission Vehicle Trucks Taking into Account Truck Technologies, Costs, and Fleet Decision Behavior (web link: https://ncst.ucdavis.edu/wp-content/uploads/2016/10/NCST-TO-033.2-Fulton_Truck-Decision-Choice_Final-Report_Nov2017.pdf, last accessed June 2019).

[103] North American Council for Fuel Efficiency, Electric Trucks: Where They Make Sense, 2018.

Figure C-6. Total Estimated Direct Costs of Proposed ACT Regulation Relative to the Baseline (million 2018$)

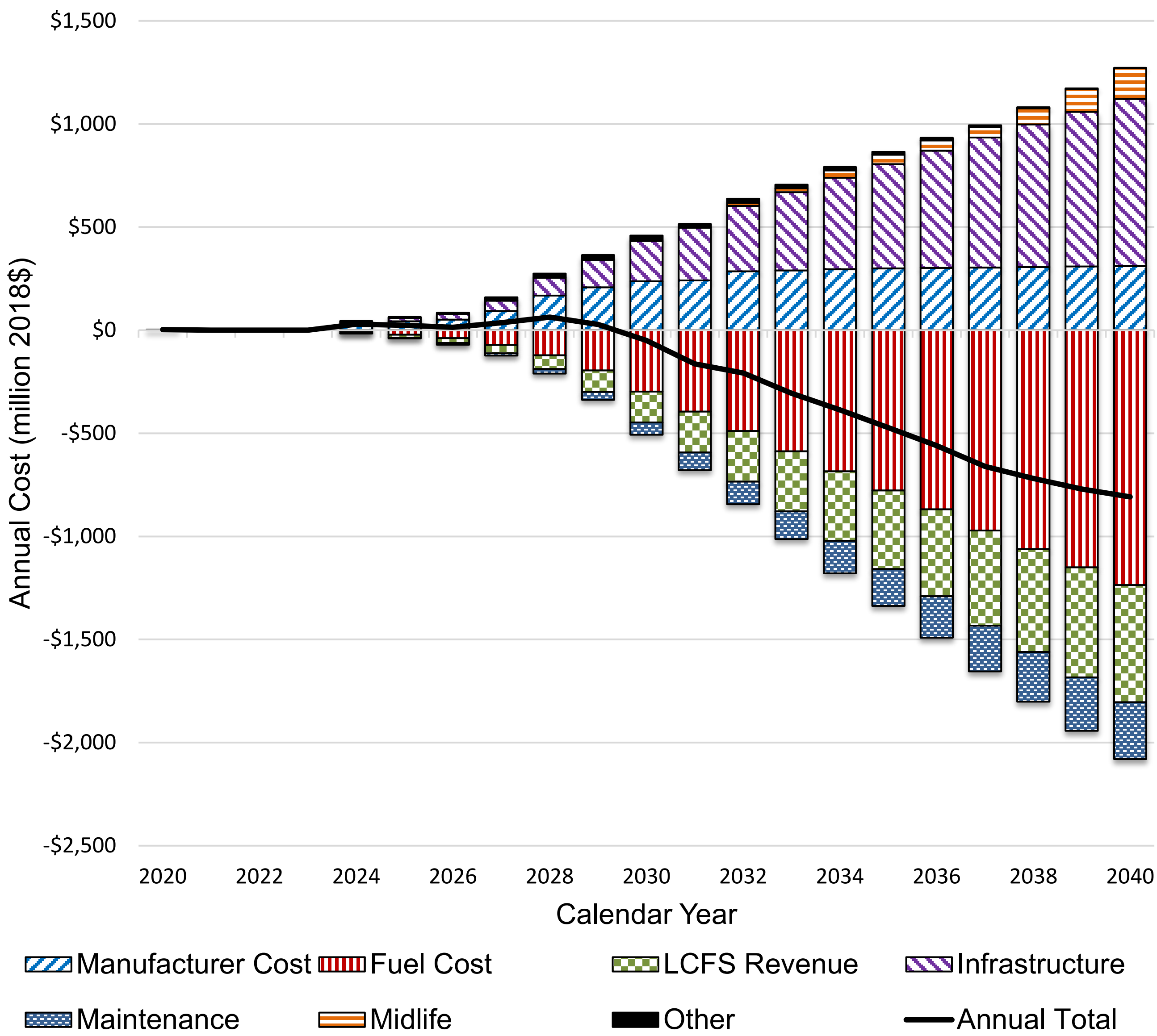

Table C-22. Total Estimated Direct Incremental Costs Relative to the Baseline (million 2018$)

Calendar Year	Cost to Manufacturers			Costs to Fleets										Total Cost*
	ZEV Price	ICE Phase 2 GHG (Cost Avoided)	ZEP Cert.	Large Entity Reporting	Sales & Excise Tax	Fuel Cost	LCFS Revenue	Vehicle Maintenance Cost	Maintenance Bay Upgrades	Midlife Costs	EVSE & Infrastructure Installation & Maintenance	Transitional Costs & Workforce Development	Registration Fees	
2020	$0	$0	$0.00	$2.4	$0	$0	$0	$0	$0	$0	$0	$0	$0	$2.4
2021	$0	$0	$0.00	$0.0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2022	$0	$0	$0.00	$0.0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2023	$0	$0	$0.00	$0.0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
2024	$43	-$9	$0.18	$0.0	$4	-$9	-$6	-$3	$0	$0	$6	$1	$0	$28
2025	$55	-$12	$0.04	$0.0	$5	-$21	-$14	-$7	$1	$0	$15	$1	$0	$23
2026	$66	-$14	$0.04	$0.0	$6	-$39	-$23	-$12	$2	$0	$26	$2	$0	$13
2027	$136	-$43	$0.04	$0.0	$14	-$70	-$40	-$21	$4	$0	$50	$3	-$1	$34
2028	$181	-$13	$0.04	$0.0	$19	-$120	-$66	-$35	$7	$0	$85	$4	-$1	$60
2029	$224	-$18	$0.04	$0.0	$23	-$193	-$103	-$54	$10	$0	$133	$6	-$3	$25
2030	$259	-$23	$0.04	$0.0	$27	-$294	-$150	-$80	$14	$0	$194	$6	-$6	-$51
2031	$263	-$23	$0.04	$0.0	$27	-$390	-$198	-$105	$18	$0	$256	$0	-$8	-$161
2032	$306	-$23	$0.04	$0.0	$31	-$483	-$245	-$130	$20	$15	$318	$0	-$10	-$202
2033	$311	-$24	$0.04	$0.0	$32	-$580	-$292	-$154	$22	$18	$380	$0	-$12	-$299
2034	$318	-$24	$0.04	$0.0	$33	-$677	-$337	-$177	$23	$37	$443	$0	-$15	-$377
2035	$322	-$24	$0.04	$0.0	$33	-$770	-$380	-$199	$23	$46	$506	$0	-$18	-$462
2036	$325	-$25	$0.04	$0.0	$33	-$860	-$422	-$221	$23	$51	$568	$0	-$20	-$548
2037	$327	-$25	$0.04	$0.0	$33	-$962	-$461	-$241	$23	$51	$630	$0	-$23	-$648
2038	$329	-$25	$0.04	$0.0	$34	-$1,051	-$499	-$260	$23	$78	$691	$0	-$26	-$706
2039	$332	-$25	$0.04	$0.0	$34	-$1,138	-$534	-$278	$23	$109	$751	$0	-$29	-$757
2040	$334	-$25	$0.04	$0.0	$34	-$1,224	-$568	-$295	$22	$150	$810	$0	-$32	-$794
Total*	$4,129	-$375	$1	$2	$423	-$8,882	-$4,337	-$2,273	$258	$554	$5,862	$24	-$203	-$4,818

*Note: Totals may differ due to rounding

2. Direct Costs on Typical Businesses

e. *Medium- and Heavy-duty Manufacturers*

Manufacturers are responsible for meeting the ZEV sales percentage requirement by either building and selling zero-emission trucks, or using flexibility provisions. While none of the regulated manufacturers build vehicles in California, this analysis is included to provide further information to stakeholders. Manufacturing ZEVs requires large upfront costs that go into research and development, prototyping, assembly line upgrades and tooling, and other categories. All these costs plus the actual component cost of the vehicle need to be recouped during the sale of the vehicle.

Manufacturers would have a requirement to sell ZEVs but most fleets do not currently have a requirement to purchase ZEVs. As a result, manufacturers bear risk in that they may have to sell vehicles below cost to fleets to meet the requirements of the regulation. Any ZEV costs that manufacturers cannot pass on through sale of their ZEVs may be added to the cost of the rest of their ICE fleet, or the manufacturer may not pass on the cost and must absorb the cost themselves.

The two extremes are either the manufacturer is able to fully pass on the cost of an electric vehicle to the purchaser, or they are not able to pass any cost on to the purchaser. One way to estimate what the purchaser would be willing to pay for would be to look at the payback of the ZEV. Studies and surveys have found that commercial fleets are willing to pay more for cost-saving technologies within a certain payback period that varies from fleet to fleet.[104,105] Two years is considered to be the time period where any cost-saving expense becomes an easy decision for a fleet. Table C-23 illustrates the percentage of incremental cost that the fleet will be willing to pay for based on a simple two-year payback analysis incorporating fuel costs, LCFS revenue, and amortized charger & infrastructure payments. These percentages should represent the floor for what portion of the incremental cost the fleet will pay for as most companies have longer horizons than two years with some looking at the full life of the vehicle.

Table C-23. Percentage of Two-Year Simple Payback vs. Incremental Cost

Vehicle Group*	2024 MY	2025 MY	2026 MY	2027 MY	2028 MY	2029 MY	2030 MY
Class 2B-3	24%	26%	28%	29%	31%	34%	38%
Class 4-5	54%	61%	69%	73%	81%	89%	101%
Class 6-7	54%	63%	72%	77%	86%	98%	113%
Class 8	28%	34%	40%	41%	47%	55%	67%
Class 7-8 Tractor - Electric	33%	38%	42%	44%	48%	53%	60%
Class 7-8 Tractor - Fuel Cell	N/A	N/A	N/A	N/A	N/A	3%	8%

*Class 2B-3 is using average of payback versus diesel and gasoline, all comparisons versus the normal range version of vehicle.

[104] Volvo Technology of North America, Heavy-Duty Class 8 Electrification Roadmap: Regional Distribution and Short Haul Applications.
[105] Environmental Protection Agency, Heavy-duty Trucking and the Energy Efficiency Paradox (web link: https://www.epa.gov/sites/production/files/2014-12/documents/heavy-duty_trucking_and_the_energy_efficiency_paradox.pdf, last accessed June 2019).

It is possible that manufacturers may shift sales for California-bound trucks out of state to avoid the requirements of the Proposed ACT Regulation which would consequentially reduce overall emissions reductions. Current California conditions include higher sales tax, registration fees and other factors that cause a portion of California tractors and trucks to be sold initially out of state despite operating within California. Generally, trucking companies make purchasing decisions based on a variety of reasons including the location of their headquarters, fleet facilities, expected duty cycles, and level of local delegation. Staff does not believe the Proposed ACT Regulation is likely to exacerbate these issues as fleet behavior determines where vehicles are purchased and operated, not manufacturer decisions.

While the proposed ACT regulation cannot ensure that sales will not affect decisions to shift sales out of state, future planned ZEV rules can require companies to incorporate zero-emission trucks into their fleets regardless of whether they were purchased in state or not. This issue can be avoided in how future regulations are structured to ensure real emissions reductions occur in California.

f. *Trucking Fleets*

Manufacturers sell trucks to trucking fleets who operate the vehicles and incur costs after the point of sale including taxes, fueling, maintenance, midlife costs, and registration fees. Adding electric trucks to their fleet will also cause fleets to incur cost relating to EVSE, infrastructure, maintenance bay upgrades, workforce training, and other transitional costs.

The Proposed ACT Regulation will reduce costs to the overall state's trucking fleet as the operational cost savings of the ZEVs outweigh the potential infrastructure and vehicle prices. Amortizing the vehicle and infrastructure help with these company's cash-flow so they can have positive cash-flow shortly after purchase.

Table C-24 illustrates an example where an example fleet purchases 20 Class 4-5 trucks for usage in last mile delivery applications in 2024 for usage over twelve years. The costs for 20 diesel vehicles, 20 battery-electric vehicles and the difference between them is shown. All other mileage and cost assumptions are the same as described previously in this section. The costs over the twelve year period are lower for the battery-electric fleet as compared to the diesel fleet; however, the upfront capital expenses are significantly higher for the BEV fleet. Access to capital or financing will be critical for fleets to take advantage of the overall savings of BEVs. A more detailed discussion of fleet costs can be found in the "Draft Advanced Clean Trucks Total Cost of Ownership Discussion Document" released earlier this year.[106]

Table C-24. Fleet Cost Example

Cost line items	Diesel	Battery Electric	Difference
Amortized Vehicle Price (including all mfr. expenses)	$1,270,361	$1,747,840	$477,479
Sales Tax	$93,280	$135,896	$42,616
Amortized EVSE Cost	$0	$104,315	$104,315
Amortized Infrastructure Upgrades	$0	$417,261	$417,261
Charger Maintenance	$0	$120,000	$120,000

[106] California Air Resources Board, Draft Advanced Clean Trucks Total Cost of Ownership Discussion Document (web link: https://ww2.arb.ca.gov/sites/default/files/2019-02/190225tco_0.pdf, last accessed June 2019).

Cost line items	Diesel	Battery Electric	Difference
Fuel Costs	$2,220,329	$947,961	-$1,272,368
LCFS Revenue	$0	-$764,063	-$764,063
Maintenance Costs	$1,914,913	$1,436,185	-$478,728
Midlife Costs	$0	$259,200	$259,200
Maintenance Bay Upgrades	$0	$20,000	$20,000
Transitional Costs and Workforce Development	$0	$12,564	$12,564
Registration Fees	$245,823	$232,840	-$12,982
Total	$5,744,706	$4,669,999	-$1,074,706

3. Direct Costs on Small Businesses

There is no expected direct cost on small businesses under the Proposed ACT Regulation. No manufacturers or fleets who are regulated under this rule are small businesses.

Small businesses who operate trucks will not be required to purchase zero-emission trucks, but may independently decide to do so. This may enable cost savings for small businesses due to electric trucks' lower cost of operation.

4. Direct Costs on Individuals

There are no direct costs onto individuals as a result of this regulation. Individuals may see health benefits as described in Section B.3 due to ZEVs displacing ICE vehicles and providing statewide, regional, and local emission benefits. Manufacturers and fleets will see increased and decreased costs as a result of this rule and will pass through to individuals in the state. Individuals may see macroeconomic benefits and costs; these costs are discussed further in Section E.

Some of the vehicles affected by this regulation, mainly Class 2B-3 pickup trucks, are purchased by individuals. Based on manufacturer estimates, this portion is roughly half of the overall Class 2B-3 population compared to the 15% sales requirement in the Class 2B-3 category in 2030.[107] Staff is assuming in this analysis that all ZEVs will be sold to businesses rather than individuals. Businesses are more likely to look at lifetime savings and the total cost of ownership compared to individuals, and the vehicles businesses purchase including vans are better suited for electrification as opposed to the pickups purchased by individuals.

D. Fiscal Impacts

1. Local Government

[107] Truck and Engine Manufacturers Association, Advanced Clean Truck Market Segment Analysis (web link: https://ww2.arb.ca.gov/sites/default/files/2018-11/181204emaanalysis_0.xlsx , last accessed June 2019).

a. Large Entity Reporting

Cities and counties are required to complete the Large Entity Reporting requirement in 2020. There are 58 counties and 482 cities in California and each would be required to report information about their fleets, and the transportation services they contract for.

b. Utility User Taxes

Many cities and counties in California levy a Utility User Tax on electricity usage. This tax varies from city to city and ranges from no tax to 11%. A value of 3.53% was used in this analysis representing a population-weighted average.[108] By increasing the amount of electricity used, there will be an increase in the amount of the utility user tax revenue collected by cities and counties.

c. Gasoline and Diesel Fuel Taxes

Fuel taxes on gasoline and diesel to fund transportation improvements at the state, county, and local levels. Displacing gasoline and diesel with electricity and hydrogen will decrease the total amount of gasoline and diesel dispensed in the state, resulting in a reduction in fuel tax revenue collected by local governments. The local tax on fuel is listed in Table C-13.

d. Local Sales Taxes

Sales taxes are levied in California to fund a variety of programs at the state and local level. The Proposed ACT Regulation will require the sale of more expensive zero-emission trucks in California which will result in direct increase in sales tax revenue collected by local governments. Overall, local sales tax revenue may increase less than the direct increase from vehicle sales if overall business spending doesn't increase.

e. Local Government Fleet Cost Pass-Through

The local government fleet is estimated to make up 2.9% of California's fleet based on information from manufacturers and the Department of General Services. A proportionate amount of the total costs outlined in Table C-22 are assumed to pass-through to local governments.

f. Fiscal Impact on Local Government

Table D-1 shows the estimated fiscal cost to local governments due to the Proposed ACT Regulation relative to baseline conditions. The fiscal impact to local government is estimated to be -$0.1 million over the first three years of the regulation and $7 million over the regulatory lifetime.

[108] California State Controller's Office, User Utility Tax Revenue and Rates (web page: https://sco.ca.gov/Files-ARD-Local/LocRep/2016-17 Cities UUT.pdf, last accessed June 2019).

Table D-1. Estimated Fiscal Impacts to Local Government (million 2018$)

Model Year	Large Entity Reporting	Utility User Tax Revenue	Local Gasoline and Diesel Fuel Taxes	Local Sales Tax	Local Government Fleet Cost Pass-Through	Fiscal Impact*
2020	-$0.1	$0	$0	$0	$0	-$0.1
2021	$0	$0	$0	$0	$0	$0
2022	$0	$0	$0	$0	$0	$0
2023	$0	$0	$0	$0	$0	$0
2024	$0	$0	-$1	$2	-$1	$0
2025	$0	$1	-$1	$2	-$1	$1
2026	$0	$1	-$2	$3	$0	$2
2027	$0	$2	-$4	$6	-$1	$3
2028	$0	$3	-$7	$8	-$2	$2
2029	$0	$5	-$12	$10	-$1	$2
2030	$0	$7	-$18	$12	$1	$2
2031	$0	$10	-$23	$12	$5	$4
2032	$0	$12	-$29	$14	$6	$3
2033	$0	$14	-$35	$14	$9	$2
2034	$0	$16	-$41	$14	$11	$0
2035	$0	$18	-$46	$15	$13	$0
2036	$0	$20	-$51	$15	$16	$0
2037	$0	$22	-$57	$15	$19	-$1
2038	$0	$24	-$62	$15	$20	-$3
2039	$0	$25	-$66	$15	$22	-$4
2040	$0	$26	-$71	$15	$23	-$7
Total	-$0.1	$206	-$526	$187	$140	$7

*Note: Totals may differ due to rounding

2. State Government

a. CARB Staffing and Resources

The Proposed ACT Regulation would have a small impact on staffing resources and would require two additional Air Pollution Specialist (APS) positions responsible for administering contracts to set up the reporting systems, assisting stakeholders with inquiries, data analysis and auditing of information submitted by manufacturers and fleets, supporting ACT enforcement actions and other general implementation duties. Each position has a fully burdened cost to CARB of $180,000 in Fiscal Year (FY) 2020-2021 and $179,000 every year afterwards.

The manufacturer reporting requirement will require modifying an existing reporting system or developing a new system to handle the reporting. We are estimating a cost of $200,000 in FY2020-2021 in contracting costs to set up the manufacturer reporting system for the rule.

Similarly, the fleet and large entity reporting requirement will require modifying an existing reporting system or developing a new system to handle the reporting. We are estimating a cost of $200,000 in FY2020-2021 in contracting costs to set up the fleet reporting system for the rule.

b. Gasoline and Diesel Fuel Taxes

Fuel taxes on gasoline and diesel to fund transportation improvements at the state, county, and local levels. Displacing gasoline and diesel with electricity and hydrogen will decrease the total amount of gasoline and diesel dispensed in the state. This will result in a reduction in revenue collected by the state for use in multiple levels of government. The state tax on fuel is listed in Table C-13.

c. Energy Resources Fee

The Energy Resource Fee is a $0.0003/kWh surcharge levied on consumers of electricity purchased from electrical utilities. The revenue collected is deposited into the Energy Resources Programs Account of the General Fund which is used for ongoing energy programs and projects deemed appropriate by the Legislature, including but not limited to, activities of the California Energy Commission.

d. Registration Fees

The state collects registration fees to fund transportation improvements at the state, county, and local levels. The fee structure for zero-emission vehicles is different from diesel vehicles with some fees such as the Vehicle License Fee being higher and others such as weight fees being lower. These differences result in lower registration fees for the zero-emission vehicles. These lower fees result in reduced revenue collected by the state for use in transportation services.

e. State Sales Tax

Sales taxes are levied in California to fund a variety of programs at the state and local level. This Proposed ACT Regulation will require the sale of more expensive zero-emission trucks in California which will result in higher sales tax collected by the state governments. Overall, state sales tax revenue may increase less than the direct increase from vehicle sales if overall business spending doesn’t increase.

f. State Fleet Cost Pass-Through

The state government fleet is estimated to make up 2.1% of California’s fleet based on information from manufacturers and the Department of General Services. A proportionate amount of the total costs outlined in Table C-22 are assumed to pass-through to the state government.

g. Fiscal Impacts on State Government

Table D-2 shows the estimated fiscal impacts to the state government due to the Proposed ACT Regulation relative to baseline conditions. The fiscal impact to local government is estimated to be -$1.4 million over the first three years of the regulation and -$2.01 billion over the regulatory lifetime.

Table D-2. Estimated Fiscal Impacts on State Government (million 2018$)

Model Year	CARB Staffing and Resources	State Gasoline and Diesel Fuel Taxes	Energy Resources Fee	Registration Fee	State Sales Taxes	State Fleet Cost Pass-Through	Fiscal Impact*
2020	-$0.6	$0	$0	$0	$0	$0	-$1
2021	-$0.4	$0	$0	$0	$0	$0	$0
2022	-$0.4	$0	$0	$0	$0	$0	$0
2023	-$0.4	$0	$0	$0	$0	$0	$0
2024	-$0.4	-$2	$0	$0	$2	$1	$1
2025	-$0.4	-$6	$0	$0	$2	$0	-$4
2026	-$0.4	-$10	$0	$0	$3	$0	-$7
2027	-$0.4	-$18	$0	-$1	$5	-$1	-$15
2028	-$0.4	-$30	$0	-$1	$7	-$1	-$25
2029	-$0.4	-$48	$0	-$3	$9	-$1	-$43
2030	-$0.4	-$72	$0	-$6	$10	$1	-$67
2031	-$0.4	-$95	$0	-$8	$10	$3	-$90
2032	-$0.4	-$117	$1	-$10	$12	$4	-$110
2033	-$0.4	-$139	$1	-$12	$12	$6	-$132
2034	-$0.4	-$161	$1	-$15	$13	$8	-$154
2035	-$0.4	-$182	$1	-$18	$13	$10	-$176
2036	-$0.4	-$201	$1	-$20	$13	$12	-$195
2037	-$0.4	-$221	$1	-$23	$13	$14	-$216
2038	-$0.4	-$240	$1	-$26	$13	$15	-$237
2039	-$0.4	-$257	$1	-$29	$13	$16	-$256
2040	-$0.4	-$273	$1	-$32	$13	$17	-$274
Total	-$9	-$2,072	$10	-$204	$163	$101	-$2,011

*Note: Totals may differ due to rounding

E. Macroeconomic Impacts

1. Methods for Determining Economic Impacts

This section describes the estimated total impact of the Proposed ACT Regulation on the California economy. The Proposed ACT Regulation will result in changes in expenditures by businesses in order to comply with its requirements. These changes in expenditures will affect employment, output, and investment in sectors that supply goods and services in support of the trucking industry and ZEVs.

These lead to additional induced effects, like changes in personal income that affect consumer expenditures across other spending categories. The incremental total economic impacts of the Proposed ACT Regulation are simulated relative to the baseline scenario using the cost data described in Section C. The analysis focuses on the incremental changes in major macroeconomic indicators from 2020 to 2040 including employment, growth, and gross state product (GSP). The years of the analysis are used to simulate the Proposed ACT Regulation through 12 months post full implementation.

Regional Economic Models, Inc. (REMI) Policy Insight Plus Version 2.2.8 is used to estimate the macroeconomic impacts of the Proposed ACT Regulation on the California economy. REMI is a structural economic forecasting and policy analysis model that integrates input-output, computable general equilibrium, econometric and economic geography methodologies.[109] REMI Policy Insight Plus provides year-by-year estimates of the total impacts of the Proposed ACT Regulation, pursuant to the requirements of SB 617 and the California Department of Finance.[110,111] CARB uses the REMI single-region, 160-sector model with the model reference case adjusted to reflect the Department of Finance conforming forecasts. These forecasts include California population figures dated May 2019, U.S. real GDP forecast, and civilian employment growth numbers dated April 2019.

2. Inputs of the Assessment

The estimated economic impact of the Proposed ACT Regulation are sensitive to modeling assumptions. This section provides a summary of the assumptions and inputs used to determine the suite of policy variables that best reflect the macroeconomic impacts of the Proposed ACT Regulation. The direct costs estimated in Section C and the non-mortality health benefits estimated in Section B are translated into REMI policy variables and used as inputs for the macroeconomic analysis.[112]

The direct costs of the Proposed ACT Regulation, as described in Section C, include costs on manufacturers for producing the ZEVs as well as cost-savings that accrue for offsetting of a portion of Federal and California Phase 2 GHG compliance costs. While these costs are directly incurred by manufacturers, those manufacturers are not located in California; because this analysis focuses on the impacts to the California economy it is assumed here that these costs must be passed on from manufacturers to fleets in California through the price of vehicles. Additionally, the Phase 2 GHG compliance costs offset by the Proposed ACT Regulation is derived primarily from the federal regulation. If these compliance cost savings are passed through to fleets it would likely be a nationwide effect. Staff therefore make a conservative assumption, as to not overestimate the cost-savings, that the savings passed through to California fleets is proportional to California's share of the national truck population; estimated at 10%.[113] The net change in vehicle costs is input into the economic model as an increase in production costs in the truck transportation industry (NAICS 484) in California.

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[109] For further information and model documentation see: https://www.remi.com/model/pi/

[110] California Legislature, Senate Bill 617, signed on October 5, 2011 (web link: http://dof.ca.gov/Forecasting/Economics/Major_Regulations/SB_617_Rulemaking_Documents/documents/Section%202000%20ISOR%201%20sb_617_bill_20111006_chaptered.pdf, last accessed June 2019)

[111] Department of Finance, Chapter 1: Standardized regulatory Impact Analysis For Major Regulations - Order of Adoption (web link http://dof.ca.gov/Forecasting/Economics/Major_Regulations/SB_617_Rulemaking_Documents/documents/Order_of_Adoption-1.pdf, last accessed June 2019)

[112] Refer to Section G: Macroeconomic Appendix for a full list of REMI inputs for this analysis.

[113] Energy Information Administration, Annual Energy Outlook 2018 (web link: https://www.eia.gov/outlooks/aeo/data/browser/#/?id=3-AEO2018&cases=ref2018&sourcekey=0, last accessed June 2019).

Fleets which use ZEVs will realize changes in production costs related to their change in fuel mix and operations and maintenance costs. Fleets will also need to make investments in infrastructure to support their use of the ZEVs, which will increase their production costs. Finally, fleets' changes in equipment, fuel, and activities will change the amount paid in federal, state, and local taxes. The total change in taxes businesses in the truck transportation industry are modeled as a reduction in production costs for the industry.

Costs and savings incurred by both manufacturers and fleets will result in corresponding changes in final demand for industries supplying those particular goods or services as shown in Table E-1. As the direct costs and cost-savings on vehicle manufacturers are incurred out of state, demand changes for the corresponding ZEV and ICE supply chain can't be directly modeled as a change in final demand in California. In order to account for this, staff estimates the share of demand which may be fulfilled be California businesses, based on California's share of national output for each industry (Electrical component mfg. and Motor vehicle parts mfg.).[114] All other changes in demand are included in this analysis. The infrastructure upgrades necessary for fleet use of ZEVs is assumed to be provided by businesses in the construction sector (NAICS 23). The electric vehicle supply equipment and maintenance is assumed to be supplied by businesses in the Other Electrical Equipment and Component Manufacturing industry (NAICS 3359). The change in demand for vehicle maintenance and midlife rebuild realized by the automotive repair and maintenance industry (NAICS 8111). The reduction in gasoline and diesel fuel demand is assumed to be incurred by the Petroleum and Coal Products manufacturing industry (NAICS 324). The increased demand for electricity and hydrogen fuel is assumed to be provided by the Electric power generation, transmission, and distribution industry (NAICS 2211) and Basic Chemical manufacturing industry (NAICS 3251), respectively. The large entity reporting and the transitional costs and workforce development are assumed to be provided by the Office administrative services (NAICS 5611, 5612) and private education services industries (NAICS 61), respectively.

Table E-1: Sources of Changes in Production Cost and Final Demand by Industry

Source of Cost or Savings	Industry with changes in Production costs (NAICS)	Industries with Changes in Final Demand (NAICS)
Vehicle Prices	Truck Transportation (484)	*One-time cost: Electrical* component mfg.* (3353)
Phase 2 GHG Compliance (Costs Offset)		*One-time cost:* Motor vehicle parts mfg.* (3363)
Infrastructure Upgrades		*One-time cost:* Construction (23)
EVSE and maintenance		*One-time and recurring cost:* Other electrical equipment and component mfg. (3359)
Vehicle maintenance and midlife rebuild		*One-time and recurring cost:* Automotive repair and maintenance (8111)

[114] Based on REMI Policy Insight Plus (v 2.2.8), California's share of national output is 4.3% for electrical component mfg. (3353) and 2.0% for motor vehicle parts mfg. (3363) in 2018.

Gas and diesel fuel		*Recurring cost:* Petroleum and Coal Products Mfg. (324)
Electricity		*Recurring cost:* Electric power generation, transmission, and distribution (2211)
Hydrogen fuel		*Recurring cost:* Basic Chemical manufacturing (3251)
Large Entity Reporting		*One-time cost:* Office administrative services; Facilities support services (5611, 5612)
Transitional Costs and Workforce Training		*Recurring costs:* Education services; private (61)

*The Industry Sales policy variable is used here rather Exogenous Final Demand.

In addition to these changes in production costs and final demand for businesses, there will also be economic impacts as a result of the fiscal effects, primarily from changes in fuel and sales tax revenue and registration fees, as described in Section D. The changes in fuel tax revenue change the production costs for the affected industry of truck transportation (484) and the corresponding change in government revenue is modeled as a change in state and local government spending, assuming this revenue reduction is not offset elsewhere. Additional CARB staff and resources in support of this regulation are modeled as changes in state government employment and spending. The change in federal excise tax revenue is outside the scope of the economic model and not evaluated here.

The health benefits resulting from the emission reductions of the Proposed ACT Regulation reduce healthcare costs for individuals on average. This reduction in healthcare cost is modeled as a decrease in spending for hospitals, with a reallocation of this spending towards other goods and increased savings. The GHG emission reductions benefits as valued through the SC-CO_2 represent the avoided damage from climate change worldwide per MT of CO2e. These benefits fall outside the scope of our economic model and are not evaluated here.

3. Results of the Assessment

The results from the REMI model provide estimates of the impact of the Proposed ACT Regulation on the California economy. These results represent the annual incremental change from the implementation of the Proposed ACT Regulation relative to the baseline scenario. The California economy is forecasted to grow through 2040, therefore, negative impacts reported here should be interpreted as a slowing of growth and positive impacts as an acceleration of growth resulting from the Proposed ACT Regulation. The results are reported here in tables for every five years from 2020 through 2040.

a. *California Employment Impacts*

Table E-2 present the impact of the Proposed ACT Regulation total employment in California across all industries. The employment impacts represent the net change in employment, which consist of positive impacts for some industries and negative impacts for others. The Proposed ACT Regulation is estimated to result in a slightly positive job impact from about

2025 to 2040. These changes in employment represent less than 0.04 percent of baseline California employment.

Table E-2: Total California Employment Impacts

	2020	2025	2030	2035	2040
California Employment	24,368,647	25,267,147	26,206,546	27,105,799	27,920,649
% Change	0.00%	0.00%	0.02%	0.02%	0.03%
Change in Total Jobs	-2	725	4,587	5,607	8,065

The total employment impacts shown above are net of changes at the industry level. The overall trend in employment changes by major sector are illustrated in Figure E-1 and Table E-3 shows the changes in employment by industries that are directly impacted by the Proposed ACT Regulation. As the requirements of the Proposed ACT Regulation go into effect the industries generally realizing reductions in production cost or increases in final demand see an increase in employment growth. This includes the truck transportation, construction, and manufacturing sectors and upstream industries. The largest decrease in employment results from the public sector, which is estimated to realize a decrease in fuel and sales tax revenue and registration fees. The oil and gas extraction industry and automotive repair and maintenance industry see a decreased employment growth rate due to a reduction in final demand for their goods and services.

Figure E-1: Job Impacts by Major Sector

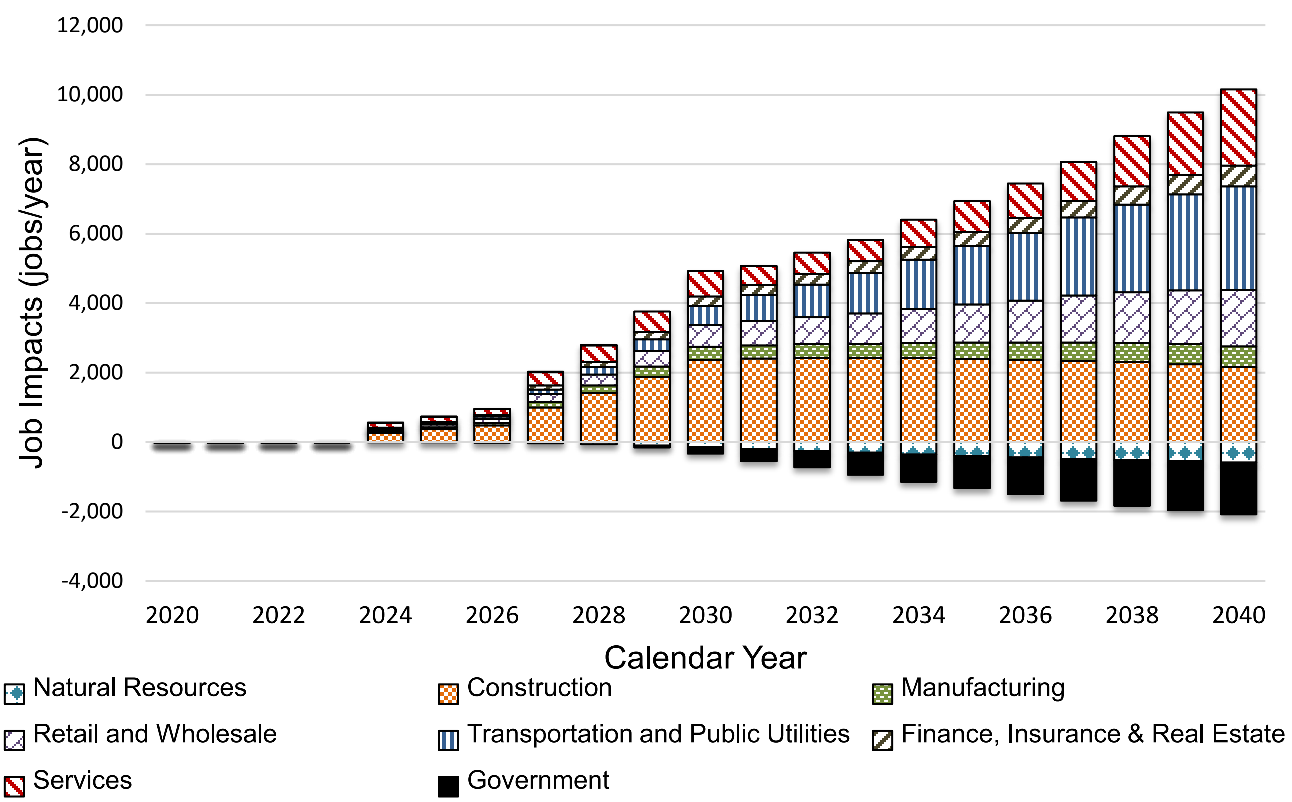


Table E-3: Job Impacts by Primary and Secondary Industries

		2020	2025	2030	2035	2040
Truck transportation (484)	% Change	0.00%	0.00%	0.10%	0.42%	0.82%
	Change in Jobs	-2	10	235	973	1,929
Electric power generation, transmission and distribution (2211)	% Change	0.00%	0.04%	0.42%	0.96%	1.28%
	Change in Jobs	0	16	181	422	568
Construction (23)	% Change	0.00%	0.03%	0.21%	0.21%	0.18%
	Change in Jobs	-2	364	2,368	2,398	2,159
Other electrical equipment and component manufacturing (3359)	% Change	0.00%	0.18%	1.33%	1.48%	1.49%
	Change in Jobs	0	28	196	213	211
Petroleum and coal products manufacturing (324)	% Change	0.00%	-0.04%	-0.46%	-1.07%	-1.42%
	Change in Jobs	0	-5	-56	-129	-170
Basic chemical manufacturing (3251)	% Change	0.00%	0.00%	0.01%	0.02%	0.03%
	Change in Jobs	0	0	1	1	2
Office administrative services; Facilities support services (5611, 5612)	% Change	0.02%	0.00%	0.01%	0.01%	0.02%
	Change in Jobs	14	1	9	14	25
Educational services; private (61)	% Change	0.00%	0.00%	0.02%	0.01%	0.02%
	Change in Jobs	0	22	119	86	131
Automotive repair and maintenance (8111)	% Change	0.00%	-0.03%	-0.30%	-0.56%	-0.49%
	Change in Jobs	0	-55	-645	-1,212	-1,061
State & Local Government	% Change	0.00%	0.00%	-0.01%	-0.04%	-0.06%
	Change in Jobs	-2	18	-184	-928	-1,498

b. *California Business Impacts*

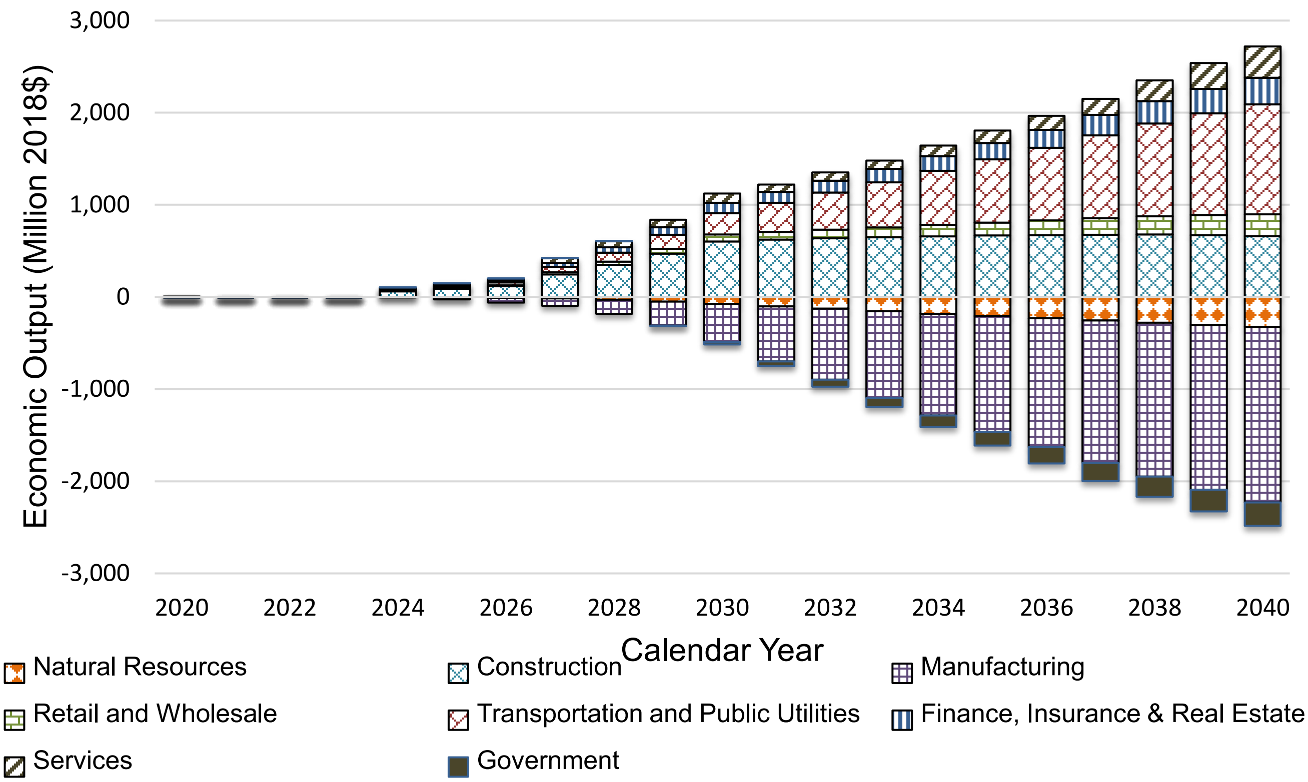
Gross output is used as a measure for business impacts because as it represents an industry's sales or receipts and tracks the quantity of goods or services produced in a given time period. Output growth is the sum of output in each private industry and State and local government as it contributes to the state's gross domestic product (GDP), and is affected by production cost and demand changes. As production cost increases or demand decreases, output is expected to contract, but as production costs decline or demand increases, industry will likely experience output growth.

The results of the Proposed ACT Regulation show an increase in output of $639 million in 2030 and an increase of $785 million in 2040 as shown in Table E-4. The trend in output changes is illustrated by major sector in Figure E-2. Similar to the employment impacts, there are positive impacts on output for transportation, public utilities, and construction and negative impacts on oil and gas extraction, automotive repair and maintenance, and the public sector. The negative output impact on manufacturing is primarily driven by the petroleum and coal products manufacturing industry, which is estimated to see a relatively large decrease in final demand for gasoline and diesel.

Table E-4: Change in California Output Growth by Industry

		2020	2025	2030	2035	2040
California Economy	Output (2018M$)	4,602,716	5,031,749	5,482,557	6,057,456	6,759,388
	% Change	0.00%	0.00%	0.01%	0.01%	0.01%
	Change (2018M$)	-1	114	639	496	785
State & Local Government	% Change	0.00%	0.00%	-0.01%	-0.04%	-0.06%
	Change (2018M$)	0	3	-32	-169	-285
Truck transportation (484)	% Change	0.00%	0.00%	0.10%	0.42%	0.83%
	Change (2018M$)	0	2	49	221	485
Electric power generation, transmission and distribution (2211)	% Change	0.00%	0.04%	0.42%	0.97%	1.29%
	Change (2018M$)	0	12	140	347	501
Construction (23)	% Change	0.00%	0.03%	0.22%	0.22%	0.19%
	Change (2018M$)	0	64	444	491	487
Petroleum and coal products manufacturing (324)	% Change	0.00%	-0.04%	-0.46%	-1.07%	-1.43%
	Change (2018M$)	0	-33	-423	-1,102	-1,669
Other electrical equipment and component manufacturing (3359)	% Change	0.00%	0.18%	1.34%	1.50%	1.52%
	Change (2018M$)	0	10	72	83	88
Basic chemical manufacturing (3251)	% Change	0.00%	0.00%	0.01%	0.02%	0.03%
	Change (2018M$)	0	0	4	8	13
Office administrative services; Facilities support services (5611, 5612)	% Change	0.02%	0.00%	0.01%	0.01%	0.02%
	Change (2018M$)	2	0	1	2	4
Educational services; private (61)	% Change	0.00%	0.00%	0.02%	0.01%	0.02%
	Change (2018M$)	0	2	10	7	12
Automotive repair and maintenance (8111)	% Change	0.00%	-0.03%	-0.30%	-0.57%	-0.51%
	Change (2018M$)	0	-6	-71	-139	-128

Figure E-2: Change in California Economic Output by Major Sector



c. ***Impacts on Investments in California***

Private domestic investment consists of purchases of residential and nonresidential structures and of equipment and software by private businesses and nonprofit institutions. It is used as a proxy for impacts on investments in California because it provides an indicator of the future productive capacity of the economy.

The relative changes to growth in private investment for the Proposed ACT Regulation are shown in Table E-5 and show an increase of private investment of about $175 million in 2030 and $425 million in 2040, or less than 0.01 percent of baseline investment.

Table E-5: Change in Gross Domestic Private Investment Growth

	2020	**2025**	**2030**	**2035**	**2040**
Private Investment (2018M$)	464,563	499,173	534,917	587,262	641,970
% Change	0.00%	0.00%	0.00%	0.00%	0.00%
Change (2018M$)	-1	22	175	307	425

d. ***Impacts on Individuals in California***

The Proposed ACT Regulation will impose no direct costs on individuals in California. However, the costs incurred by affected businesses and the public sector will cascade through the economy and affect individuals.

One measure of this impact is the change in real personal income. Table E-6 shows annual change in real personal income across all individuals in California. Total personal income growth increases by about $470 million in 2030 and $1.40 billion in 2040 as a result of the Proposed ACT Regulation, representing about 0.01 percent of the baseline. The change in personal income estimated here can also be divided by the California population to show the average or per capita impact on personal income. The increase in personal income growth is estimated to be about $6 per person in 2030 and $11 per person in 2040.

Table E-6: Change in Personal Income Growth

	2020	2025	2030	2035	2040
Personal Income (2018M$)	2,483,138	2,786,816	3,102,269	3,439,395	3,826,616
% Change	0.00%	0.00%	0.02%	0.02%	0.04%
Change (2018M$)	-2	54	470	859	1,397
Personal Income per capita (2018$)	61,362	66,247	71,102	76,213	82,320
% Change	0.00%	0.00%	0.01%	0.01%	0.01%
Change (2018$)	0	1	6	8	11

e. ***Impacts on Gross State Product (GSP)***

Gross State Product (GSP) is the market value of all goods and services produced in California and is one of the primary indicators used to gauge the health of an economy. Under the Proposed ACT Regulation, GSP growth is anticipated to increase by about $438 million in 2030 and decrease by $670 million in 2040 as shown in Table E-7. These changes do not exceed 0.01 percent of baseline GSP.

Table E-7: Change in Gross State Product

	2020	2025	2030	2035	2040
GSP (2018M$)	2,787,689	2,905	3,160	3,459	3,797
% Change	0.00%	0.00%	0.01%	0.01%	0.02%
Change (2018M$)	0	72	438	451	670

f. ***Creation or Elimination of Businesses***

The REMI model cannot directly estimate the creation or elimination of businesses. Changes in jobs and output for the California economy described above can be used to understand some potential impacts. The overall jobs and output impacts of the Proposed ACT Regulation are very small relative to the total California economy, representing changes of less than 0.01 percent. However, impacts to specific industries are larger as described in previous sections. The trend of in decreasing production costs for the truck transportation industry has the potential to result in an expansion or increases in businesses in this industry if sustained over time. While, the decreasing trend in demand for gasoline and diesel fuel following from this Proposed ACT Regulation has the potential to result in a decrease in businesses in this industry if sustained over time.

g. ***Incentives for Innovation***

Staff are proposing incentives for early ZEV sales by allowing credits to be generated from ZEV sales starting in 2021 MY, 3 years prior to the beginning requirements in 2024 MY. Staff anticipates growth in industries that manufacture ZEV technologies, including first and second tier suppliers for manufacturers of ZEVs, which will strengthen the supply chain, and promote technology improvements earlier than they would have otherwise occurred. This growth will help foster and support a self-sustaining medium- and heavy-duty ZEV market.

h. ***Competitive Advantage or Disadvantage***

The Proposed ACT Regulation imposes a sales mandate on large truck manufacturers. These truck manufacturers are headquartered and produce vehicles entirely out-of-state for a national and international market. There are small manufacturing entities in- and out-of-state that would not be required to sell ZEVs in California. Any risk of creating a competitive advantage is mitigated by the 500 vehicle sales threshold. Any small manufacturer that is able to increase sales would become subject to the same ZEV requirements as other large manufacturers.

Early credit generation incentives are proposed to benefit all manufacturing entities, and therefore would not give an explicit competitive advantage or disadvantage to competing manufacturers.

4. Summary and Agency Interpretation of the Assessment Results

The results of the macroeconomic analysis of the Proposed ACT Regulation are summarized in Table E-8. As analyzed here, CARB estimates the Proposed ACT Regulation is unlikely to have a significant impact on the California economy. Overall, the change in the growth of jobs, State GDP, and output is projected to not exceed 0.03 percent of the baseline. The Proposed ACT Regulation results in increased growth in the truck transportation industry in California as fuel savings and LCFS credit generation from the use of ZEVs grow over time. The fuel savings for the truck transportation industry represent decreased demand for gasoline and diesel from the industry, implying a decrease in growth for the industry. This analysis also shows the negative impact estimated for state and local government output and employment due to tax revenue decreases, without any offsetting revenues.

Table E-8: Summary of Macroeconomic Impacts of Proposed ACT Regulation

		2020	2025	2030	2035	2040
GSP	% Change	0.00%	0.00%	0.01%	0.01%	0.02%
	Change (2018M$)	0	72	438	451	670
Personal Income	% Change	0.00%	0.00%	0.02%	0.02%	0.04%
	Change (2018M$)	-2	54	470	859	1,397
Employment	% Change	0.00%	0.00%	0.02%	0.02%	0.03%
	Change in Jobs	-2	725	4,587	5,607	8,065
Output	% Change	0.00%	0.00%	0.01%	0.01%	0.01%
	Change (2018M$)	-1	114	639	496	785
Private Investment	% Change	0.00%	0.00%	0.00%	0.00%	0.00%

	Change (2018M$)	-1	22	175	307	425

F. Alternatives

1. Alternative 1

Alternative 1 is a less stringent ZEV sales requirement than the Proposed ACT Regulation and would apply to the same manufacturers. Under this alternative, three percent of regulated manufacturer sales would need to be ZEVs in Class 2B-7 ramping up to 15 percent in 2030. Class 2B-3 pickup trucks and all Class 8 vehicles would be excluded from the ZEV sales requirement. This alternative would result in fewer ZEV sales compared to the Proposed ACT Regulation, but more ZEVs compared to the baseline scenario. Alternative 1 is based on the original ACT rule proposal presented in April 2017.[115] Table F-1 summarizes the ZEV sales percentage requirements of Alternative 1.

Table F-1. Alternative 1 ZEV Sales Requirement

Model Year	Class 2B-3*	Class 4-7	Class 8
2024	3%	3%	0%
2025	5%	5%	0%
2026	7%	7%	0%
2027	9%	9%	0%
2028	11%	11%	0%
2029	13%	13%	0%
2030 and beyond	15%	15%	0%

*Pickups excluded

Table F-2 shows the assumptions for vehicle groups in the baseline scenario and Alternative 1. The main difference between the assumptions for Alternative 1 and the Proposed ACT Regulation is Alternative 1 does not assume any long range BEVs need to be sold in Class 4-5 and Class 6-7 during the analysis period. Due to the reduced ZEV sales percentage requirements on the manufacturer, they would not need to sell more expensive long range vehicles to meet their requirement.

Table F-2. Alternative 1 Vehicle Groups and Technologies

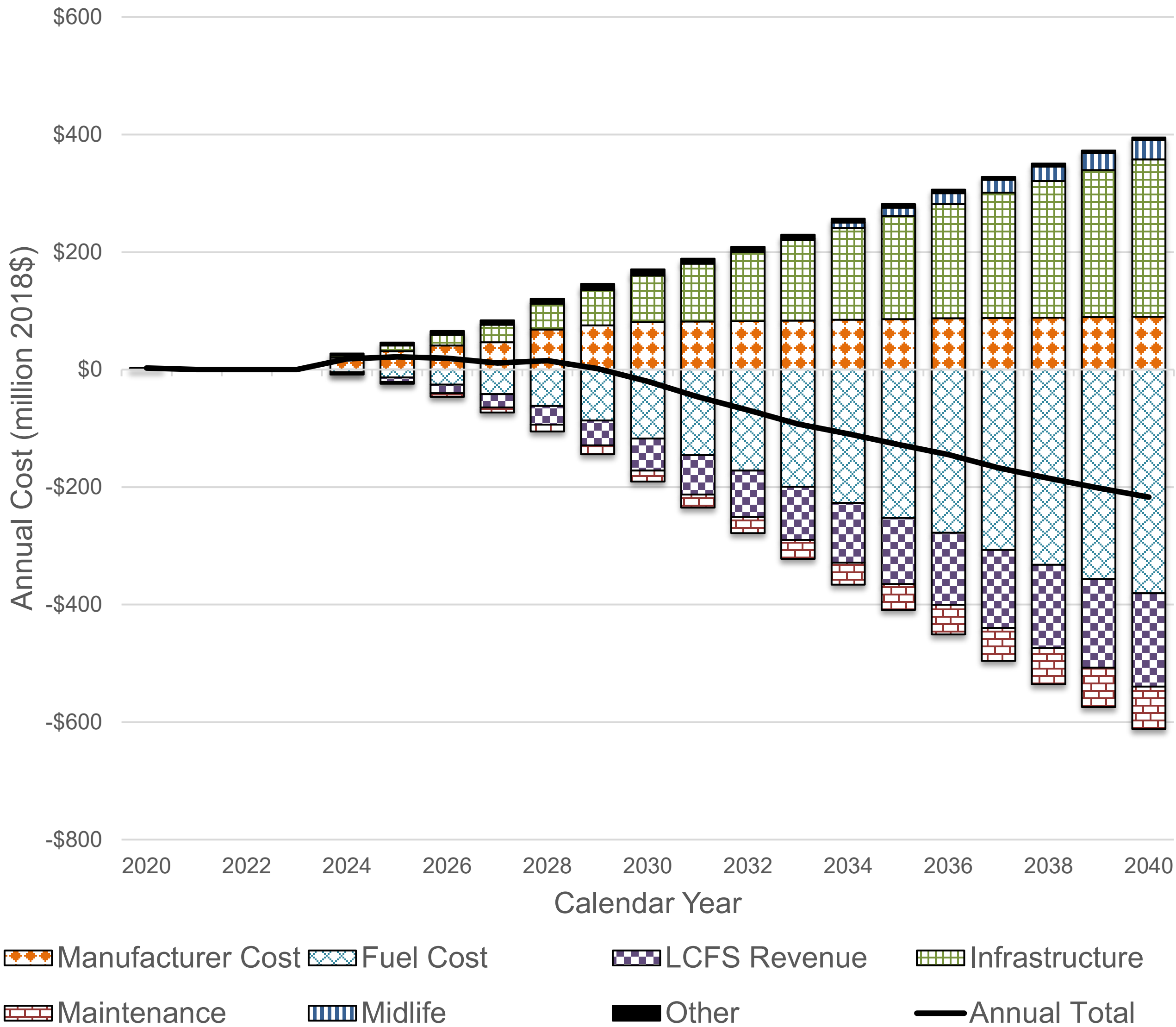
Vehicle Group	Baseline Scenario	Proposal Scenario
Class 2B-3	Gasoline (43%) Diesel (57%)	Battery-electric (All normal range)
Class 4-5	Diesel	Battery-electric (All normal range)
Class 6-7	Diesel	Battery-electric (All normal range)
Class 7 Tractor	Diesel	Battery-electric (90%) Fuel Cell Electric (10%)

115 California Air Resources Board, Advanced Clean Trucks Workshop (web link: https://ww2.arb.ca.gov/sites/default/files/2018-10/170425workshoppresentation.pdf, last accessed June 2019).

a. ***Costs***

Alternative 1 would increase the number of ZEVs sold in California relative to the baseline, but would not deploy as many ZEVs as the Proposed ACT Regulation. This will result in lower costs to California compared to the baseline but increased costs compared to the Proposed ACT Regulation. The cost to the California economy when assuming all costs occur in California would be -$1.3 billion between 2020 and 2040 in Alternative 1 versus the baseline scenario, versus a cost of -$4.8 billion between 2020 and 2040 in the Proposed ACT Regulation versus the baseline. Figure F-1 illustrates the difference in cost between Alternative 1 and the baseline scenario.

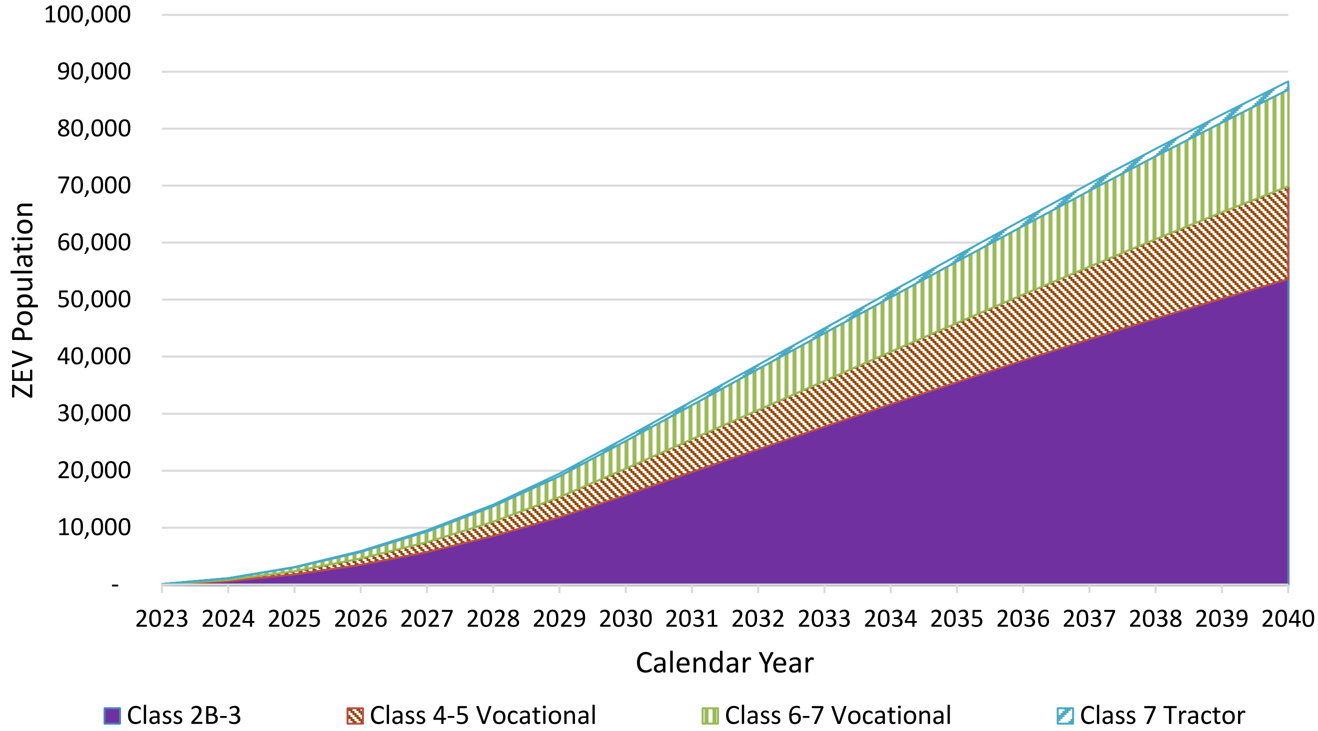
Figure F-1. Alternative 1 Costs Compared to Baseline



b. ***Benefits***

Alternative 1 results in more ZEVs deployed than the baseline scenario providing NOx and $PM_{2.5}$ emission reductions, but less total ZEVs than the Proposed ACT Regulation. Figure F-2 illustrates the ZEV population over time under Alternative 1.

Figure F-2. Alternative 1 ZEV Population Forecast over Time (>8,500 lb. GVWR)



i. Emission Benefits

The ZEVs deployed as a result of Alternative 1 provides NOx and $PM_{2.5}$ benefits compared to the baseline scenario, but results in fewer NOx, $PM_{2.5}$, and GHG benefits compared to the Proposed ACT Regulation. This alternative does not provide any additional GHG emission reductions compared to the baseline because all the required ZEV sales are assumed to be counted towards Phase 2 GHG compliance meaning this alternative does not achieve any additional GHG emissions benefits. Table F-3 summarizes the expected annual NOx, $PM_{2.5}$, and CO_2 reductions in Alternative 1 in 2031 and 2040when compared to the baseline.

Table F-3. Alternative 1 NOx, GHG, and $PM_{2.5}$ Benefits Relative to Baseline

Calendar Year	NOx (tpd)	$PM_{2.5}$ (tpd)	CO_2 (MMT/yr)
2031	1.3	0.05	0
2040	3.5	0.14	0

Figure F-3, Figure F-4, and Figure F-5 show the difference in GHG, NOx, and $PM_{2.5}$ emissions between baseline, Alternative 1, and the Proposed ACT Regulation.

Figure F-3. Projected GHG Emissions under Baseline, Proposed ACT Regulation, and Alternative 1

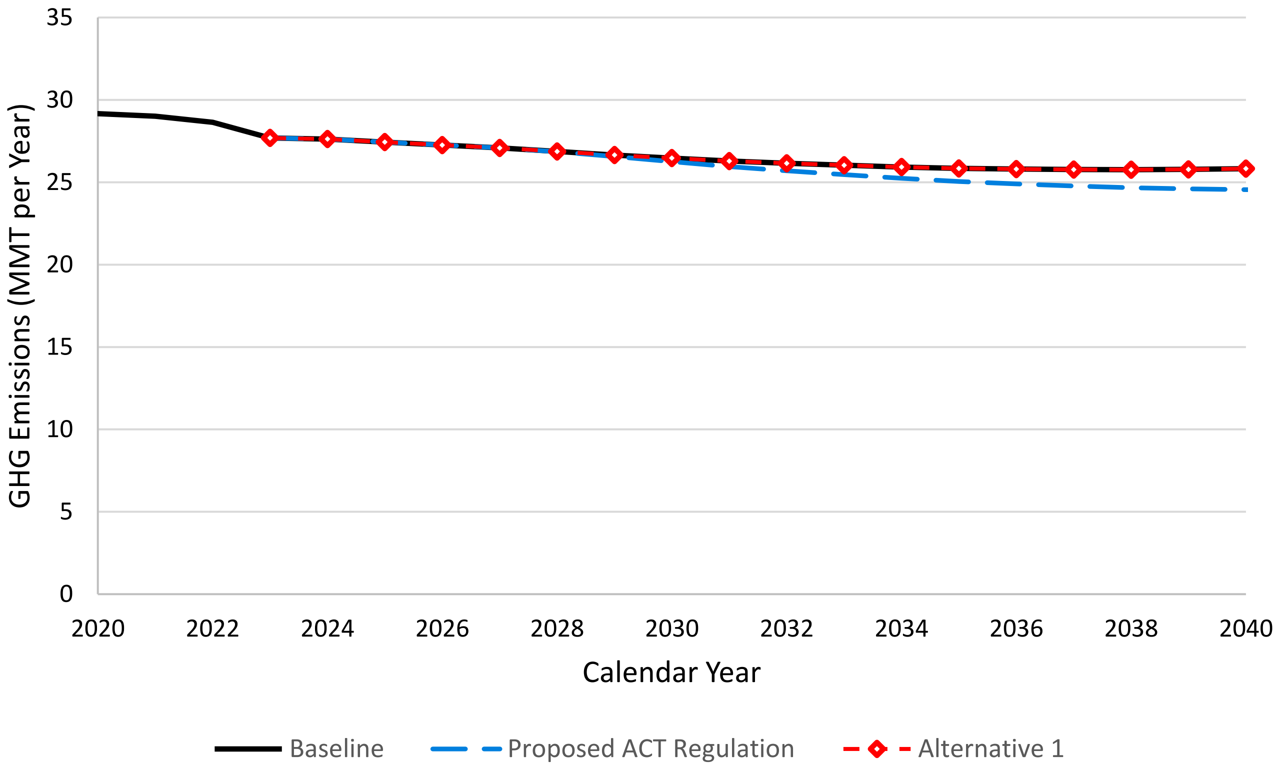


Figure F-4. Projected NOx Emissions under Baseline, Proposed ACT Regulation, and Alternative 1

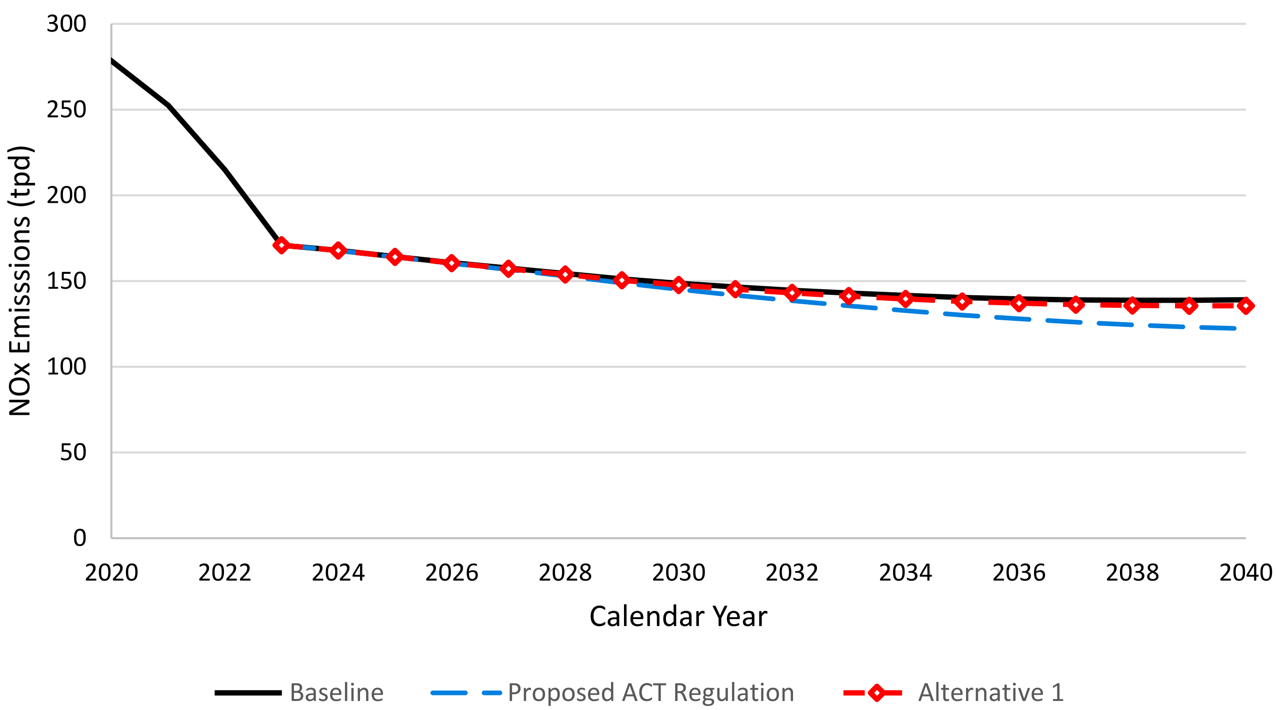
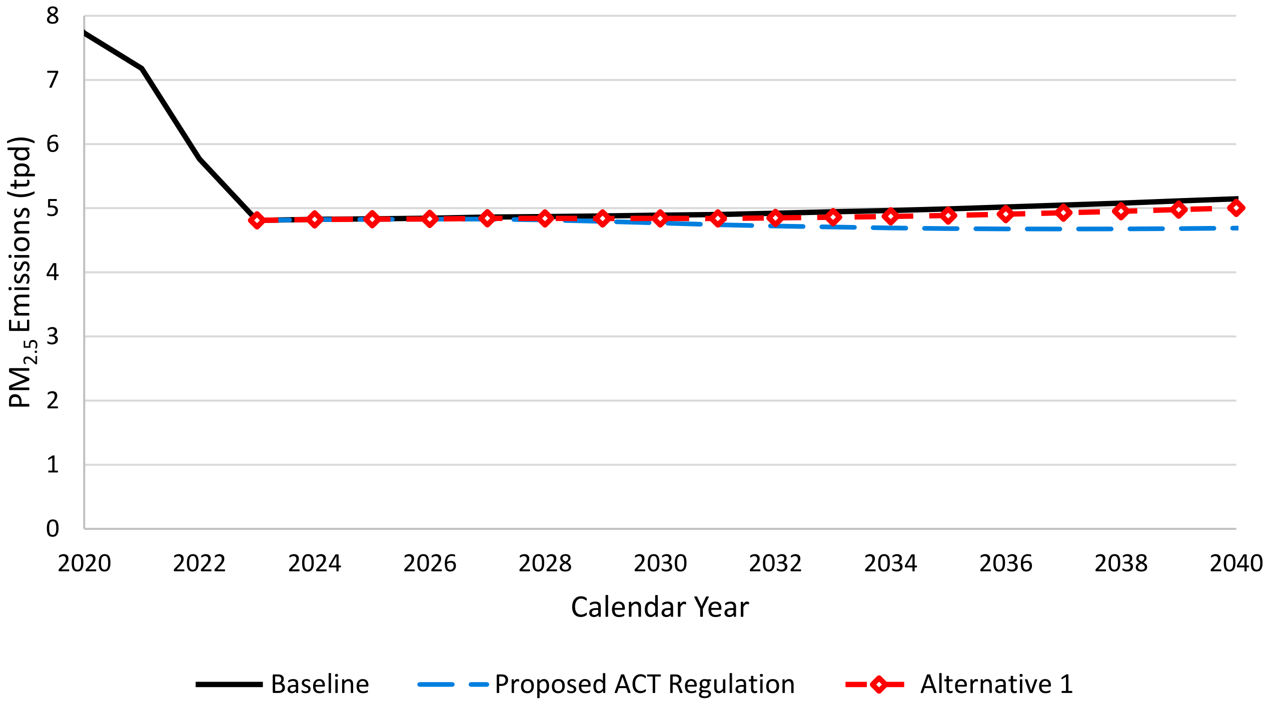


Figure F-5. Projected $PM_{2.5}$ Emissions under Baseline, Proposed ACT Regulation, and Alternative 1



ii. Health Benefits

Alternative 1 results in emission reductions relative to the baseline leading to health benefits as shown in Table F-4. The health benefits are less than those of the Proposed ACT Regulation (Table B-6) due to less emission reductions estimated for this alternative.

Table F-4. Statewide Valuation from Avoided Health Outcomes for Alternative 1

Outcome	Avoided Incidents	Valuation (Million 2018$)
Avoided Premature Mortality	157	$1,483.1
Avoided Cardiovascular Hospitalizations	25	$1.4
Avoided Acute Respiratory Hospitalizations	30	$1.5
Avoided Emergency Room Visits	77	$0.1
Total		**$1,486**

c. *Economic Impacts*

Alternative 1 imposes a less stringent ZEVs sales requirement compared to the Proposed ACT Regulation. This results in lower incremental vehicle cost as passed-through to fleets, but also less Phase 2 GHG cost offsets and lower fuel savings. The macroeconomic impact analysis results are qualitatively similar to the results of the Proposed ACT Regulation, but of a smaller magnitude as shown in Table F-5. Figure F-6 and Figure F-7 show the job and economic impact changes of Alternative 1, respectively.

Table F-5: Change in Growth of Economic Indicators for Alternative 1 Relative to Baseline

		2020	2025	2030	2035	2040
GSP	% Change	0.00%	0.00%	0.00%	0.00%	0.01%
	Change (2018M$)	0	51	137	152	195
Personal Income	% Change	0.00%	0.00%	0.01%	0.01%	0.01%
	Change (2018M$)	-2	36	158	274	412
Employment	% Change	0.00%	0.00%	0.01%	0.01%	0.01%
	Change in Jobs	-2	513	1,498	1,842	2,317
Output	% Change	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	-1	83	190	171	221
Private Investment	% Change	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	-1	14	60	96	122

Figure F-6: Job Impacts of Alternative 1 by Major Sector

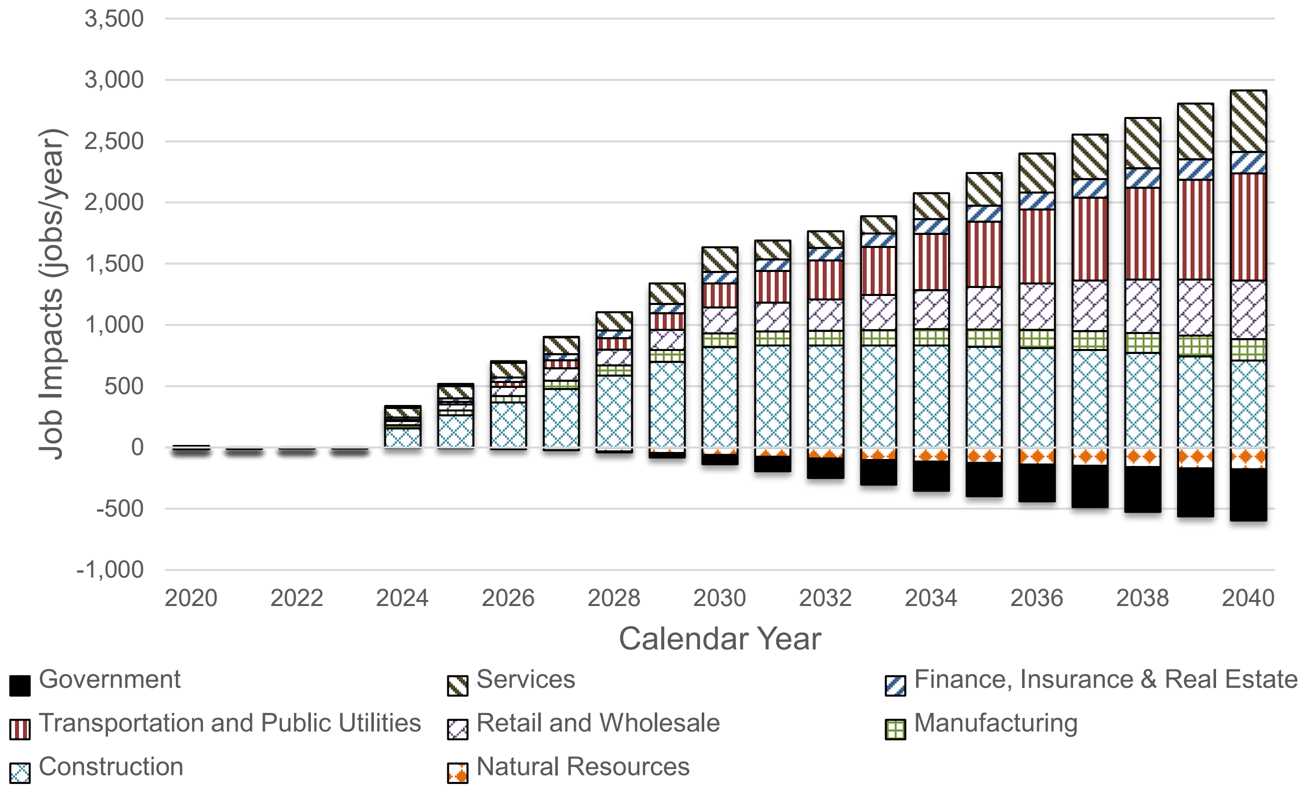
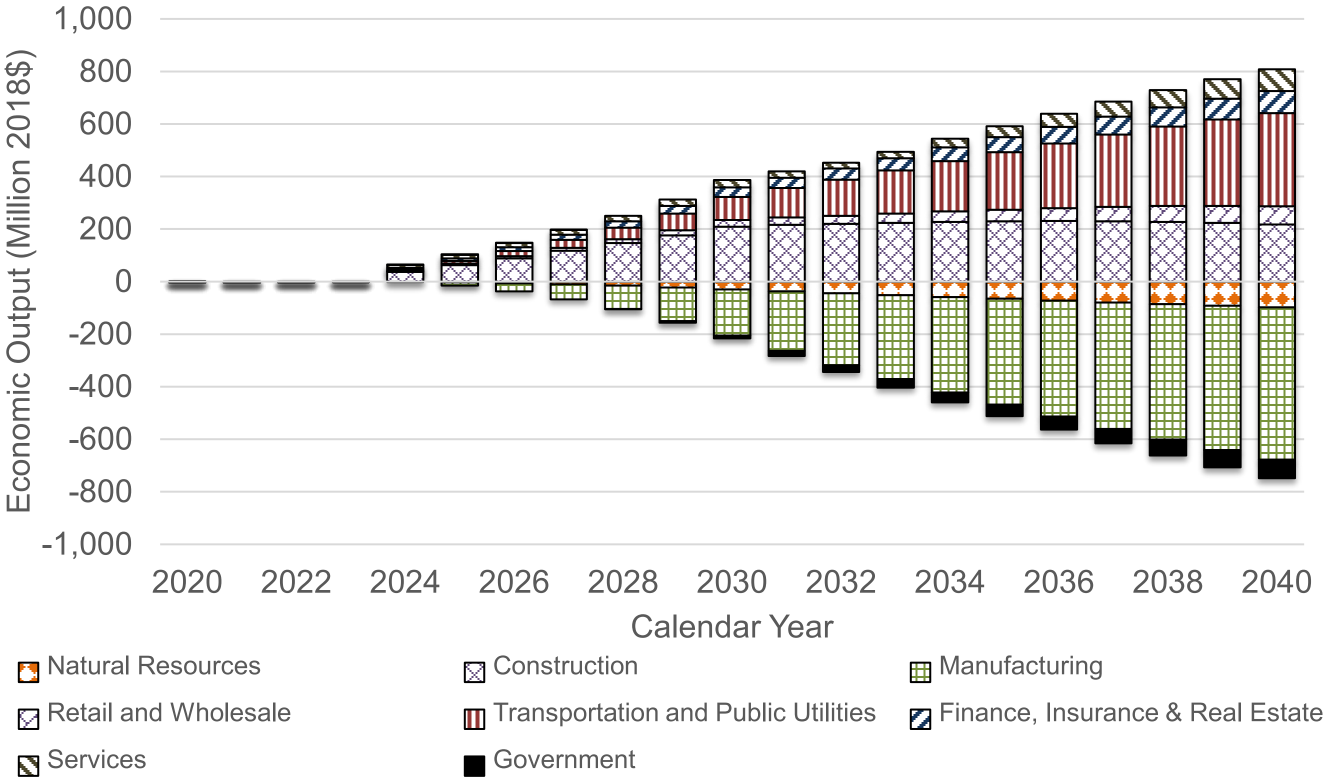


Figure F-7: Changes in Economic Output from Alternative 1 by Major Sector



d. ***Cost-Effectiveness***

Cost-effectiveness is defined as the cost to achieve a ton of emission reduction. In the case of Alternative 1, the total cost from 2024 to 2040 is higher (lower net savings) than the proposed ACT regulation and would achieve less emission reductions. Alternative 1 is a less cost-effective alternative compared to the proposed ACT regulation.

e. ***Reason for Rejecting***

Alternative 1 is rejected because it fails to maximize the number of ZEVs deployed, does not maximize NOx, $PM_{2.5}$, and GHG reductions, and does not adequately foster ZEV market development in California. The Proposed ACT Regulation is identified as a technology-forcing measure in the State SIP Strategy as well as part of the Climate Change Scoping Plan as a necessary component needed to improve California's air quality and achieve the state's climate protection goals.

Alternative 1 does not maximize the number of ZEVs deployed in California as it requires a low amount of ZEVs to be produced and excludes both Class 2B-3 pickup trucks and all Class 8 vehicles. Because of the low number of vehicles deployed, Alternative 1 does not maximize NOx and $PM_{2.5}$ emission reductions which are necessary to meet SIP attainment goals. Alternative 1 does not reduce GHG emissions as its requirements do not exceed the standards already set by Phase 2 GHG, failing to meet the goals of the Climate Change Scoping Plan.

2. Alternative 2

Alternative 2 is a more stringent ZEV sales requirement than the Proposed ACT Regulation and would apply to the same manufacturers. Under this alternative, 15 percent of regulated manufacturer sales would need to be ZEVs in Class 2B-8 ramping up to 40 percent in 2030. Unlike the proposal and Alternative 1, no vehicle types are excluded from the ZEV sales requirement in this scenario. This alternative was proposed by Earthjustice, Union of Concerned Scientists, and Sierra Club in a letter to CARB on March 25th, 2019.[116] Alternative 2 would result in greater zero-emission vehicle sales compared to the baseline and Proposed ACT Regulation.

Table F-6 summarizes the ZEV sales percentage requirements of Alternative 1.

Table F-6. Alternative 2 ZEV Sales Requirement

Model Year	Class 2B-8
2024	15%
2025	20%
2026	24%
2027	28%
2028	32%
2029	36%
2030 and beyond	40%

Table F-7 shows the assumptions for vehicle groups in the baseline scenario and Alternative 2. The main difference between the assumptions for Alternative 2 and the Proposed ACT Regulation is Alternative 2 assumes long range BEVs need to be sold in Class 2B-3 and more fuel cell vehicles would need to be sold in Class 7-8 tractors. Due to the increased ZEV sales percentage requirements on the manufacturer, they would need to sell more capable and expensive longer range vehicles to meet their requirement.

Table F-7. Vehicle Groups and Technologies

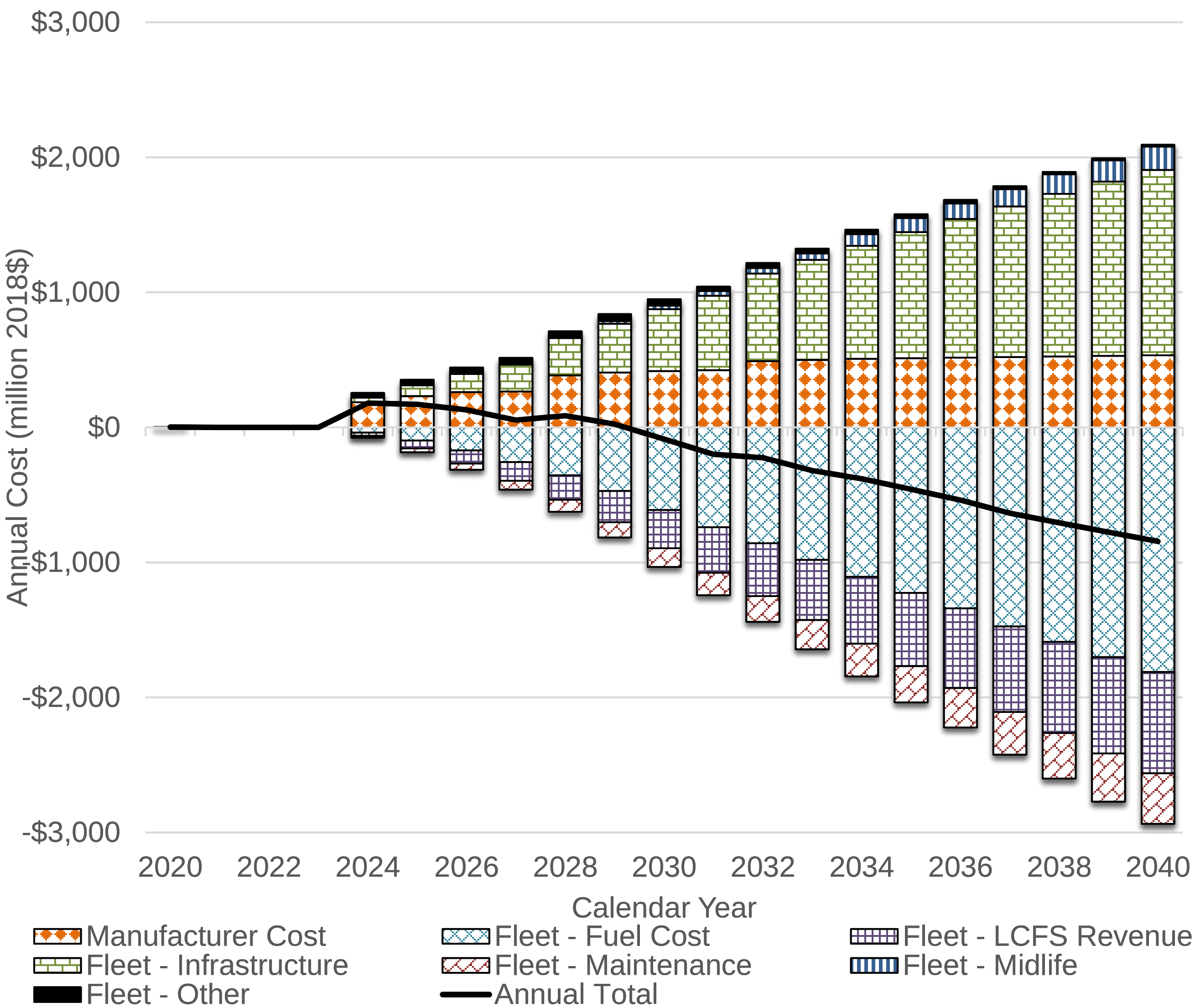
Vehicle Group	Baseline Scenario	Proposal Scenario
Class 2B-3	Gasoline (43%) Diesel (57%)	Battery-electric (50% long range after 2030)
Class 4-5	Diesel	Battery-electric (50% long range after 2030)
Class 6-7	Diesel	Battery-electric (50% long range after 2030)
Class 8	Diesel	Battery-electric (50% long range after 2030)
Class 7-8 Tractor	Diesel	Battery-electric (75%) Fuel Cell Electric (25%)

[116] Cort, Paul; O'Dea, Jimmy; Pingle, Ray, Advanced Clean Truck Rulemaking, 2019.

a. ***Costs***

Alternative 2 would increase the number of ZEVs sold in California relative to the baseline and the Proposed ACT Regulation. This will result in lower costs to California compared to the baseline and the Proposed ACT Regulation. The cost to the California economy when assuming all costs occur in California would be -$4.5 billion between 2020 and 2040 in Alternative 2 versus the baseline scenario, versus a cost of -$4.8 billion between 2020 and 2040 in the Proposed ACT Regulation versus the baseline. Figure F-8 illustrates the difference in cost between Alternative 2 and the baseline scenario.

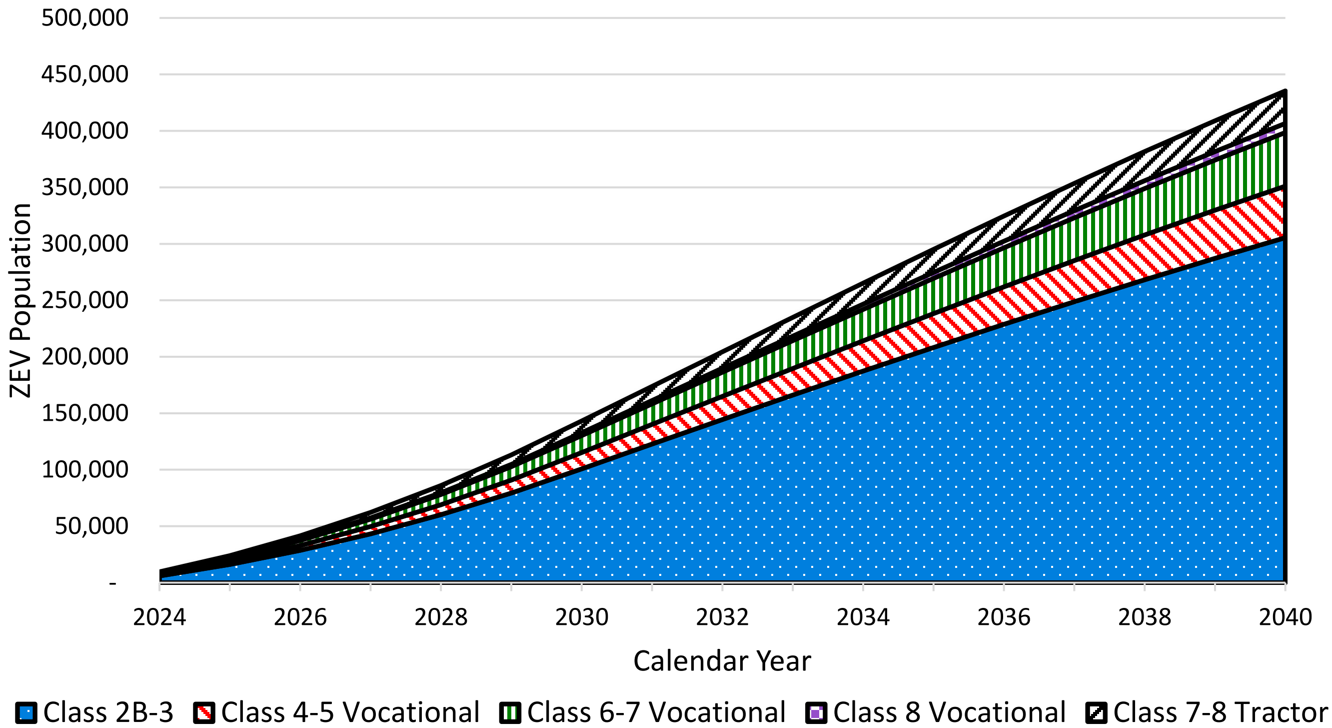
Figure F-8. Alternative 2 Costs Compared to Baseline



b. ***Benefits***

Alternative 2 results in more ZEVs deployed than the baseline scenario and the Proposed ACT Regulation providing NOx, $PM_{2.5}$ and GHG emission reductions. Figure F-9 illustrates the ZEV population over time under Alternative 2.

Figure F-9. Alternative 2 ZEV Population Forecast over Time (>8,500 lb. GVWR)



i. Emission Benefits

Alternative 2 results in greater ZEV deployments compared to the baseline scenario and the Proposed ACT Regulation. These ZEVs will provide NOx, $PM_{2.5}$ and CO_2 benefits compared to both the baseline scenario and the Proposed ACT Regulation. Table F-8 summarizes the expected annual NOx, $PM_{2.5}$, and CO_2 benefits in Alternative 2 in 2031 and 2040.

Table F-8. Alternative 2 NOx, GHG, and $PM_{2.5}$ Benefits Relative to Baseline

Calendar Year	NOx (tpd)	$PM_{2.5}$ (tpd)	CO_2 (MMT/yr)
2031	8.7	0.32	1.16
2040	22.6	0.70	2.78

Figure F-10, Figure F-11, and Figure F-12 represent the difference in GHG, NOx, and $PM_{2.5}$ emissions between baseline and Alternative 2.

Figure F-10. Projected GHG Emissions under Baseline, Proposed ACT Regulation, and Alternative 2

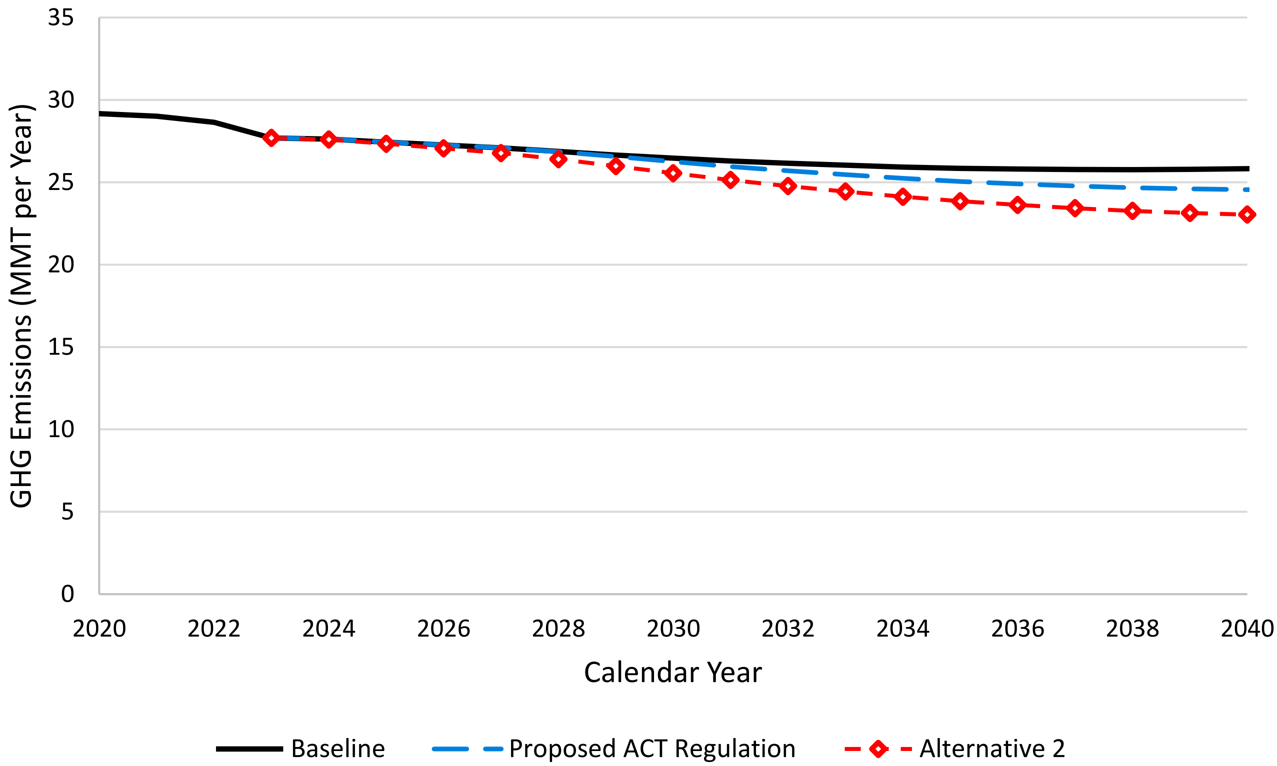


Figure F-11. Projected NOx Emissions under Baseline, Proposed ACT Regulation, and Alternative 2

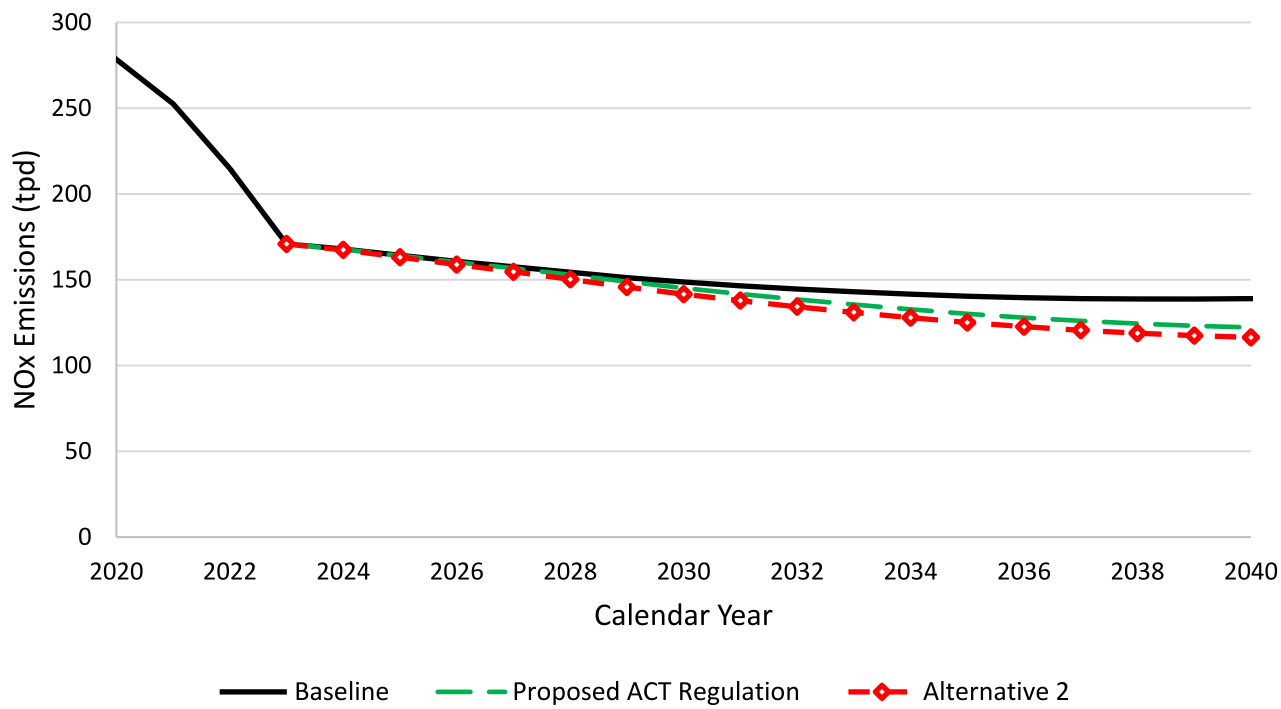
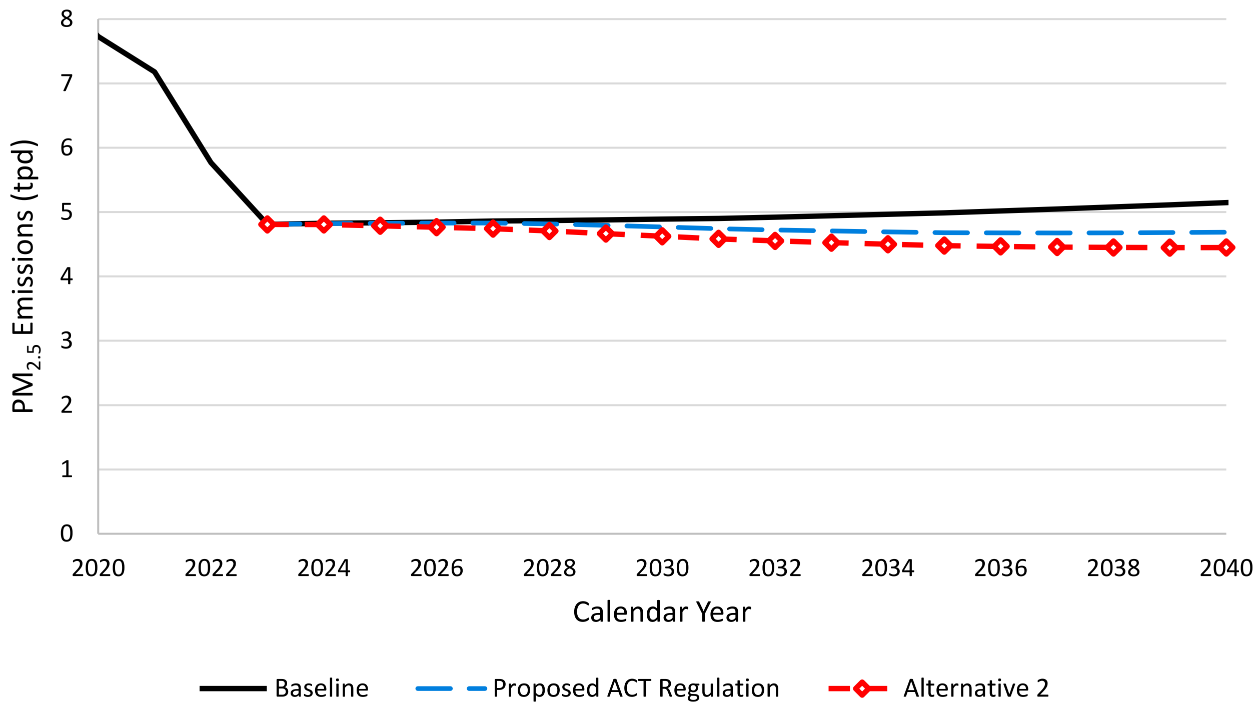


Figure F-12. Projected $PM_{2.5}$ Emissions under Baseline, Proposed ACT Regulation, and Alternative 2



The cumulative GHG emission reductions multiplied by the SC-CO2 values shown in Table B-2 gives a monetary estimate of the benefit of GHG emission reductions from Alternative 2. These benefits range from about $624 million to $2.67 billion through 2040, depending on the chosen discount rate.

ii. Health Benefits

Alternative 2 results in emission reductions relative to the baseline leading to health benefits as shown in Table F-9. The health benefits are greater than those of the Proposed ACT Regulation (Table B-6) due to greater emission reductions estimated for this alternative.

Table F-9. Statewide Valuation from Avoided Health Outcomes for Alternative 2

Outcome	Avoided Incidents	Valuation (Million 2018$)
Avoided Premature Mortality	920	$8,663.7
Avoided Cardiovascular Hospitalizations	143	$8.1
Avoided Acute Respiratory Hospitalizations	171	$8.4
Avoided Emergency Room Visits	442	$0.4
Total		**$8,681**

c. ***Economic Impacts***

Alternative 2 would impose a more stringent ZEVs sales requirement compared to the Proposed ACT Regulation. This results in a greater incremental vehicle cost as passed-through to fleets, but also more Phase 2 GHG cost offsets and more fuel savings. The macroeconomic impacts analysis results shows that this alternative would result in similar impacts to the proposal on employment and output but of a smaller magnitude as displayed in Table F-10. These smaller positive impact appears to result primarily from the greater reduction in gasoline in diesel fuel demand. This reduces output more substantially in the petroleum and coal products manufacturing industry, shown in Figure F-14, and reduces employment more substantially in the public sector as the result of lower tax revenues, shown in Figure F-13.

Table F-10: Change in Growth of Economic Indicators for Alternative 2 Relative to Baseline

		2020	2025	2030	2035	2040
GSP	% Change	0.00%	0.01%	0.01%	0.01%	0.01%
	Change (2018M$)	0	349	464	294	308
Personal Income	% Change	0.00%	0.01%	0.02%	0.03%	0.03%
	Change (2018M$)	-2	226	598	868	1,334
Employment	% Change	0.00%	0.01%	0.02%	0.02%	0.02%
	Change in Jobs	-2	3,529	5,774	5,594	6,615
Output	% Change	0.00%	0.01%	0.01%	0.00%	0.00%
	Change (2018M$)	-1	562	562	62	-43
Private Investment	% Change	0.00%	0.00%	0.00%	0.00%	0.00%
	Change (2018M$)	-1	94	237	331	430

Figure F-13: Job Impacts from Alternative 2 by Major Sector

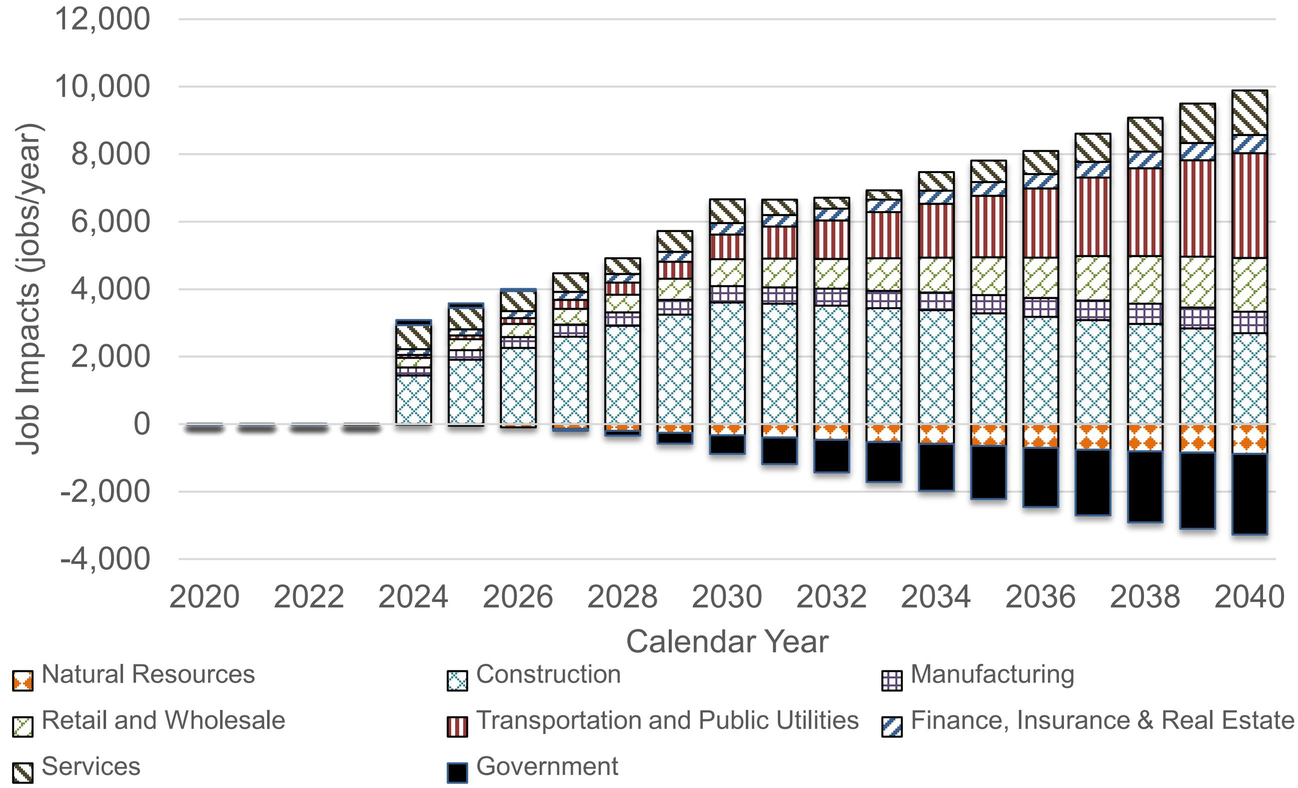
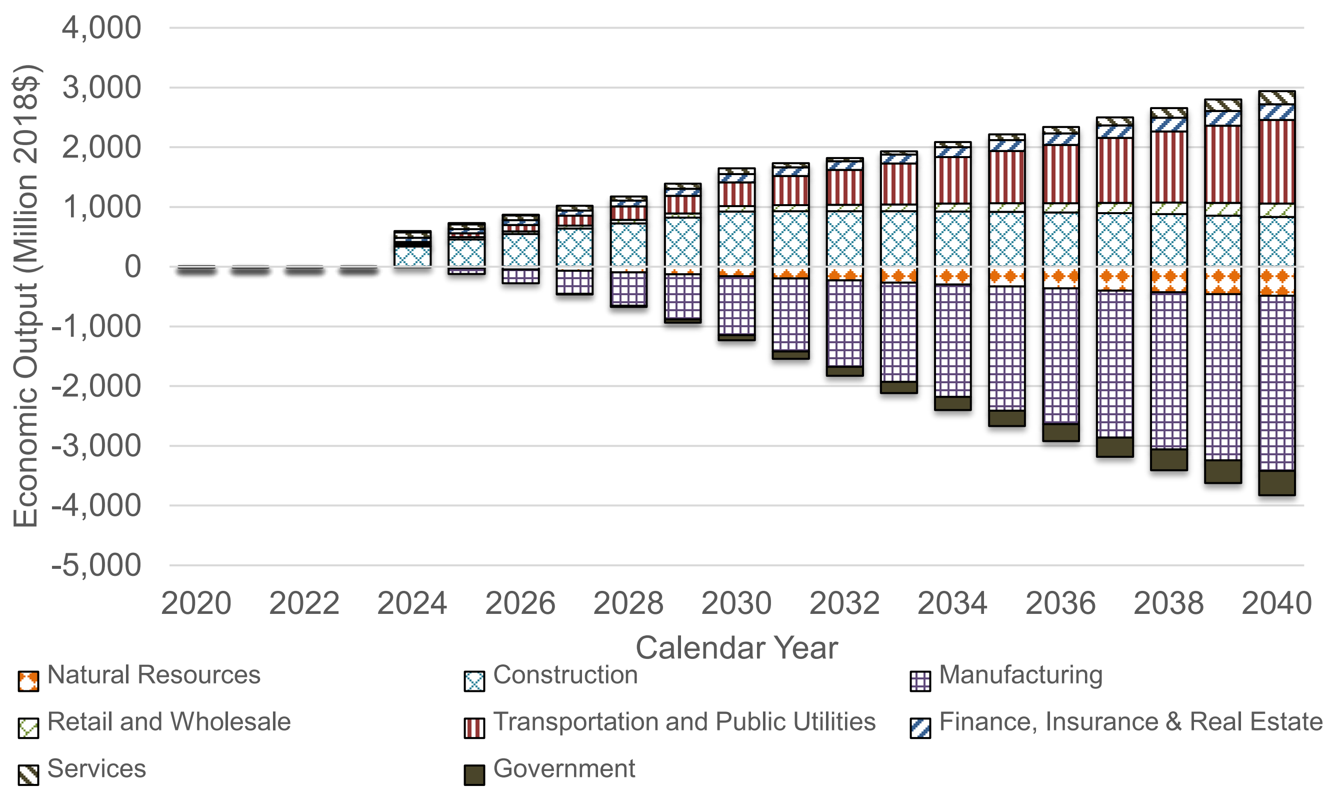


Figure F-14: Change in Economic Output from Alternative 2 by Major Sector



d. ***Cost-Effectiveness***

Cost-effectiveness is defined as the cost to achieve a ton of emission reduction. As Alternative 2 is modeled, the total cost from 2020 to 2040 is slightly higher (lower net savings) than the proposed ACT regulation and would achieve greater emission reductions. Alternative 2 is a more cost-effective alternative compared to the proposed ACT regulation.

e. ***Reason for Rejecting***

Alternative 2 is rejected as the more aggressive timeframe raises questions about feasibility for manufacturers to comply with its requirements. Alternative 2 nearly doubles the cumulative number of ZEVs to be sold between 2020 and 2040 with all of the increased sales occurring in the Class 2B-3 and Class 7-8 tractor categories. The current scarcity of commercial vehicle deployments in these categories present uncertainty in setting future requirements. Both Class 2B-3 and Class 7-8 tractors have increased concerns about payload, range, towing, charging/refueling infrastructure availability which may present barriers to their deployment. Given the greater emissions benefits and greater cost-effectiveness of Alternative 2, staff continues to analyze the rapidly evolving technical progress of these categories to determine if additional stringency is warranted.

G. Health Benefits Methodology Appendix

DRAFT (8/1/2019): Estimating Health Benefits Associated with Reductions in PM and NOx Emissions: Detailed Description

1. Introduction

CARB uses two different methods to estimate the number of adverse health outcomes, including premature death, related to exposure to particulate matter less than or equal to 2.5 μm in diameter (PM2.5). In most cases, CARB uses the *incidence-per-ton* (IPT) methodology to estimate health outcomes from emissions data. The IPT methodology is a simplified procedure that uses pre-calculated results, obtained by running a mathematical health model on a baseline scenario, to compute estimates of the number of cases of adverse health outcomes. In cases where measured or modeled PM2.5 concentrations are available at a high spatial resolution, CARB staff may input them directly into the health model to obtain estimates of health outcomes. This is referred to as *direct estimation*.

2. Overview of the IPT methodology

CARB uses the IPT methodology to quantify the health benefits of regulations and programs that reduce PM2.5 and precursor emissions. It is based on an approach developed by the U.S. Environmental Protection Agency (EPA), as described by Fann et al. (2009, 2012, 2018). The mathematical relationship between changes in emissions and changes in health outcomes is approximately linear. The IPT methodology is based upon this relationship, and makes the following assumptions:

(1) Changes in health outcomes are proportional to changes in PM concentration;
(2) Changes in primary pollutant concentrations are proportional to changes in emissions; and
(3) Changes in secondary pollutant concentrations are approximately proportional to changes in emissions. It should be noted that there may be cases where the relationship between emission of oxides of nitrogen (NOx) and ammonium nitrate aerosol is not linear.

Due to the approximately linear relationship between premature deaths (or other health outcomes) and emission concentrations, the number of premature deaths can be estimated by multiplying emissions by a scaling factor: the *IPT factor*. IPT factors are developed by a applying a health model to measured air pollution concentrations for a baseline period to estimate the number of health outcomes associated with PM2.5 exposure, then dividing by emissions of PM2.5 or a precursor.

Measured or modeled air pollution concentrations, baseline incidence rates, projections of future population size, and a concentration-response function relating changes in PM2.5 exposure to changes in mortality incidence are used to perform calculations.
Current IPT factors were developed from a baseline scenario using air quality data, incidence data and emission inventories for 2014-2016, and age-stratified population projections for 2010 through 2060. IPT factors are calculated separately for each air basin.

IPT factors are currently available for two types of PM: diesel particulate matter (DPM) primarily from on-road sources, and secondary ammonium nitrate formed from NOx. Health effects of primary PM2.5 from sources other than on-road diesel engines are estimated by using IPT factors developed for DPM and multiplied by a relative potency factor, as described below.

In addition to premature mortality from cardiopulmonary causes, CARB currently uses IPT factors to estimate hospitalizations due to cardiovascular and respiratory causes and emergency room visits due to asthma.

Since the total incidence of health effects is proportional to population, results for future years are adjusted by the ratio of the projected population in the target year to the average population in the base years 2014-2016.

3. CARB's health model

CARB's health model is based on the methodology used by US EPA's BenMAP benefits mapping and analysis software [US EPA BenMAP]. CARB developed its own health model in order to overcome limitations of BenMAP, primarily to provide the capacity to handle very large data sets, enable automation of repetitive tasks, and facilitate the incorporation of California-specific data. The health model uses a multi-step process to estimate health impacts from measured or modeled PM2.5 concentrations. These steps are described below.

Estimating exposure from measured concentrations
CARB's health model estimates population-weighed exposure to primary and secondary PM2.5 is from annual concentrations measured at monitors located throughout California. The mortality quantification method requires estimation of exposure between monitors across a geographic area, not only at points where monitors are located. The model uses a well established spatial interpolation method known as inverse distance-squared weighting. Since PM2.5 is emitted directly from sources (primary PM2.5) and also formed from gases that convert to PM2.5 through atmospheric chemical processes (secondary PM2.5), separate exposure estimates are made for each:

- ***Estimating Diesel particulate matter concentrations***

Annual diesel particulate matter (DPM) concentrations are not measured directly. Rather, they are estimated indirectly from annual average NOx concentrations by multiplying them by air basin and year-specific DPM/NOx emission ratios computed from CARB emission inventories.

The emissions and air quality used to perform this calculation are tabulated in the appendix. The methodology and its rationale is described in greater detail in CARB 2010a and Propper et al., 2015. DPM concentrations were estimated at 106 monitors located throughout the state. In order for an annual NOx average to be considered valid, the data were required to be at least 75% complete.

- ***Estimating secondary ammonium nitrate concentrations***

In addition to DPM, CARB computes health impacts for secondary ammonium nitrates PM2.5 formed in the atmosphere from NOx by chemical processes. To estimate ammonium nitrate PM2.5 exposure, CARB staff use speciated PM2.5 nitrate ion (NO_3^-) concentration data from two sources: the air quality monitoring network maintained by CARB and local air quality districts, and the IMPROVE visibility network (IMPROVE Visibility Network).

CARB and air pollution control districts operate a network of PM2.5 monitors around the state, mostly in urban areas (ARB AQMN). PM2.5 samples are collected as 24-hour filter samples, once every 3-6 days. Samples from some monitors are further analyzed to determine the concentration of nitrate ion and other constituents. During 2014-2016, nitrate data were available from 18 urban monitors. Data for these monitors are retrieved from ARB's ADAM air quality database (ARB ADAM).

In addition to the urban monitors, the national IMPROVE visibility network operated 20 PM2.5 nitrate ion monitor during 2014-2016, mainly in national parks and other remote locations (IMPROVE Visibility Network). These instruments collect one sample every three days. IMPROVE data are retrieved from the project web site (IMPROVE Visibility Network).

Daily samples were aggregated by monitor to obtain annual averages. In order for an annual average to be considered valid, the data were required to be at least 75% complete. To convert from nitrate ion concentration to ammonium nitrate (NH_4NO_3) concentration, the annual averages were multiplied by the ratio of the molecular weight of ammonium nitrate to that of the nitrate ion.

Prior to May, 2019 CARB used PM10 nitrate data instead of more accurate PM2.5 nitrate data to estimate ammonium nitrate aerosol concentrations to compute health impacts. This is because speciated PM10 data was available for more locations than speciated PM2.5, and better reflected the spatial variability in ammonium concentrations across California. However, the number of monitors in the speciated PM10 network has shrunk and is now comparable in size and coverage to the speciated PM2.5 network. Therefore, as of May, 2019 CARB uses PM2.5 nitrate data to compute impacts instead. The PM2.5 nitrate monitors are more accurate because they store the filters in a refrigerated compartment, and less of the sample is lost to volatilization. Consequently, the estimated PM2.5 nitrate concentrations and associated IPT factors for NOx emissions are approximately 50% higher than those used prior to May, 2019.

Estimating exposure using from modeled concentrations

The health model can also be run with concentrations derived from an air quality model as input. Air quality models include dispersion models, which model how pollutants are dispersed by the wind, and photochemical models, which are more elaborate and capture the effects of sunlight, temperature, chemical reactions and other physical processes on pollutants. Dispersion models are only used for primary pollutants, as they are not capable of modeling formation of secondary pollutants. Air quality models generate gridded results, with grid cells typically in the range of 500-2,000m square.

Population projections at the census tract level

CARB's health model uses age-resolved population data at the census tract level, for the 2010 Census, obtained from the U.S. Census Bureau (U.S. Census Bureau). These were projected to 2011-2060 using age-resolved county population projections from the California Department of Finance (CDOF).

Age-specific growth factors for each county, for each year, were computed from the CDOF projections by dividing each county population for the target year by the average county population for the base years 2014-2016. These growth factors were applied to each census tract in the county, for each age group separately. Population was projected for five-year age groups 0-4 through 80-84, and for age 85 and older.

This method of projection reflects growth in overall county population, but does not model changes in population distribution within counties, such as expansion of urban areas into surrounding rural land.

Estimating baseline incidence

CARB's health model uses incidence data for cardiopulmonary mortality extracted from the Center of Disease Control (CDC) Wonder database. Incidence data for hospitalizations for cardiovascular and respiratory causes, and emergency room visits for asthma are taken from US EPA BenMAP benefits mapping software (US EPA BenMAP).

Baseline incidence rates vary by age bracket. Incidence was estimated separately for five-year age groups 0-4 through 80-84, and for age 85 and older.

Mortality incidence data are county-specific. Incidence data for other health outcomes is uniform throughout California.

Baseline incidence of mortality, hospitalizations and emergency room visits is tabulated in the appendix.

Estimating health outcomes using a concentration-response function

CARB's health model estimates the incidence of premature death and other health outcomes at each census tract or modeling grid cell by an equation

$$\text{Incidence} = [\text{population}]_i \times [\text{baseline incidence}]_i \times [\,1 - \exp(-\beta \times \text{PM2.5})\,]$$

where the subscript *i* indexes the age groups. The incidence is summed over age groups to obtain the total incidence for the census tract. The coefficient β is taken from one of the health studies discussed below.

The specific form of this equation is determined by the type of statistical model used by the health studies to model the relationship between PM2.5 exposure and health risk. All the studies selected by CARB use a so-called log-linear relationship, so all the equation for the incidence takes the form shown above.

CARB draws upon health studies used by the U.S. EPA for its risk assessments (US EPA 2010). CARB uses a subset of the endpoints used by U.S. EPA, chosen on the basis of their strength and robustness. For premature mortality, CARB uses the cardiopulmonary mortality risk coefficient for the 1999-2000 time period from Krewski et al., 2009, among the largest studies of its kind, with 360,000 participants. For cardiovascular and respiratory hospitalizations, CARB used Bell et al., 2008, and for emergency room visits for asthma CARB used Ito et al., 2007.

The process for selecting these studies was described in detail in CARB's 2010 PM2.5 mortality report (CARB 2010b).

Aggregating health outcomes by air basin

To aggregate results from census tracts to larger geographical subdivisions such as counties or air basins, CARB's health model uses a geospatial technique called areal interpolation. Areal interpolation is a procedure for translating spatial data from one set of geographical subdivisions to another when the boundaries do not exactly overlap. Numerous variants of the technique exist, but for the purpose of this analysis the simplest form, which uses area of polygon intersection, was employed (Goodchild and Lam, 1980, Flowerdew and Green, 1994). The precision of this method depends on the size of the geographical subdivisions and the spatial homogeneity of the quantity being apportioned. In urban areas, where census tracts are small and population is distributed more evenly, areal interpolation to larger subdivisions such as air basins yields relatively precise estimates. In rural areas where the population is distributed unevenly over large census tracts, estimates are less precise.

4. Computing IPT factors From health outcomes and emissions

IPT factors are computed separately for each air basin. To compute IPT factors for DPM, the estimates incidence of premature death or other health outcomes associated with DPM exposure for the baseline years is divided by DPM emissions for each air basin. To compute IPT factors for secondary ammonium nitrate, incidence is divided by emissions of the precursor, NOx.

Health benefit calculations using IPT factors

To estimate the reduction in health outcomes associated with reductions in DPM and NOx from a regulation, the change in emissions is multiplied by IPT factor. This value is then multiplied by the ratio of the projected target year population with the 2014-2016 average population to adjust for population growth.

5. Uncertainty in health impact estimates

This methodology is well-established and includes up-to-date information. However, there are uncertainties in the underlying data and assumptions:

- *Air quality data is subject to natural variability from meteorological conditions, local activity, etc.*
- *The assumption that changes in concentrations of pollutants are proportional to changes in emissions of those pollutants or their precursors is an approximation. There may be cases where actual changes in concentrations are higher or lower than predicted.*
- *The estimation of DPM concentrations and DPM/NOx emission ratios is subject to uncertainty. Emissions are reported at an air basin resolution, and do not capture local variations.*
- *Inverse distance-squared weighting, the spatial interpolation method is used to estimate concentrations each census tract. Compared with other geospatial estimation methods such as Kriging, inverse distance-squared interpolation has the virtue of simplicity, and does not require selection of parameters. When data are abundant, most simple interpolation techniques give similar results (Jarvis et al., 2001). All geospatial estimation techniques exhibit greater uncertainty when data points are sparser, and uncertainty increases with distance from the nearest data points.*
- *Future population estimates are subject to increasing uncertainty as they are projected further into the future. For reasons of computational efficiency, the spatial resolution of population estimates is limited to census tract resolution.*
- *Observed baseline incidence rates change over time, and are subject to random year-to-year variation and systematic shifts as population characteristics and medical treatments evolve. Sample size requirements necessitate estimating baseline incidence rates at large geographic scales, state or county.*
- *Relative risks in the concentration response function are estimated with uncertainty and reported as confidence ranges.*

6. Relative potency factors for non on-road diesel sources

To quantify the health benefits of reductions in primary PM2.5 from sources other than on-road diesel vehicles, CARB uses IPT factors developed for DPM and multiplies the results by a relative potency factor specific to the source and location of the emissions.

Relative potency may be determined in several ways, including but not limited to

- *The ratio of the Intake Fraction of the source to the Intake Fraction for DPM. The Intake Fraction is a measure of the fraction of the emissions from a given source that is inhaled by the receptor population. It is specific to a source and a location; e.g., a particular type of facility in a given air basin.*
- *Comparison of IPT results with direct estimation results for the same scenario. The ratio of the results obtained by the two methods may then be used to adjust the results obtained by IPT factors in a larger setting. For example, the ratio of results obtained by IPT and direct estimation for one air basin may be used to adjust results for other air basins.*
- *General consideration of conditions under which emissions take place. For example, if an on-road vehicle delivers goods from a facility in a remote location to a facility located in an urban area, half of idling emissions may be considered to occur far from receptor populations. Hence an adjustment factor of 0.5 may be appropriate for computing the health benefits of reducing idling emissions.*

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H. Macroeconomic Appendix

Table H-1 REMI Inputs for the Proposed ACT Regulation (Million 2016$)

REMI Policy Variable	REMI Industry /Spending Category	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Production Costs	Truck transportation	2.1	-	-	0.0	(0.1)	(4.7)	(12.1)	(17.9)	(30.6)	(65.1)	(126.4)	(184.6)	(216.3)	(276.0)	(329.5)	(395.5)	(460.9)	(548.1)	(598.7)	(642.9)	(675.8)
Exogenous Final Demand	Electric power generation, transmission and distribution	-	-	-	-	6.6	15.8	27.5	48.9	82.6	130.5	192.6	255.1	315.3	372.9	428.6	481.5	530.9	577.3	619.7	658.1	693.3
Exogenous Final Demand	Construction	-	-	-	-	40.1	58.1	77.4	166.6	240.4	324.4	411.2	417.6	423.0	426.6	430.1	430.1	427.9	423.2	417.8	411.1	403.5
Exogenous Final Demand	Other electrical equipment and component manufacturing	-	-	-	-	21.6	30.4	40.3	83.0	128.2	181.7	238.4	248.8	259.4	269.5	280.1	289.2	296.7	302.8	308.6	313.5	318.0
Exogenous Final Demand	Petroleum and coal products manufacturing	-	-	-	-	(17.8)	(43.0)	(75.3)	(134.8)	(228.1)	(361.4)	(538.3)	(713.8)	(883.4)	(1,053.1)	(1,220.3)	(1,379.4)	(1,532.4)	(1,690.6)	(1,832.9)	(1,968.6)	(2,098.5)
Exogenous Final Demand	Basic chemical manufacturing	-	-	-	-	-	-	-	0.8	1.7	2.6	3.7	4.8	5.9	6.9	7.9	8.8	9.6	10.4	11.1	11.7	12.3
Exogenous Final Demand	Office administrative services; Facilities support services	2.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Exogenous Final Demand	Educational services; private	-	-	-	-	1.0	1.3	1.5	3.2	4.2	5.2	6.0	-	-	-	-	-	-	-	-	-	-
Exogenous Final Demand	Automotive repair and maintenance	-	-	-	-	(2.7)	(6.5)	(11.3)	(19.4)	(32.5)	(51.0)	(75.0)	(98.7)	(107.	(126.	(131.	(144.	(159.	(178.	(171.	(158.	(136.
Industry Sales	Electrical equipment manufacturing	-	-	-	-	1.6	2.0	2.5	5.1	6.8	8.4	9.7	9.8	11.5	11.7	11.9	12.1	12.2	12.2	12.3	12.4	12.5

REMI Policy Variable	REMI Industry /Spending Category	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Industry Sales	Motor vehicle parts manufacturing	-	-	-	-	(0.2)	(0.2)	(0.3)	(0.8)	(0.3)	(0.3)	(0.4)	(0.4)	(0.4)	(0.4)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)	(0.5)
Consumer Spending	Hospitals	-	-	-	-	(0.0)	(0.0)	(0.0)	(0.1)	(0.1)	(0.2)	(0.3)	(0.4)	(0.5)	(0.6)	(0.8)	(0.9)	(1.0)	(1.1)	(1.3)	(1.4)	(1.5)
Government Spending	State	(0.5)	(0.3)	(0.3)	(0.3)	(1.0)	(3.6)	(7.0)	(12.5)	(21.4)	(36.9)	(59.6)	(82.2)	(102.	(124.	(146.	(167.	(188.	(209.	(229.	(247.	(265.
Government Spending	Local	0.1	-	-	0.0	1.2	1.1	0.7	1.6	2.7	0.9	(3.2)	(8.1)	(10.6)	(15.6)	(20.3)	(25.3)	(30.3)	(36.4)	(40.9)	(45.2)	(49.0)
Government Employment (jobs)	State	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

Table H-2 REMI Inputs for the Alternative 1 (Million 2016$)

REMI Policy Variable	REMI Industry /Spending Category	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Production Costs	Truck transportation	2.1	-	-	0.0	1.4	0.0	(3.5)	(9.8)	(15.0)	(25.7)	(43.4)	(58.9)	(71.2)	(89.2)	(103.1)	(118.9)	(134.1)	(153.9)	(169.1)	(183.4)	(196.8)
Exogenous Final Demand	Electric power generation, transmission and distribution	-	-	-	-	3.5	9.7	18.1	28.6	41.6	57.1	75.1	92.9	109.5	125.1	140.1	154.2	167.4	179.9	191.3	201.4	210.6
Exogenous Final Demand	Construction	-	-	-	-	25.2	42.7	60.8	80.6	101.4	122.5	144.6	148.2	150.1	151.6	152.6	152.1	151.8	150.1	147.8	144.7	140.9
Exogenous Final Demand	Other electrical equipment and component manufacturing	-	-	-	-	11.0	19.1	27.8	37.3	47.3	57.6	68.4	71.4	74.1	77.1	80.5	83.4	86.6	89.1	91.3	93.0	94.3
Exogenous Final Demand	Petroleum and coal products manufacturing	-	-	-	-	(9.4)	(26.0)	(49.4)	(78.6)	(114.2)	(157.3)	(208.4)	(257.9)	(304.4)	(350.4)	(395.4)	(437.9)	(479.0)	(522.3)	(560.7)	(597.3)	(632.0)
Exogenous Final Demand	Basic chemical manufacturing	-	-	-	-	0.1	0.1	0.2	0.4	0.5	0.6	0.8	0.9	1.1	1.2	1.3	1.4	1.5	1.5	1.6	1.7	1.8
Exogenous Final Demand	Office administrative services; Facilities support services	2.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Exogenous Final Demand	Educational services; private	-	-	-	-	0.6	1.0	1.2	1.5	1.7	1.9	2.0	-	-	-	-	-	-	-	-	-	-
Exogenous Final Demand	Automotive repair and maintenance	-	-	-	-	(1.4)	(3.8)	(7.3)	(11.7)	(17.0)	(22.7)	(29.6)	(36.2)	(42.5)	(48.4)	(48.3)	(49.7)	(51.2)	(54.1)	(56.0)	(57.3)	(58.1)
Industry Sales	Electrical equipment manufacturing	-	-	-	-	1.0	1.5	2.0	2.4	2.8	3.1	3.3	3.3	3.4	3.4	3.5	3.5	3.6	3.6	3.6	3.6	3.7
Industry Sales	Motor vehicle parts manufacturing	-	-	-	-	(0.1)	(0.2)	(0.2)	(0.3)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)

REMI Policy Variable	REMI Industry /Spending Category	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Consumer Spending	Hospitals	-	-	-	-	(0.0)	(0.0)	(0.0)	(0.0)	(0.1)	(0.1)	(0.1)	(0.1)	(0.1)	(0.2)	(0.2)	(0.2)	(0.3)	(0.3)	(0.3)	(0.3)	(0.4)
Government Spending	State	1.6	(0.3)	(0.3)	(0.3)	(0.6)	(2.0)	(4.2)	(7.4)	(10.6)	(15.3)	(21.4)	(27.0)	(32.4)	(37.8)	(43.0)	(48.0)	(52.9)	(57.9)	(62.5)	(66.9)	(71.0)
Government Spending	Local	-	-	-	-	0.7	0.9	0.9	0.7	1.0	0.5	(0.2)	(1.1)	(1.9)	(2.7)	(3.5)	(4.3)	(5.1)	(6.0)	(6.8)	(7.5)	(8.3)
Government Employment (jobs)	State	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

Table H-3 REMI Inputs for the Alternative 2 (Million 2016$)

REMI Policy Variable	REMI Industry /Spending Category	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Production Costs	Truck transportation	2.1	-	-	0.1	24.2	20.7	6.6	(19.5)	(30.1)	(61.0)	(134.8)	(188.5)	(211.2)	(267.9)	(302.6)	(355.4)	(411.4)	(496.7)	(559.2)	(621.6)	(682.3)
Exogenous Final Demand	Electric power generation, transmission and distribution	-	-	-	-	29.9	72.2	121.8	176.5	239.0	310.2	389.2	467.5	541.2	610.5	677.4	740.3	798.7	853.5	902.8	946.6	986.0
Exogenous Final Demand	Construction	-	-	-	-	232.9	315.4	383.7	452.4	522.9	593.9	666.9	669.8	672.1	671.2	670.0	663.7	654.0	640.7	625.1	606.7	586.9
Exogenous Final Demand	Other electrical equipment and component manufacturing	-	-	-	-	104.5	146.8	184.9	224.3	265.6	308.1	353.1	367.0	382.4	396.1	411.2	423.0	432.7	440.3	446.5	450.7	454.1
Exogenous Final Demand	Petroleum and coal products manufacturing	-	-	-	-	(81.9)	(199.4)	(339.8)	(497.4)	(674.5)	(878.3)	(1,112.0)	(1,337.1)	(1,550.0)	(1,762.2)	(1,971.4)	(2,168.9)	(2,357.9)	(2,557.2)	(2,732.2)	(2,898.5)	(3,056.6)
Exogenous Final Demand	Basic chemical manufacturing	-	-	-	-	3.6	8.2	13.4	18.8	24.6	30.6	36.7	43.4	49.8	55.9	61.8	67.2	72.1	76.5	80.4	83.8	86.7
Exogenous Final Demand	Office administrative services; Facilities support services	2.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Exogenous Final Demand	Educational services; private	-	-	-	-	5.9	7.4	8.3	9.0	9.6	10.1	10.4	-	-	-	-	-	-	-	-	-	-
Exogenous Final Demand	Automotive repair and maintenance	-	-	-	-	(10.8)	(26.2)	(44.5)	(65.4)	(89.0)	(95.4)	(119.	(139.	(160.	(179.	(168.	(174.	(186.	(197.	(202.	(207.	(212.
Industry Sales	Electrical equipment manufacturing	-	-	-	-	9.5	11.8	13.3	14.5	15.6	16.5	17.2	17.4	20.0	20.2	20.6	20.8	21.0	21.2	21.3	21.5	21.7
Industry Sales	Motor vehicle parts manufacturing	-	-	-	-	(1.3)	(1.5)	(1.7)	(2.3)	(0.6)	(0.7)	(0.7)	(0.8)	(0.8)	(0.8)	(0.8)	(0.8)	(0.8)	(0.8)	(0.8)	(0.8)	(0.8)

REMI Policy Variable	**REMI Industry /Spending Category**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**	**2026**	**2027**	**2028**	**2029**	**2030**	**2031**	**2032**	**2033**	**2034**	**2035**	**2036**	**2037**	**2038**	**2039**	**2040**
Consumer Spending	Hospitals	-	-	-	-	(0.0)	(0.1)	(0.1)	(0.2)	(0.3)	(0.4)	(0.6)	(0.7)	(0.9)	(1.0)	(1.2)	(1.3)	(1.5)	(1.6)	(1.8)	(1.9)	(2.1)
Government Spending	State	(0.5)	(0.3)	(0.3)	(0.3)	(2.1)	(13.8)	(29.5)	(48.6)	(66.5)	(92.1)	(125.	(154.	(179.	(206.	(233.	(259.	(284.	(311.	(334.	(357.	(378.
Government Spending	Local	0.1	-	-	0.0	7.8	8.2	7.1	4.4	6.1	1.9	(4.7)	(10.7)	(13.0)	(18.6)	(23.4)	(28.7)	(34.0)	(40.9)	(46.3)	(51.7)	(56.9)
Government Employment (jobs)	State	1.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0

Errata to Advanced Clean Trucks Standardized Regulatory Impact Analysis

1) The cumulative NOx and PM2.5 emission reductions shown on page 14 are erroneous because they are based on benefits from 2020 to 2050, not 2020 to 2040 as written in the text. The correct emission benefit numbers for 2020 to 2040 cumulative emissions are 36,770 tons of NOx and 1,092 tons of $PM_{2.5}$.

2) The cumulative GHG emission reductions shown on page 17 are erroneous because they do not account for the difference between short tons and metric tons. The correct emission benefit numbers for 2020 to 2040 cumulative emissions is 9.6 MMT CO_2e

3) To better follow CARB guidelines on references, Reference 52 is replaced with the following: California Air Resources Board, Class 4-5/6-7 Population Analysis, 2019.

4) To better follow CARB guidelines on references, References 58-62 are replaced with the following: California Air Resources Board, New Vehicle Prices, 2019.

5) Figures have been graphically edited to better comply with the American with Disabilities Act of 1990, the Rehabilitation Act of 1973, and Assembly Bill 434 (2017). The content contained within figures has not changed from what was originally submitted to Department of Finance on August 8, 2019.

Advanced Clean Trucks Compliance and Incentives Update

CATEGORIES

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Do truck manufacturers need to sell zero-emission vehicles (ZEVs)?

Yes, starting with the 2024 model year, the Advanced Clean Trucks (ACT) regulation requires manufacturers to sell ZEVs as an increasing percent of total medium- and heavy-duty sales in California. By the end of the 2024 model year 5% to 9% of sales will need to be ZEVs depending on the truck category. We estimate the statewide ZEV sales will need to be about 6% of total vehicle sales in 2024.

Manufacturers can get early credits for selling 2021 through 2023 model year ZEVs. They also have flexibility to sell more ZEVs in one category while selling less of another except they must still sell a minimum number of ZEV tractors. Manufacturers also can trade, or bank credits from excess ZEV sales and have one extra year to make up any shortfall.

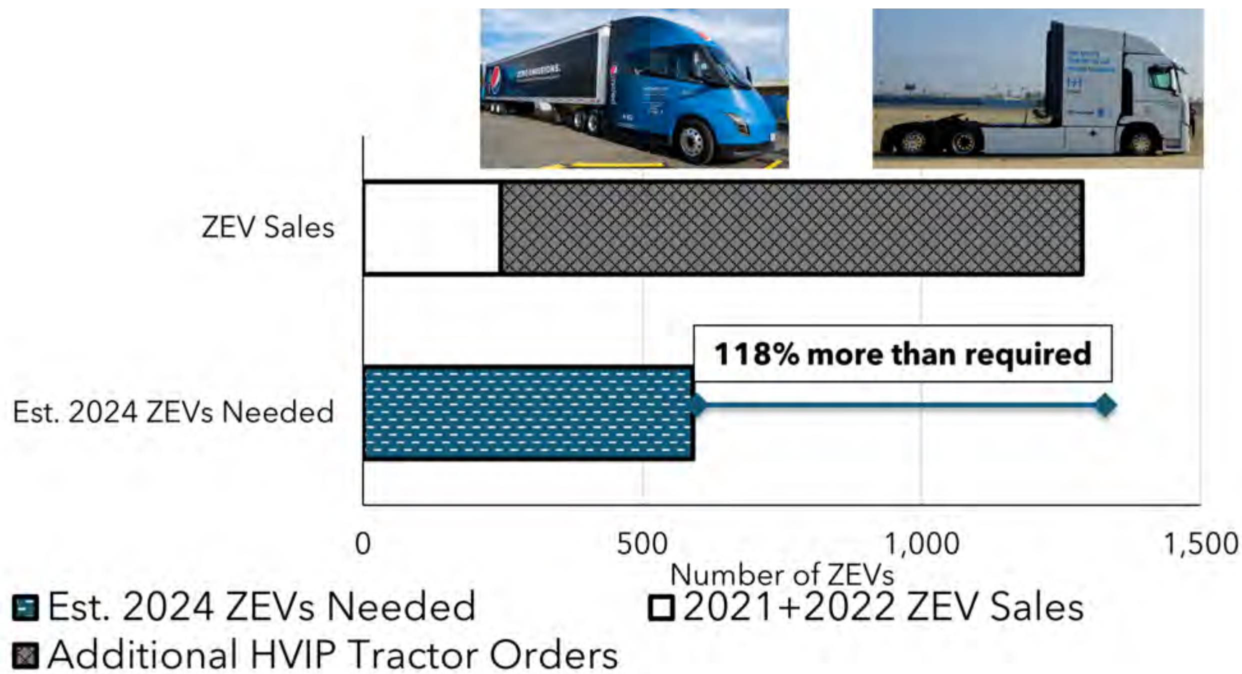
Will there be enough ZEVs by the end of the 2024 model year?

Yes, manufacturers already have sold more single unit medium- and heavy-duty ZEVs than is needed for 2024 based on data reported by manufacturers for 2021 and 2022. Manufacturers are also on track to more than double the required ZEV tractors sales based on existing sales and funding vouchers that have been issued. Some manufacturers already have excess credits, while others are just beginning to build their credit banks with early ZEV sales. Figure 1 illustrates that for Class 2b-8 single unit trucks, manufacturers have already sold 60% more ZEVs than is required by the end of 2024 when including vehicles which have received HVIP vouchers in 2023.

Figure 1: Expected Single Unit ZEV Truck Sales

For Class 7-8 tractors, currently 290 ZE tractors have been delivered for sale in 2021 and 2022. In addition, there are over 1,000 ZE tractors that have received HVIP vouchers and are expected to be delivered in 2023 or 2024. With these combined sales, there will be more than twice as many ZEV tractors sold than is needed to comply with the ACT regulation by the end of 2024. The estimated total sales including tractors with HVIP vouchers is shown in Figure 2. The chart shows 118% more ZE tractors are expected to be sold than will be needed to comply by the end of 2024.

Figure 2: Expected Class 7-8 Tractor ZEV Sales



In addition, the regulation has flexibility provisions for individual manufacturers to use. First, manufacturers can trade earned ZEV credits with other manufacturer as part of their overall compliance strategy. For example, to meet its 2024 ACT requirement, a manufacturer could choose to buy ZEV credits from another manufacturer with excess ZEV sales. Some manufacturers have already transferred their earned ZEV credits into other markets. Second, the ACT regulation includes a one-year grace period for manufacturers that sell fewer ZEVs than required by the end of 2024. More information is available in the *Advanced Clean Trucks Credit Summary Through the 2022 Model Year* and on the *Advanced Clean Trucks* website.

What percent of California sales are ZEVs?

In 2022, a total of 104,558 medium- and heavy-duty trucks were produced and delivered for sale in California as shown in Table 1. Of that total, about 7,639 were ZEVs. This means that about 7.5% of medium- and heavy-duty vehicle sales in 2022 were ZEVs. This is two years ahead of the first compliance date for manufacturers to produce any medium and heavy-duty ZEVs. This percentage is also higher than the annual sales percentage required for 2024. It is likely that ZEV sales will grow as manufacturers launch new ZEV models.

Manufacturer (Parent Company)	Total Number of Vehicles Produced and Delivered for Sale	Total Number of ZEVs Produced and Delivered for Sale	Total Number of ZEVs Sold to the Ultimate Purchaser
Blue Bird	638	97	93
BYD	38	38	-
Daimler	6,814	26	16
Ford	28,606	1,727	1,686
GM	24,500	-	-
Isuzu	1,450	-	-
Lightning eMotors	43	43	41
Lion Electric	4	4	2
Mercedes Benz Group	5,859	-	-
Navistar	1,733	111	104
Nikola Motor	13	13	13
Nissan	61	-	-
Paccar	8,166	49	31

Rivian	5,289	5,289	5,286
Stellantis	18,260	-	-
Volvo	2,995	153	66
XOS Trucks	89	89	89
Totals	**104,558**	**7,639**	**7,427**

Can manufacturers get credit for ZEVs that were supported with funding?

Yes, the ZEVs produced or delivered for sale in California can count towards ACT compliance, regardless of whether they are funded through the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP) or any other funding program. This also means that ZEV sales supported by funding programs will also help manufacturers meet or exceed their ZEV sales requirements.

Which manufacturers met the 2024 ZEV sales requirements early?

Several manufacturers already delivered enough ZEVs for sale in California through the 2022 model year to earn enough ZEV credits to comply with the ACT regulation by the end of 2024. They include Bluebird, BYD, Ford, GreenPower, Lightning eMotors, Lion Electric, Nikola Motor, Rivian, Volvo, and XOS Trucks.

Is there any risk that a lack of ACT ZEV credits will result in a shortage of internal combustion truck sales in 2024?

No, there are ample medium- and heavy-duty ZEV sales that have already occurred or are currently on order supported by public funding to more than satisfy the statewide ACT sales requirement at the end of 2024. In addition, several manufacturers are likely to have excess credits that can be used towards meeting the end of the 2025 model year requirements. These early ZEV sales means the ZEV requirements do not impact manufacturer's ability to satisfy remaining internal combustion engine demand.

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Under this proposed regulation example, the operator owns a 2014 MY diesel day cab tractor purchased in 2022. The drayage operator would likely turn over their diesel tractor at the end of 2029 when the tractor is 15-years-old (average age or MY of tractors reaching 800,000 miles) and has exceeded the useful life and would replace it with a new 2030 MY battery-electric tractor which they would operate for 20 years.

Most assumptions are the same as previously described in this document; however, some modifications were made for this example to better illustrate the costs the small business would face:

- The drayage operator is assumed to finance their vehicles for 5 years at an interest rate of 15 percent;
- The drayage operator would not install infrastructure themselves and instead would rely solely on retail charging; and
- No transitional costs associated with maintenance or infrastructure planning are assumed as these are costs are associated with organizational shifts within a large business.

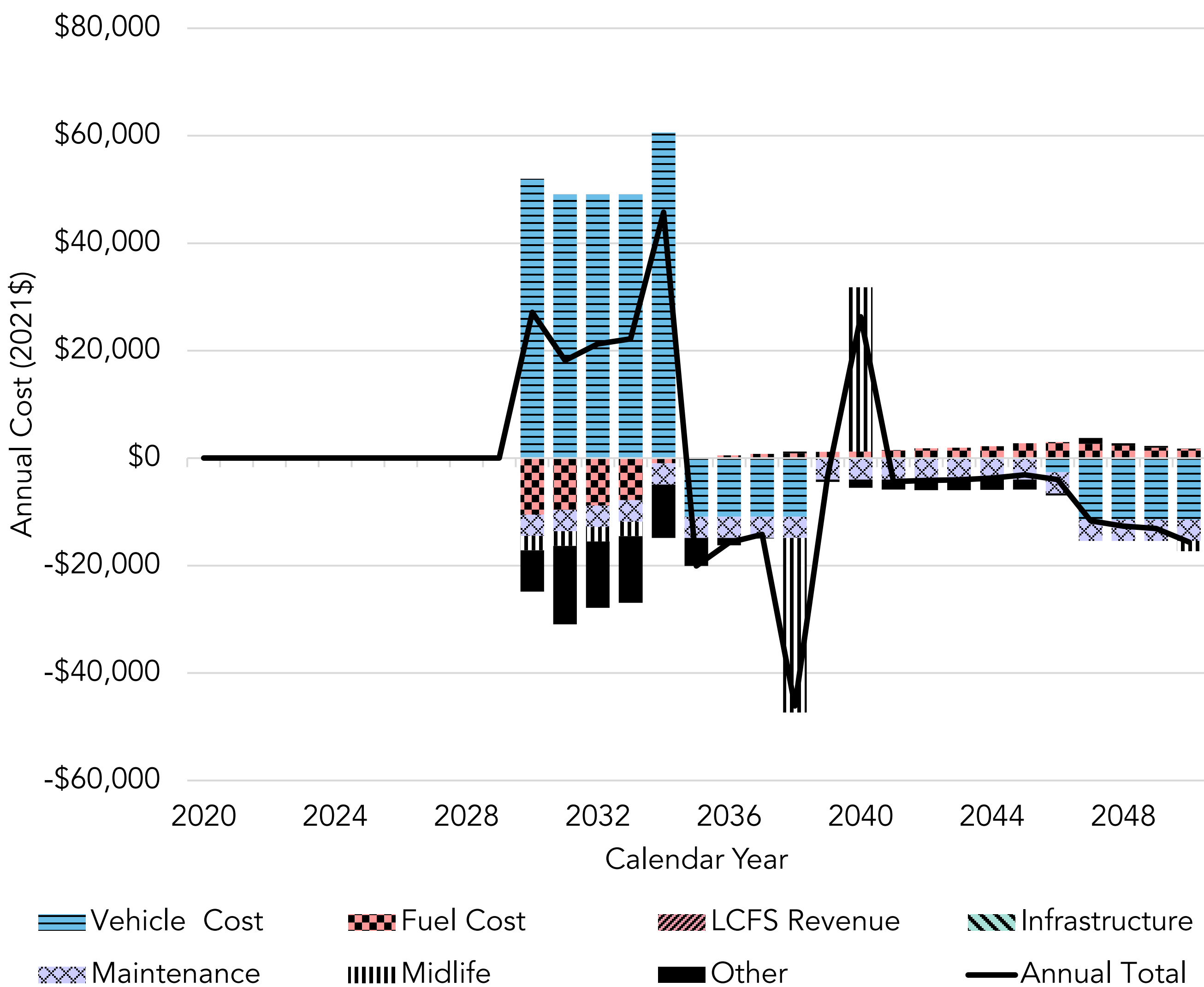
Table 42 and Figure 23 illustrate the costs for the example small business. The small business would see a net savings by 2040 and thereafter but would need to make significant upfront capital expenses in 2030 to purchase a new battery-electric tractor rather than buying another used diesel tractor. Incentives, financing assistance, and other programs offered will be helpful to support smaller operators with upfront capital expenses.

Table 42. Small Business Cumulative Cost Example 2024 to 2050

Cost line items	Legal Baseline 2030	ACF Proposal 2030	Legal Baseline 2040	ACF Proposal 2040	Legal Baseline 2050	ACF Proposal 2050	Difference 2050
Vehicle Price	$0	$49,106	$54,449	$245,531	$245,531	$245,531	$133,837
Sales and Excise Tax	$0	$33,745	$7,483	$33,745	$33,745	$33,745	$18,394
EVSE & Infrastructure Costs	$0	$0	$0	$0	$0	$0	$0
Maintenance Bay Upgrades	$0	$0	$0	$0	$0	$0	$0
Fuel Cost	$286,310	$275,812	$618,647	$585,387	$585,387	$932,196	-$11,466
DEF Consumption	$3,862	$3,380	$8,157	$3,380	$3,380	$3,380	-$8,803
LCFS Revenue	$0	$0	$0	$0	$0	$0	$0
Maintenance Cost	$79,265	$75,302	$178,347	$134,751	$134,751	$194,200	-$83,229
Midlife Costs	$21,667	$18,958	$62,292	$49,534	$49,534	$80,110	-$14,681
Registration Fees	$22,732	$21,915	$49,388	$34,591	$34,591	$43,736	-$32,399
Transitional Costs	$0	$0	$0	$0	$0	$0	$0

Cost line items	Legal Baseline 2030	ACF Proposal 2030	Legal Baseline 2040	ACF Proposal 2040	Legal Baseline 2050	ACF Proposal 2050	Difference 2050
Residual Values	$0	-$30,854	-$29,858	-$30,854	-$30,854	-$30,854	$15,693
Depreciation	$0	-$8,287	-$14,492	-$66,113	-$66,113	-$66,113	-$38,353
Insurance Cost	$4,431	$6,342	$9,172	$14,971	$14,971	$19,574	$5,876
Reporting Cost	$0	$48	$0	$109	$109	$169	$169
Total	$418,267	$445,466	$943,587	$1,005,031	$1,005,031	$1,455,672	-$14,961

Figure 23. Estimated Costs of Proposed Regulation to the Example Small Business (2021$)



3.4 Direct Costs on Individuals

There would be no direct costs on individuals as a result of this regulation. Individuals will realize health benefits, described in the Benefits Chapter, from statewide, regional, and local emissions benefits due to medium- and heavy-duty ZEVs displacing ICE vehicles. Manufacturers and fleets would see increased and decreased costs because of this rule which will indirectly impact individuals in the state. These indirect impacts are considered in the Macroeconomic Impacts Section.

4 Fiscal Impacts

The proposed regulation would impact State and local government expenditures through the purchase and operation of new vehicles and would impact revenues generated from a variety of State and local taxes and vehicle registration fee revenues that are collected.

These revenues, particularly those from State and local gasoline taxes and registration fees, are used to fund transportation projects across the state including road maintenance, construction of state highways and local streets, transit facilities and operation, and active transportation projects as described in Table 43 below. Thus, increases or decreases will impact funds available for these projects at the state, county, and local levels for use on road and transportation infrastructure improvements. We note that, though outside of this specific analysis, the transition towards zero emission vehicles and its impacts on some of these revenues, are the subject of continued policy development given the importance of the services funded. Thus, though this analysis does not assume the creation of new specific revenue-raising measures, such measures are not unlikely.

Table 43. Transportation Funding Source and Purpose

Revenue Source	Account/Program	Allocation Funding Purpose
Gasoline Excise Tax	State Highway Account (SHA)	highway projects and transportation maintenance and operational needs
	Road Maintenance & Rehabilitation Account (RMRA)	prioritized road maintenance and rehabilitation projects for state and local transportation systems
	Highway Users' Tax Account (HUTA)	local streets and roads projects
Diesel Excise Tax	Public Transportation Account (PTA)	transit and intercity and commuter rail operating programs and projects.
	RMRA	prioritized road maintenance and rehabilitation projects for the state and local transportation systems.
	SHA	highway projects and transportation maintenance and operational needs.
	Trade Corridors Enhancement Account (TCEA)	trade corridor projects

Revenue Source	Account/Program	Allocation Funding Purpose
State Sales Tax (diesel)	State Transit Assistance (STA)	transit purposes as outlined in the Transportation Development Act (TDA); local transit operation and capital purposes
	State Rail Assistance Program	intercity and commuter rail agencies for operation and capital purposes
Zero-Emission Vehicle Registration Fee	RMRA	basic road maintenance, rehabilitation, critical safety projects and other transportation initiatives, including complete street components for the state and local transportation systems
Motor Vehicle Registration Fees	California Highway Patrol (CHP) and Department of Motor Vehicles (DMV)	traffic law enforcement and regulations
Local Sales Tax Measures[182]	City/County Road Funds	Maintenance, new construction, engineering/administration, right of way, mass transit, and other
	Regional Transportation Planning Agencies (RTPAs)/Transit Operators	transit operations, transit planning

4.1 Local Government

4.1.1 Local Government Fleet Cost Pass-Through

The local government fleet is estimated to make up roughly 81 percent of California's public fleet based the total public fleet population and information from the Department of General Services. All local government fleets are subject to the proposed regulation with

[182] Counties can adopt a sales tax increase for transportation programs. The passage of a local sales tax measure requires 2/3 of local voter approval, generally lasting 20 to 30 years. Twenty-five counties have implemented sales tax measures for their transportation needs; and four transit authorities have approved permanent local tax measures.

requirements beginning for most fleets in 2024. Fleets located in designated counties would face their first requirements in 2027. A proportionate amount of the total costs outlined in Table 44 would be assumed to pass-through to local governments. Cost passthrough has been split into three categories – upfront costs, operating costs, and operating savings.

4.1.2 Utility User Taxes

Many cities and counties in California levy a Utility User Tax on electricity usage. This tax varies from city to city and ranges from no tax to 11 percent. A value of 3.53 percent was used in this analysis representing a population-weighted average.[183] By increasing the amount of electricity used, there would be an increase in the amount of the utility user tax revenue collected by cities and counties.

4.1.3 Gasoline and Diesel Fuel Taxes

Fuel taxes on gasoline and diesel fund transportation improvements at the state, county, and local levels. Displacing gasoline and diesel with electricity and hydrogen would decrease the total amount of gasoline and diesel dispensed in the state, resulting in a reduction in fuel tax revenue collected by local governments. Natural gas is not taxed by local governments and therefore is not included in this section. The local tax on fuel is listed in Table 28.

4.1.4 Local Sales Taxes

Sales taxes are levied in California to fund a variety of programs at the state and local level. The proposed regulation would require the sale of medium- and heavy-duty ZEVs in California resulting in a direct increase in sales tax revenue collected by local governments in the initial years of the regulation. Overall, local sales tax revenue may increase less than the direct increase from vehicle sales if overall business spending does not increase.

4.1.5 Fiscal Impacts on Local Government

Table 44 shows the estimated fiscal cost to local governments due to the proposed regulation relative to the Legal Baseline scenario. The fiscal impact to local government is estimated to be $288 million over the first 3 years of the regulation and $4.5 billion over the regulatory analysis period to 2050.

Table 44. Estimated Fiscal Impacts to Local Government (million 2021$)

Year	Local Government Fleet Upfront Cost Passthrough	Local Government Fleet Operational Cost Passthrough	Local Government Fleet Operational Saving Passthrough	Utility User Tax Revenue	Local Gasoline and Diesel Fuel Taxes	Local Sales Tax	Total Fiscal Impact*
2024	-$93	-$10	$27	$2	$97	$16	$40

[183] California State Controller's Office, *User Utility Tax Revenue and Rates*, 2017 (web page: https://sco.ca.gov/Files-ARD-Local/LocRep/2016-17 Cities UUT.pdf, last accessed January 2022).

Year	Local Government Fleet Upfront Cost Passthrough	Local Government Fleet Operational Cost Passthrough	Local Government Fleet Operational Saving Passthrough	Utility User Tax Revenue	Local Gasoline and Diesel Fuel Taxes	Local Sales Tax	Total Fiscal Impact*
2025	-$95	-$10	$56	$4	$90	$17	$63
2026	-$103	-$11	$83	$11	$79	$64	$123
2027	-$164	-$21	$128	$18	$66	$81	$107
2028	-$165	-$21	$170	$26	$54	$64	$128
2029	-$154	-$21	$206	$39	$35	$98	$203
2030	-$148	-$20	$216	$53	$14	$98	$213
2031	-$150	-$12	$237	$71	-$9	$123	$261
2032	-$148	-$14	$255	$91	-$32	$127	$279
2033	-$146	-$15	$267	$109	-$52	$105	$267
2034	-$145	-$17	$271	$132	-$78	$127	$290
2035	-$143	-$17	$274	$158	-$105	$125	$292
2036	-$146	-$18	$292	$181	-$130	$70	$248
2037	-$149	-$19	$293	$204	-$157	$79	$251
2038	-$152	-$19	$294	$228	-$185	$87	$254
2039	-$155	-$19	$313	$253	-$209	$81	$265
2040	-$158	-$19	$310	$276	-$241	-$44	$124
2041	-$160	-$18	$303	$300	-$276	-$27	$122
2042	-$161	-$18	$299	$325	-$312	-$9	$123
2043	-$163	-$18	$295	$339	-$331	-$69	$53
2044	-$152	-$19	$288	$346	-$348	-$49	$66
2045	-$143	-$19	$280	$360	-$367	-$28	$82
2046	-$136	-$20	$284	$370	-$391	-$13	$95
2047	-$118	-$21	$285	$381	-$412	$0	$115
2048	-$101	-$21	$289	$391	-$432	$13	$140
2049	-$88	-$21	$294	$402	-$453	$22	$155
2050	-$74	-$22	$298	$424	-$492	$32	$166
Total	**-$3,708**	**-$479**	**$6,607**	**$5,496**	**-$4,579**	**$1,187**	**$4,524**

*Note: Totals may differ due to rounding

4.2 State Government

4.2.1 CARB Staffing and Resources

To implement the proposed regulation, CARB would require permanent staffing resources. This would be met through a combination of new staffing resources and redirecting existing staffing resources. These resource needs are identified as follows:

- One new section consisting of one Air Resources Supervisor (ARS) I, two Air Resources Engineers (ARE), five Air Pollution Specialists (APS), and four Air Resources Technician (ART) II positions beginning in fiscal year (FY) 2023-2024 to implement the proposed regulation requirements on public and private fleets. Staff in this new section would provide compliance assistance to affected stakeholders, assist in outreach activities with business, public agencies, and fleet operators affected by the regulation to provided compliance assistance, and to support enforcement of the regulation. Staff would recognize ZEV fleets by posting compliant fleet information online and implement the ZEV Partner Program. Staff would develop program guidelines and applications, develop outreach materials, assist participants with inquiries, and audit information submitted by participants in the program.
- One ARE position beginning in FY 2023-2024 would be needed to develop and implement the database reporting system for the proposed regulation and provide ongoing support and maintenance.
- Two ART II, 0.25 ARS I, and 0.5 APS to assist drayage truck owners with CARB registration, verify annual compliance reporting requirements for the legacy fleet, provide technical assistance, answer calls and emails, analyze reported data sets, and develop and maintain an updated CARB online reporting system.
- Two APS, two ART II, and two ART I positions beginning in FY 2023-2024 would be used to conduct enforcement activities including data mining, reporting verification, inspections, audits, and other related activities. Table 45 shows the total number of additional positions and estimated cost per position.

Table 45. Estimated CARB Staffing Needs (million 2021$)

Position	Number of Positions	Initial Budget Year Cost ($/year per person)	Ongoing Cost ($/year per person)
Air Resources Supervisor	1.25	$238,000	$237,000
Air Resources Engineer	3	$206,000	$205,000
Air Pollution Specialist	7.5	$195,000	$194,000
Air Resources Technician I	2	$85,000	$84,000
Air Resources Technician II	8	$101,000	$100,000

In addition to staffing needs, the proposed regulation would require modifying an existing reporting system or developing a new system to handle the reporting. Staff is estimating contracting costs of $200,000 in FY 2023-2024 to set up or augment existing fleet reporting systems for this rule. The proposed regulation would also require contract funds for outreach related to the "Optional Certified ZEV Fleet and Partner Program"; however, staff estimates that current agency funds allocated towards outreach can cover these proposed costs, so no additional funding is necessary.

Six permanent intermittent personnel years would be redirected from the CARB Truck and Bus Call Center Team to primarily provide compliance assistance and respond to stakeholder inquiries via phone or email about all aspects of the proposed regulation.

4.2.2 State Fleet Cost Pass-Through

The State government fleet is estimated to make up 19 percent of California's public fleet based the total public fleet population and information from the Department of General Services. A proportionate amount of the total costs outlined in Table 46 would be assumed to pass-through the State governments. Cost passthrough has been split into three categories – upfront costs, operating costs, and operating savings.

4.2.3 Gasoline, Natural Gas, and Diesel Fuel Taxes

Fuel taxes on gasoline, natural gas, and diesel are used to fund transportation improvements at the state, county, and local levels. Displacing these combustion fuels with electricity and hydrogen would decrease the total amount of gasoline, natural gas, and diesel dispensed in the state. This would result in a reduction in revenue collected by the State for use in multiple levels of government. As noted above, though outside the scope of this analysis, State policy efforts continue to explore replacement revenue sources in light of the need for the zero-emission transition and the continuing need to fund vital services.

4.2.4 Energy Resources Fee

The Energy Resource Fee is a $0.0003/kWh surcharge levied on consumers of electricity purchased from electrical utilities. The revenue collected is deposited into the Energy Resources Programs Account of the General Fund which is used for ongoing energy programs and projects deemed appropriate by the Legislature, including but not limited to, activities of the CEC.

4.2.5 Registration Fees

The State collects registration fees to fund transportation improvements at the state, county, and local levels. The fee structure for ZEVs is different from diesel vehicles with some fees such as the Vehicle License Fee being higher and others such as weight fees being lower. These differences result in lower registration fees for the ZEVs which would reduce revenue collected by the State for use in transportation services.

4.2.6 State Sales Tax

Sales taxes are levied in California to fund a variety of programs at the state and local level. This proposed regulation would require the sale of medium- and heavy-duty ZEVs in California resulting in higher sales tax collected by the State government in the initial years of the regulation.

4.2.7 Depreciation

In California, the State collects corporate income tax from businesses based on their net profit for the year at a rate of 8.84 percent. Depreciation can be treated as an expense and would reduce the tax burden for a fleet and decrease tax revenue for the State.

4.2.8 Fiscal Impacts on State Government

shows the estimated fiscal impacts to the State government due to the proposed regulation relative to Legal Baseline conditions. The fiscal impact to local government is estimated to be -$83 million over the first 3 years of the regulation and -$38.0 billion over the regulatory analysis period to 2050.

Table 46. Estimated Fiscal Impacts on State Government (million 2021$)

Year	CARB Staffing and Resources	State Government Fleet Upfront Cost Passthrough	State Government Fleet Operational Cost Passthrough	State Government Fleet Operational Saving Passthrough	State Fuel Taxes	Energy Resources Fees	Registration Fees	State Sales Taxes	Depreciation	Total Fiscal Impact*
2023	-$2	$0	$0	$0	$0	$0	$0	$0	$0	-$2
2024	-$3	-$22	-$2	$6	-$15	$0	$0	$14	-$6	-$28
2025	-$3	-$22	-$2	$13	-$27	$0	-$2	$14	-$24	-$53
2026	-$3	-$24	-$3	$19	-$59	$0	-$8	$54	-$80	-$104
2027	-$3	-$39	-$5	$30	-$100	$0	-$17	$68	-$177	-$242
2028	-$3	-$39	-$5	$40	-$138	$1	-$24	$54	-$266	-$380
2029	-$3	-$36	-$5	$48	-$208	$1	-$35	$83	-$365	-$520
2030	-$3	-$35	-$5	$51	-$285	$1	-$52	$83	-$487	-$732
2031	-$3	-$35	-$3	$56	-$369	$1	-$72	$104	-$595	-$917
2032	-$3	-$35	-$3	$60	-$453	$2	-$90	$107	-$683	-$1,099
2033	-$3	-$34	-$4	$63	-$523	$2	-$108	$88	-$732	-$1,252
2034	-$3	-$34	-$4	$64	-$621	$2	-$136	$107	-$778	-$1,404
2035	-$3	-$34	-$4	$64	-$724	$3	-$164	$106	-$829	-$1,585
2036	-$3	-$34	-$4	$68	-$816	$3	-$193	$59	-$827	-$1,747
2037	-$3	-$35	-$4	$69	-$917	$3	-$226	$66	-$788	-$1,836
2038	-$3	-$36	-$4	$69	-$1,025	$4	-$259	$73	-$762	-$1,943
2039	-$3	-$36	-$4	$73	-$1,120	$4	-$286	$69	-$731	-$2,035
2040	-$3	-$37	-$4	$73	-$1,218	$4	-$309	-$37	-$584	-$2,116
2041	-$3	-$37	-$4	$71	-$1,329	$5	-$340	-$23	-$385	-$2,045
2042	-$3	-$38	-$4	$70	-$1,445	$5	-$369	-$8	-$254	-$2,046
2043	-$3	-$38	-$4	$69	-$1,491	$5	-$379	-$58	-$81	-$1,980
2044	-$3	-$36	-$4	$68	-$1,535	$5	-$394	-$42	$121	-$1,821
2045	-$3	-$34	-$4	$66	-$1,594	$6	-$409	-$24	$221	-$1,776
2046	-$3	-$32	-$5	$67	-$1,662	$6	-$421	-$11	$239	-$1,823
2047	-$3	-$28	-$5	$67	-$1,726	$6	-$431	$0	$225	-$1,896
2048	-$3	-$24	-$5	$68	-$1,791	$6	-$442	$11	$174	-$2,006
2049	-$3	-$21	-$5	$69	-$1,858	$6	-$451	$18	$85	-$2,160
2050	-$3	-$17	-$5	$70	-$2,006	$7	-$483	$27	-$8	-$2,420
Total*	-$92	-$870	-$112	$1,550	-$25,056	$89	-$6,102	$1,004	-$8,378	-$37,968

*Note: Totals may differ due to rounding

5 Macroeconomic Impacts

5.1 Methods for determining economic impacts

This section describes the estimated total impact of the proposed regulation on the California economy. The proposed regulation would result in incremental cost and cost-savings for businesses to comply with the regulation. These costs would result in direct changes in expenditures in the economy and are passed on to businesses. These changes in expenditures by businesses would indirectly affect employment, output, and investment in sectors that move freight and provide services to affected businesses.

These direct and indirect effects would lead to induced effects, such as changes in personal income that affect consumer expenditures across other spending categories. The total economic impact is the sum of these effects and is presented in this section. The total economic impact of the proposed regulation is simulated relative to the baseline scenario using the cost estimates described in Section C. The analysis focuses on the changes in major macroeconomic indicators from 2022 to 2050, including employment, output, personal income, and gross state product (GSP). The years of the analysis are used to simulate the proposed regulations through more than 12 months post full implementation.

Regional Economic Models, Inc. (REMI) Policy Insight Plus Version 2.5.0 is used to estimate the macroeconomic impacts of the Proposed Regulation on the California economy. REMI is a structural economic forecasting and policy analysis model that integrates input-output, computable general equilibrium, econometric and economic geography methodologies.[184] REMI Policy Insight Plus provides year-by-year estimates of the total impacts of the Proposed Regulation, pursuant to the requirements of SB 617 and the California Department of Finance. Staff used the REMI single region, 160 sector model with the model reference case adjusted to reflect California Department of Finance's most current publicly available economic and demographic projections.[185,186]

Specifically, REMI model's National and Regional Control was updated to conform to the most recent California Department of Finance economic forecasts which include U.S. Real Gross Domestic Product, income, and employment, as well as California civilian employment by industry, released with the Governor's Budget on January 10, 2022 and Department of Finance demographic forecasts for California population forecasts, last updated in July

[184] For further information and model documentation see: *https://www.remi.com/model/pi/*
[185] California Legislature, Senate Bill 617. October 2011.
[186] California Department of Finance, Chapter 1: Standardized Regulatory Impact Analysis for Major Regulations - Order of Adoption. December 2013.

2021.[187,188,189,190] After the Department of Finance economic forecasts end in 2025, CARB staff made assumptions that post-2025, economic variables would continue to grow at the same rate projected in the REMI baseline forecasts.

5.2 Inputs and Assumptions of the Assessment

The estimated economic impact of the proposed regulation is sensitive to modeling assumptions. This section provides a summary of the assumptions and inputs used to determine the suite of policy variables that best reflect the macroeconomic impacts of the proposed regulation. The direct costs and savings estimated in Section C and the non-mortality related health benefits estimated in Section B are translated into REMI policy variables and used as inputs for the macroeconomic analysis.[191]

The direct costs of the proposed regulation, as described in Section C, would include changes in upfront costs to fleets for the increased purchase of ZEVs and decreased purchase of ICE vehicles. The net change in vehicle costs is input into the economic model as an increase in production costs for all industries in California that operate fleets anticipated to be affected by the proposed regulation (see Table 47). Fleets which use ZEVs would realize changes in production costs related to their change in fuel mix, operations costs, and maintenance and repair costs. Fleets would also need to make investments in infrastructure to support their use of the ZEVs, which would increase their production costs. Fleets that own ZEV infrastructure to charge their vehicles would be able to generate LCFS credits and receive a direct financial benefit. Fleets required to accelerate the retirement of their non-ZEVs may see an increased residual value from resale of the vehicles on the used market, as described in the Direct Costs Section of this report. This however is not expected to result in any statewide economic impact, as other fleets would also be purchasing the vehicles at the higher residual value, directly offsetting revenue received by the seller as an expenditure to the buyer. Finally, changes in fleets' vehicle purchases, fuel use, and other activities would reduce the amount paid in federal, State, and local taxes and fees. The total change in taxes and fees businesses pay are modeled as a reduction in production costs for the fleets.

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[187] California Department of Finance. Economic Research Unit. National Economic Forecast – Annual & Quarterly. Sacramento: California. November 2021.

[188] California Department of Finance. Economic Research Unit. California Economic Forecast – Annual & Quarterly. Sacramento: California. November 2021.

[189] California Department of Finance. Economic Research Unit. National Deflators: Calendar Year averages: from 1929, April 2021. Sacramento: California. January 2022.

[190] California Department of Finance. Demographic Research Unit. Report P-3: Population Projections, California, 2010-2060 (Baseline 2019 Population Projections; Vintage 2020 Release). Sacramento: California. July 2021.

[191] Refer to the Macroeconomic Appendix for a full list of REMI inputs for this analysis.

Table 47. Share of Vehicles Owned and Operated by Fleets Affected by the High Priority and Federal Fleet Requirements of the Proposed Regulation

Major Sectors	NAICS	Share of Vehicles
Agriculture and Natural Resources	111-115, 21	5.12%
Construction	23	9.35%
Manufacturing	31-33	4.37%
Retail and Wholesale	42, 44-45	15.44%
Transportation and Public Utilities	22, 48, 492-493	50.40%
Finance, Insurance & Real Estate	52, 53	1.13%
Services	51, 54-56, 61, 62, 71, 72, 81	14.14%
Government (Public Administration)	92	0.05%

Costs and savings incurred by fleets would result in corresponding changes in final demand for industries supplying those particular goods or services as shown in Table 48. The term "fleets" in the table includes all of the industries with businesses operating affected vehicles as shown in Table 47. As fleets' purchase of vehicles are estimated to be primarily from out-of-state manufacturers, demand changes for the corresponding ZEV supply chain cannot be directly modeled as a change in final demand in California. In order to account for this, staff estimates the share of demand which may be fulfilled by California businesses, based on California's share of national output for the industry (electrical component mfg.).[192] All other changes in demand are included in this analysis. The infrastructure upgrades necessary for fleet use of ZEVs is assumed to be provided by businesses in the construction sector (NAICS 23). The EVSE and maintenance is assumed to be supplied by businesses in the Other Electrical Equipment and Component Manufacturing industry (NAICS 3359). The change in demand for vehicle maintenance and midlife rebuild is realized by the automotive repair and maintenance industry (NAICS 8111). The reduction in gasoline and diesel fuel demand is assumed to be incurred by the Petroleum and Coal Products manufacturing industry (NAICS 324), while the decrease in natural gas demand occurs for the Natural gas distribution industry (NAICS 2212). The increased demand for electricity and hydrogen fuel is assumed to be provided by the Electric power generation, transmission, and distribution industry (NAICS 2211) and Basic Chemical manufacturing industry (NAICS 3251), respectively. The reporting cost and the workforce training and development are assumed to be provided by the Office administrative services (NAICS 5611, 5612) and private education services industries (NAICS 61), respectively. The change in demand for gasoline stations (NAICS 4471) selling some of the products above, is estimated based on the retail margin for that industry and entered in

[192] Based on REMI Policy Insight Plus (v 2.4.1), California's share of national output is 2.3 percent for motor vehicle parts mfg. (3363) in 2019.

as change in final demand for the retail sector (NAICS 44-45).[193] Finally, the LCFS credits generated by fleets that install and use EVSE are assumed to be purchased by producers of fossil fuels, which pass those costs through in the price of fuel; this is modeled as an increase in fuel costs for individuals and businesses in California.

Table 48. Sources of Changes in Production Cost and Final Demand by Industry

Source of Cost or Savings for Fleets	Industries with Changes in Final Demand (NAICS)
Vehicle Prices	Upfront cost: Electrical Component Mfg.[a] (3363)
Infrastructure upgrades	Upfront cost: Construction (23)
Electric Vehicle Supply Equipment	Upfront cost: Other Electrical Equipment and Component Mfg. (3359)
EVSE maintenance	Upfront cost: Construction (23)
Vehicle maintenance and midlife rebuild	One-time and recurring cost: Automotive Repair and Maintenance (8111)
Gas and diesel fuel	Recurring cost: Petroleum and Coal Products Mfg. (324)
Natural gas	Recurring cost: Natural Gas Distribution (2212)
Hydrogen fuel	Recurring cost: Basic Chemical Manufacturing (3251)
Diesel Exhaust Fluid	Recurring cost: Agricultural Chemical mfg. (3253)
Workforce training and education	Recurring costs: Education Services; Private (61)

[193] A gross margin 10.5 percent is used, based on the average gross margin of small and medium gasoline stations (NAICS 4471) from *Bizminer* (https://www.bizminer.com/).

Source of Cost or Savings for Fleets	Industries with Changes in Final Demand (NAICS)
Reporting	One-time cost: Office Administrative Services; Facilities Support Services (5611, 5612)
LCFS credit generation	Recurring cost: Fuel prices[b]

[a] The Industry Sales policy variable is used here rather than Exogenous Final Demand.
[b] Individuals and each industry share of cost resulting from increasing fuel prices is based on data from REMI v2.5 (see the Macroeconomic Appendix for the distribution).

In addition to these changes in production costs and final demand for businesses, there would also be economic impacts as a result of the fiscal effects, primarily from changes in fuel and sales tax revenue, depreciation, and registration fees, as described in Section D. The changes in fuel tax revenue would change the production costs for fleets and the corresponding change in government revenue is modeled as a change in State and local government spending, assuming this revenue reduction is not offset elsewhere. Additional CARB staff and resources in support of this regulation are modeled as changes in State government employment and spending. The change in federal excise tax revenue and depreciation is outside the scope of the economic model and not evaluated here.

The health benefits resulting from the emissions reductions of the proposed regulation would reduce healthcare costs for individuals on average. This reduction in healthcare cost is modeled as a decrease in spending for hospitals, with a reallocation of this spending towards other goods and increased savings. The GHG emissions reductions benefits, as valued through the SC-CO_2, represent the avoided damage from climate change worldwide per metric ton of CO_2e. These benefits fall outside the scope of our economic model and are not evaluated here.

5.3 Results of the assessment

The results from the REMI model provide estimates of the impact of the proposed regulation on the California economy. These results represent the annual incremental change from the implementation of the proposed regulation relative to the baseline scenario. The California economy is forecasted to grow through 2050, therefore, negative statewide impacts reported here should be interpreted as a slowing of growth and positive impacts as an acceleration of growth resulting from the proposed regulation. The results are reported here in tables for every four years from 2022 through 2050.

5.3.1 California Employment Impacts

Table 49 presents the impact of the proposed regulation on total employment in California across all industries. Employment comprises estimates of the number of jobs, full-time plus part-time, by place of work for all industries. Full-time and part-time jobs are counted at equal weight. Employees, sole proprietors, and active partners are included, but unpaid family workers and volunteers are not included. The employment impacts represent the net change in employment, which consist of positive impacts for some industries and negative impacts for others. The proposed regulation is estimated to initially result in a slightly positive employment impact through about 2026 after which the trend reverses with a negative employment impact through rest of the regulatory horizon. The results are further described at the industry level in the following paragraph. These changes in employment do not exceed 0.2 percent of baseline California employment across the entire regulatory horizon.

Table 49. Total California Employment Impacts

Metric	2026	2030	2034	2038	2042	2046	2050
California Employment	25,955,120	25,988,237	26,215,483	26,620,729	27,193,545	27,865,042	28,673,835
% Change	0.00%	-0.07%	-0.13%	-0.16%	-0.13%	-0.09%	-0.15%
Change in Total Jobs	21	-18,835	-33,107	-43,138	-34,577	-25,572	-41,990

The total employment impacts shown above are net of changes at the industry level. The overall trend in employment changes by major sector are illustrated in Figure 24 and Table 50 shows the changes in employment by industries that would be directly impacted by the proposed regulation. As the requirements of the proposed regulation go into effect the industries generally realizing reductions in production cost or increases in final demand would see an increase in employment growth. This initially includes the construction sector as businesses install EVSE and make other facility upgrades, and the electric power sector due to increased demand. The directly affected fleets, which primarily operate in the transportation and warehousing sector, would initially see a decrease in employment due to higher vehicle costs, but as those vehicles are operated the operational savings build up over time, reducing production costs for the industry reducing the negative impact. The reduced spending on maintenance and repair costs for ZE trucks would result in a downward trend in employment for the industry. The largest decrease in employment results from the public sector, which is estimated to realize a decrease in fuel and sales tax revenue and registration fees. This foregone revenue may eventually be replaced by revenue from other sources, in which case these negative job impacts to State and local government would be diminished. However, this is outside the scope of the proposed regulation and not evaluated here. It is important to note that many of these negative job impacts represent a structural shift for these industries that directly correspond to substantial benefits to ZEV owners who would have much lower operational costs from the lower fuel expenses and reduced maintenance and repair of ZEVs.

Figure 24. Job Impacts by Major Sector

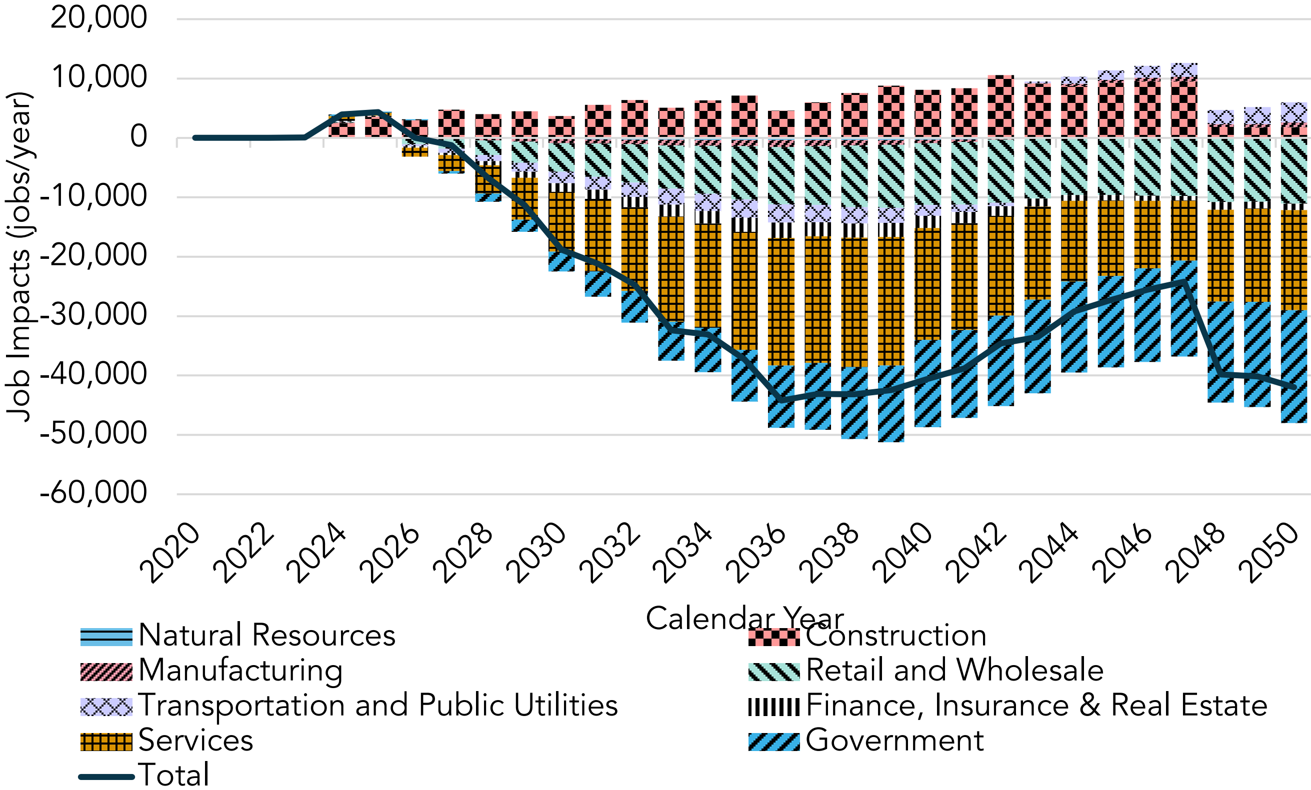


Table 50. Employment Impacts by Primary and Secondary Industries

Industry	Metric	2026	2030	2034	2038	2042	2046	2050
Transportation and Warehousing (48, 492-493)	% Change	0.00%	-0.12%	-0.22%	-0.26%	-0.14%	-0.01%	0.06%
	Change in Jobs	-70	-1,718	-3,238	-3,967	-2,229	-160	1,001
Electric power generation, transmission and distribution (2211)	% Change	0.20%	0.92%	2.30%	3.93%	5.73%	6.07%	6.66%
	Change in Jobs	75	332	791	1,302	1,819	1,882	2,013
Natural gas distribution (2212)	% Change	-0.07%	-0.35%	-0.66%	-0.95%	-1.12%	-1.15%	-1.30%
	Change in Jobs	-9	-43	-80	-112	-127	-128	-141
Construction (23)	% Change	0.22%	0.28%	0.48%	0.57%	0.67%	0.69%	0.11%
	Change in Jobs	3,009	3,660	6,327	7,573	9,124	9,468	1,610
Petroleum and coal products manufacturing (324)	% Change	-0.16%	-0.83%	-1.62%	-2.40%	-3.07%	-3.20%	-3.62%
	Change in Jobs	-20	-100	-189	-270	-333	-340	-376

Industry	Metric	2026	2030	2034	2038	2042	2046	2050
Retail trade (44-45)	% Change	-0.04%	-0.20%	-0.35%	-0.45%	-0.43%	-0.41%	-0.45%
	Change in Jobs	-829	-3,870	-6,605	-8,481	-8,438	-8,277	-9,437
Automotive repair and maintenance (8111)	% Change	-0.39%	-1.63%	-2.95%	-4.02%	-3.76%	-3.07%	-4.95%
	Change in Jobs	-903	-3,778	-6,834	-9,343	-8,750	-7,174	-11,634
State & Local Government	% Change	0.01%	-0.14%	-0.30%	-0.48%	-0.59%	-0.61%	-0.72%
	Change in Jobs	162	-3,375	-7,474	-12,132	-15,218	-15,747	-19,019

5.3.2 California Business Impacts

Gross output is used as a measure for business impacts as it represents an industry's sales or receipts and tracks the quantity of goods or services produced in a given time period. Output growth is the sum of output in each private industry and State and local government as it contributes to the state's GDP and is affected by production cost and demand changes. As production cost increases or demand decreases, output is expected to contract, but as production costs decline or demand increases, industry would likely experience output growth.

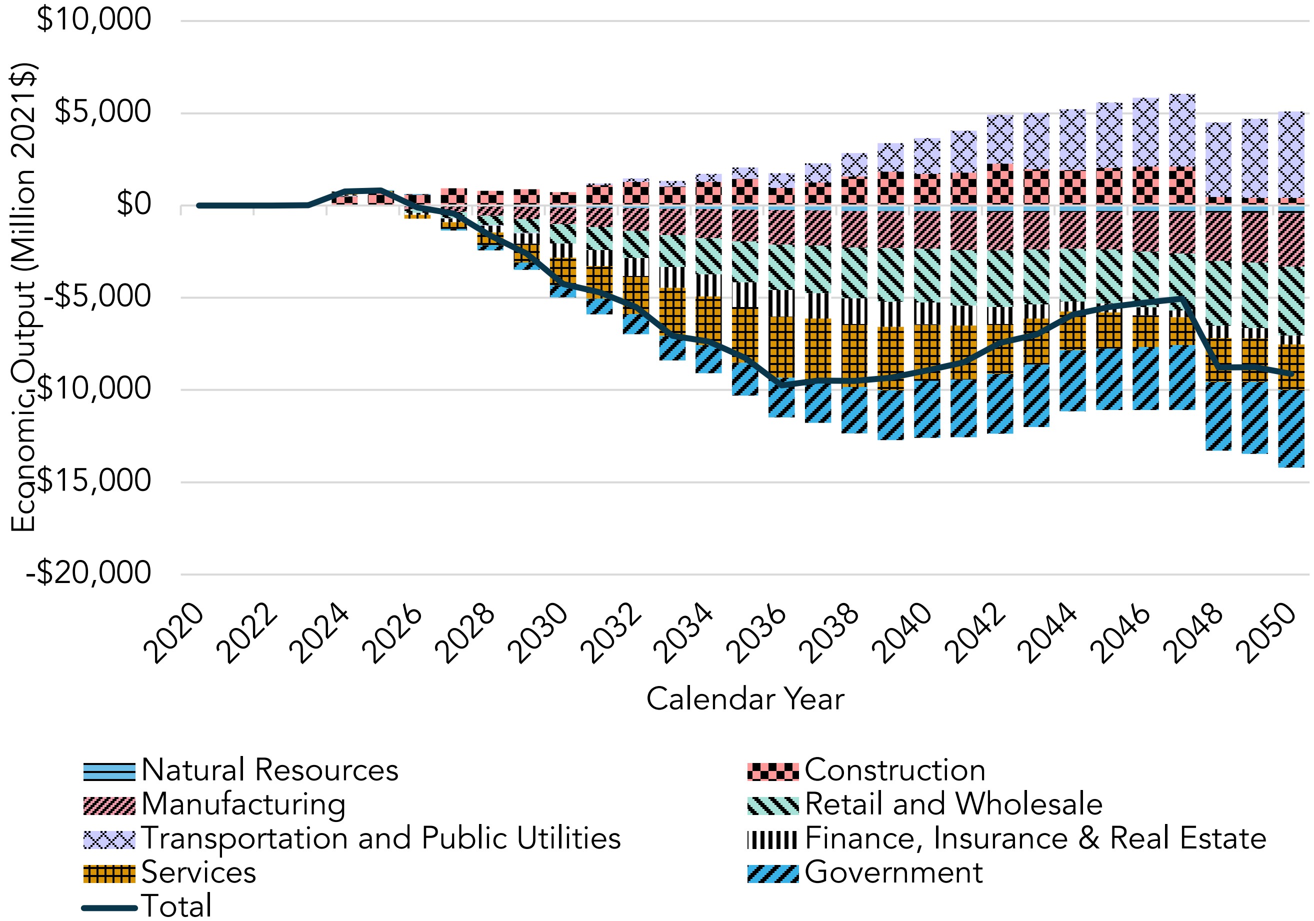
The results of the proposed regulation show a decrease in output of $99 million in 2030 and a decrease of $5.3 billion in 2050 as shown in Table 51. The trend in output changes is illustrated by major sector in Figure 25. Similar to the employment impacts, there would initially be positive impacts on output for construction and electric power sectors, which trend towards positive impacts over time as the operational savings accumulate, leading to output growth. There would be negative impacts on output in the oil and gas extraction, automotive repair and maintenance, and public sectors. The negative output impact on manufacturing is primarily driven by the petroleum and coal products manufacturing industry, which is estimated to see a relatively large decrease in final demand for diesel and gasoline.

Table 51. Change in Output Growth in California by Industry

Industry	Metric	2026	2030	2034	2038	2042	2046	2050
California Economy	Output (2021M$)	6,064,336	6,365,917	6,725,733	7,189,243	7,777,733	8,433,448	9,169,339
	% Change	0.00%	0.00%	-0.07%	-0.11%	-0.13%	-0.10%	-0.06%
	Change (2021M$)	0	-99	-4,256	-7,379	-9,506	-7,440	-5,253
Transportation and Warehousing (48, 492-493)	% Change	0.00%	-0.01%	-0.17%	-0.31%	-0.39%	-0.30%	-0.09%
	Change (2021M$)	0	-18	-351	-685	-905	-731	-226

Industry	Metric	2026	2030	2034	2038	2042	2046	2050
Electric power generation, transmission and distribution (2211)	% Change	0.00%	0.20%	0.93%	2.31%	3.96%	5.56%	6.13%
	Change (2021M$)	0	102	494	1,284	2,310	3,434	4,014
Natural gas distribution (2212)	% Change	0.00%	-0.07%	-0.35%	-0.67%	-0.96%	-1.14%	-1.15%
	Change (2021M$)	0	-7	-39	-76	-112	-138	-144
Construction (23)	% Change	0.00%	0.23%	0.28%	0.49%	0.58%	0.80%	0.71%
	Change (2021M$)	0	581	732	1,284	1,574	2,261	2,108
Petroleum and coal products manufacturing (324)	% Change	0.00%	-0.16%	-0.83%	-1.63%	-2.41%	-3.05%	-3.21%
	Change (2021M$)	0	-154	-855	-1,782	-2,800	-3,795	-4,288
Retail trade (44-45)	% Change	0.00%	-0.04%	-0.21%	-0.36%	-0.47%	-0.47%	-0.43%
	Change (2021M$)	0	-120	-624	-1,173	-1,665	-1,920	-1,985
Automotive repair and maintenance (8111)	% Change	0.00%	-0.39%	-1.66%	-3.02%	-4.13%	-3.75%	-3.20%
	Change (2021M$)	0	-103	-449	-844	-1,199	-1,133	-1,006
State & Local Government	% Change	0.00%	0.01%	-0.14%	-0.30%	-0.48%	-0.59%	-0.60%
	Change (2021M$)	0	32	-674	-1,519	-2,517	-3,237	-3,427

Figure 25. Change in Output in California by Major Sector



5.3.3 Impacts on Investments in California

Private domestic investment consists of purchases of residential and nonresidential structures and of equipment and software by private businesses and nonprofit institutions. It is used as a proxy for impacts on investments in California because it provides an indicator of the future productive capacity of the economy.

The relative changes to growth in private investment for the proposed regulation are shown in Table 52 and shows a decrease of private investment of about $1.0 billion in 2030 which trends towards an increase of $2.49 billion in 2050. These changes in investment do not exceed 0.4 percent baseline investment across the regulatory horizon.

Table 52. Change in Gross Domestic Private Investment Growth

Metric	2026	2030	2034	2038	2042	2046	2050
Private Investment (2021M$)	547,621	571,932	605,292	646,614	693,307	742,261	795,973
% Change	-0.03%	-0.18%	-0.19%	-0.07%	0.17%	0.33%	0.31%
Change (2021M$)	-172	-1,040	-1,141	-453	1,200	2,436	2,492

5.3.4 Impacts on Individuals in California

The proposed regulation would impose no direct costs on individuals in California. However, the costs incurred by affected businesses and the public sector would cascade through the economy and affect individuals.

One measure of this impact is the change in real personal income, which is income received from all sources, including compensation of employees and government and business transfer activity, adjusted for inflation. This is an aggregate statewide measure of personal income change, representing a net of income lost from jobs foregone in some sectors and jobs gained in other sectors. Table 53 estimates annual change in real personal income across all individuals in California due to the proposed regulation. Total personal income growth decreases by about $3.86 billion in 2030 but the impact begins to diminish after 2040, resulting in a decrease of about $2.1 billion by 2050, not exceeding 0.2 percent of the baseline. The change in personal income estimated here can also be divided by the California population to show the average or per capita impact on personal income. The change in personal income growth is estimated to decrease $19 per person in 2030, which trends positive over time resulting in an increase of $68 per person in 2050.[194]

Table 53. Impacts on Individuals in California

Metric	2026	2030	2034	2038	2042	2046	2050
Personal Income (2021M$)	2,861,550	3,187,013	3,477,682	3,737,691	4,040,484	4,378,592	4,745,721
% Change	-0.02%	-0.11%	-0.17%	-0.18%	-0.11%	-0.05%	-0.04%
Change (2021M$)	-764	-3,855	-6,195	-7,140	-4,745	-2,180	-2,071

[194] The sign of the change in personal income per capita differs from overall personal income due to population growth changes estimated by the REMI model as a result of the proposed regulation.

Metric	2026	2030	2034	2038	2042	2046	2050
Personal Income per capita (2021$)	68,996	76,178	81,152	86,202	91,813	98,550	106,058
% Change	-0.02%	-0.08%	-0.08%	-0.05%	0.03%	0.06%	0.06%
Change (2021$)	-19	-64	-71	-44	25	62	68

5.3.5 Impacts on Gross State Product

GSP is the market value of all goods and services produced in California and is one of the primary indicators of economic growth. It is calculated as the sum of the dollar value of consumption, investment, net exports, and government spending. Under the proposed regulation, GSP growth would be anticipated to decrease by about $2.42 billion in 2030 and by $4.28 billion in 2050 as shown in Table 54. These changes do not exceed 0.2 percent of baseline GSP. This metric summarizes impacts discussed above, including consumer spending, investment, and government spending. This is why the results trend negative, as the decrease in consumer and government spending in California would outweigh the increase in investment resulting from the proposed regulation.

Table 54. Change in Gross State Product

Metric	2026	2030	2034	2038	2042	2046	2050
GSP (2021M$)	3,666,219	3,893,045	4,161,493	4,471,810	4,822,161	5,207,097	5,630,591
% Change	0.00%	-0.06%	-0.10%	-0.12%	-0.08%	-0.04%	-0.08%
Change (2021M$)	-43	-2,420	-4,169	-5,276	-3,796	-2,293	-4,276

5.3.6 Creation or Elimination of Businesses

The REMI model cannot directly estimate the creation or elimination of businesses. However, changes in jobs and output for the California economy described above can be used to understand some potential impacts. The overall jobs and output impacts of the proposed regulation would be small relative to the total California economy, representing changes of no greater than 0.2 percent. However, impacts to specific industries are larger as described in previous sections. While there would initially be negative impacts on the transportation and warehousing sector, these diminish over time. The trend of increasing demand for the construction sector to provide services related to EV charging has the potential to lead to an expansion or creation of businesses over time. While the electric power sector similarly sees large increases in demand, its services are provided by public utilities, which would not directly impact business creation. The decreasing trend in demand for gasoline and diesel fuel following from this proposed regulation has the potential to result in the elimination of businesses in this industry and downstream industries, such as gasoline stations and vehicle repair businesses, if sustained over time.

5.3.7 Incentives for Innovation

The proposed regulation provides flexibility for fleets to purchase ZEVs ahead of their requirements. Private and public fleet owners that purchase ZEVs before they are required would be able to count them towards a future compliance requirement to gain flexibility when making future vehicle purchase. This may encourage fleets to make ZEV purchases early for vehicles that are well suited to their needs which could provide flexibility to purchase ICE vehicles in later years. High priority and federal fleets could purchase Group 1 ZEVs at any point prior to 2025, Group 2 ZEVs at any point prior to 2027, and Group 3 ZEVs at any point prior to 2030. Drayage fleets could add ZEVs to the drayage online reporting system at any point prior to turnover requirements or the 2035 ZEV deadline. Fleets that act early would be more likely to be eligible for incentive programs that may be available to finance costs or lower the upfront cost.

ZEVs are anticipated to lead to other unquantified benefits and operational efficiencies that may provide another incentive for fleets to use ZEVs to better serve customers. For example, ZEV may be able to make deliveries at night where noise ordinances limit deliveries, their quiet operation can also improve safety at a work site, and the ability to plug in power tools or export power at a job site or as back-up power may increase overall productivity.

Staff anticipates growth in industries who manufacture or support ZEVs including ZEV manufacturer and component suppliers, infrastructure installers, electrical vehicle technicians, and others. This growth would strengthen the ZEV supply chain, foster a ZE market, and promote technology growth sooner than would have otherwise occurred.

5.3.8 Competitive Advantage or Disadvantage

The proposed regulation has three primary regulatory components for different fleet types and each addresses competitive advantage or disadvantage differently.

The public fleet requirement would not be anticipated to create a competitive advantage or disadvantage. Public agencies do not compete against each other, and each agency would be able to identify the strategy which allows them to comply within their allocated budgets.

The drayage truck requirement would not be anticipated to create a competitive advantage or disadvantage. The proposal applies equally to all drayage trucks that enter seaports and railyards. It also applies equally to California companies as well as companies headquartered out-of-state.

The high priority and federal fleet requirement would not be anticipated to create a significant change in competitive advantage or disadvantage. First, federal agencies do not compete with other fleets and would not have a competitive advantage or disadvantage. For high priority fleets, the milestone requirements apply to all trucks that operate in California regardless of where the truck or company is headquartered and would be phased in by truck type. This ensures that all vehicles in these fleets would be subject to the same requirements.

Fleets that do not meet the fleet size or revenue threshold would not be regulated by this proposal, but the risk of creating a competitive advantage or disadvantage is mitigated as these fleets would become subject to the regulation if their revenue or fleet size increases above the thresholds established in the regulation. In addition, the fleet size for determining which fleet would be subject to the regulation includes all medium- and heavy-duty vehicles that are operated under common ownership and control. This ensures a level playing field between businesses that compete for the same work regardless of their business model.

5.4 Summary and Agency Interpretation of the Assessment Results

The results of the macroeconomic analysis of the proposed regulation are summarized in Table 55. As analyzed here, CARB estimates the proposed regulation would be unlikely to have a significant impact on the California economy. Overall, the change in the growth of jobs, state GDP, and output is projected to not exceed 0.2 percent of the baseline. While the proposed regulation would initially result in decreased growth in the transportation and warehousing sector in California, it trends positively over time diminishing the negative impact. Both the construction and electric power sectors would see large positive growth by providing their services to affected fleets. The diesel and gasoline fuel savings for the fleets represent decreased demand for gasoline and diesel from the industry, implying a decrease in growth for the industry and downstream industries such as gasoline stations and vehicle repair. This analysis also shows the negative impact estimated for State and local government output and employment due to tax revenue decreases, without any offsetting revenues. This foregone revenue, which supports important programs in the state, may eventually be replaced by revenue from other sources, in which case these negative impacts to State and local government would be diminished.

Table 55. Summary of Macroeconomic Impacts of Proposed Regulation

Indicator	Metric	2026	2030	2034	2038	2042	2046	2050
GSP	% Change	0.00%	-0.06%	-0.10%	-0.12%	-0.08%	-0.04%	-0.08%
	Change (2021M$)	-43	-2,420	-4,169	-5,276	-3,796	-2,293	-4,276
Personal Income	% Change	-0.02%	-0.11%	-0.17%	-0.18%	-0.11%	-0.05%	-0.04%
	Change (2021M$)	-764	-3,855	-6,195	-7,140	-4,745	-2,180	-2,071
Employment	% Change	0.00%	-0.07%	-0.13%	-0.16%	-0.13%	-0.09%	-0.15%
	Change in Jobs	21	-18,835	-33,107	-43,138	-34,577	-25,572	-41,990
Output	% Change	0.00%	-0.07%	-0.11%	-0.13%	-0.10%	-0.06%	-0.10%
	Change (2021M$)	-99	-4,256	-7,379	-9,506	-7,440	-5,253	-9,117

Indicator	Metric	2026	2030	2034	2038	2042	2046	2050
Private Investment	% Change	-0.03%	-0.18%	-0.19%	-0.07%	0.17%	0.33%	0.31%
	Change (2021M$)	-172	-1,040	-1,141	-453	1,200	2,436	2,492

6 Alternatives

Pursuant to SB 617,[195] and HSC Sections 11346.2, 11346.3, 11346.5, 11346.9, 11347.3, 11349.1, 13401, 13402, 13403, 13404, 13405, 13406, 13407, 11342.548, 11346.36, and 11349.1.5, CARB staff solicited alternatives for the proposed regulation during workgroups, public workshops, and individual meetings with industry. CARB staff encouraged public input on alternative approaches that may yield the same or greater benefits compared to the proposed regulation or may achieve the goals at a lower cost. Based on comments received, two alternatives, one more stringent and one less stringent than the proposed regulation, are shown below. The analysis includes a comparison of costs, benefits, economic impacts, and cost-effectiveness.

6.1 Alternative 1

Alternative 1 is a less stringent alternative to the proposed regulation. This alternative is based on an alternative concept suggested by the California Council for Environmental and Economic Balance and applies to the same fleets as the proposed regulation. This alternative is structured as a cleaner combustion option that would count engines certified to the Heavy-Duty Omnibus regulation equivalent to a ZEV purchase for the same regulated fleets as the proposed regulation.[196]

Under this alternative, regulated fleets would have the option to meet compliance requirements by purchasing a combination of ZEVs or engines certified to the engine standards established by the Heavy-Duty Omnibus regulation. All medium- and heavy-duty engines sold in California need to be certified to this standard regardless of fuel type. Engines certified in California starting in 2024 are initially certified to standards 75 percent to 90 percent lower than U.S. EPA certified engines and have additional requirements that ensure real world emissions remain low for a longer period of time in all modes of operation through improved test procedures, lengthened warranty, strengthened durability demonstrations, and other emissions control requirements.[197] We expect real world NOx emissions to be about 90 percent lower during the life of the vehicle than existing engines starting in 2024.

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[195] Senate Bill 617, Calderon. State government: *Financial and administrative accountability*. October 6, 2011 (web link: http://dof.ca.gov/Forecasting/Economics/Major_Regulations/SB_617_Rulemaking_Documents/documents/Section%202000%20ISOR%201%20sb_617_bill_20111006_chaptered.pdf, last accessed January 2022).

[196] California Council for Economic and Environmental Balance, *Re:Comments on Advanced Clean Fleets Proposed Regulation and Alternatives for the Environmental Analysis*, 2021 (web link: https://www.arb.ca.gov/lists/com-attach/29-acf-comments-ws-UDNUMVUxUGZWMlcl.pdf, last accessed January 2022).

[197] California Air Resources Board, *Heavy-Duty Omnibus: Appendix D – Emissions Inventory and Results for the Proposed Amendments*, 2020 (web link: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2020/hdomnibuslownox/appd.pdf, last accessed January 2021).

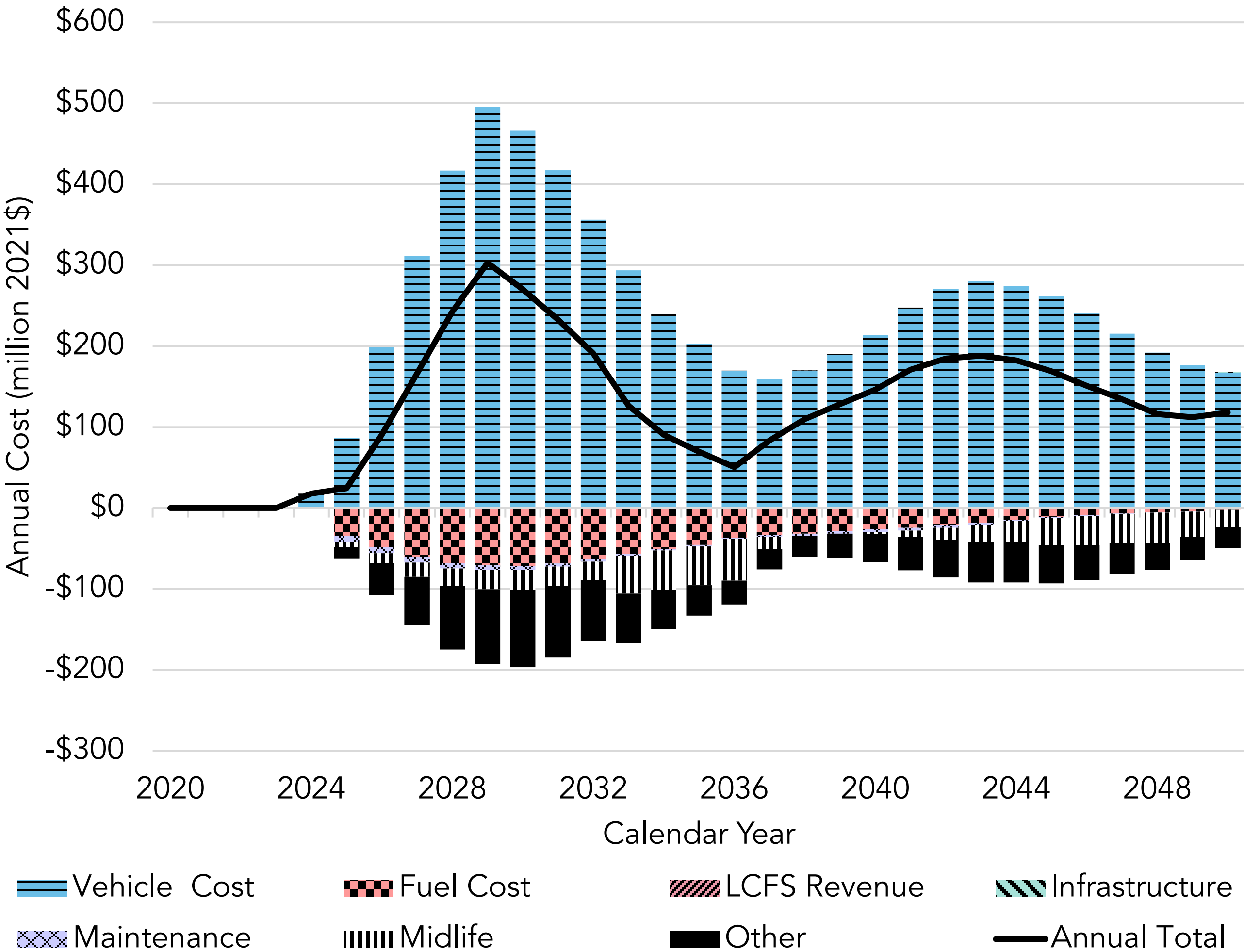
In this alternative, starting in 2024, public fleets and high priority fleets would be required to purchase either ZEVs or engines certified to the California Omnibus engine standards. For State and local government fleets, this alternative is not expected to result in any changes because they already buy California certified engines. For high priority and federal fleets, this would result in accelerated emissions benefits and increased costs as fleets that would have otherwise normally purchased used federally certified engines in the baseline, would now be required to purchase new California Omnibus certified engines. For drayage fleets, pre-2024 MY trucks would be removed from the CARB drayage online reporting system at the end of their useful life and all vehicles added in the online reporting system would be either a ZEV or 2024 MY or newer engine certified to the Heavy-Duty Omnibus requirements. Under this alternative, the number of ZEVs would not increase beyond what is expected from the ACT regulation already reflected in the Legal Baseline.

When compared to the proposed regulation, this alternative would result in fewer ZEVs, lower criteria emissions benefits, lower health benefits, and lower climate emissions reductions benefits as shown in the following sections.

6.1.1 Costs

Alternative 1 results in incremental costs of California certified engines versus federal certified engines which is partially offset by incremental savings associated with projected improved fuel economy of newer vehicles. The cost to the California economy when assuming all costs occur in California would be $3.8 billion between 2024 and 2050 in Alternative 1 versus the Legal Baseline. Figure 26 illustrates the incremental difference in cost between Alternative 1 and the Legal Baseline scenario.

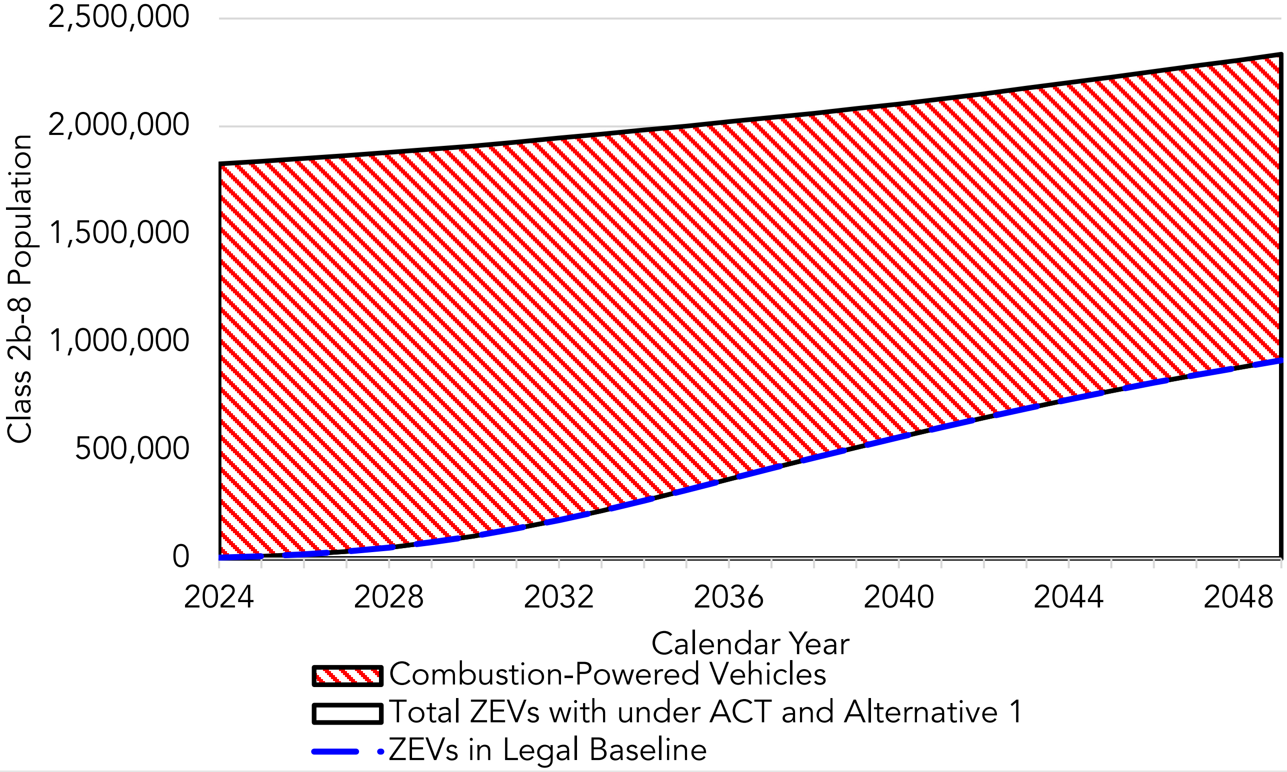
Figure 26. Total Estimated Direct Costs of Alternative 1 Relative to the Legal Baseline Scenario (million 2021$)



6.1.2 Benefits

Alternative 1 results in NOx emissions benefits relative to the Legal Baseline from the more stringent NOx standards of California certified engines compared to federal engine standards. Alternative 1 results in some $PM_{2.5}$ emissions benefits and negligible GHG benefits. Figure 27 illustrates the ZEV population over time under Alternative 1. Alternative 1 results in roughly 650,000 ZEVs by 2035 and 950,000 ZEVs by 2050, the same number as in the Legal Baseline. This represents 200,000 fewer ZEVs by 2035 and 650,000 fewer ZEVs by 2050 when compared to the proposed regulation. Because of the identical number of ZEVs between Alternative 1 and the Legal Baseline, the "ZEVs due to ACT" line overlaps with the "Total ZEVs" line.

Figure 27. Statewide Vehicle Population Forecast over Time under Alternative 1



6.1.2.1 Emissions Benefits

Alternative 1 results in lower NOx, $PM_{2.5}$, and GHG emissions compared to the Legal Baseline scenario. However, this alternative results in significantly fewer NOx, $PM_{2.5}$, and GHG benefits compared to the proposed regulation. Table 56 summarizes the expected annual NOx, $PM_{2.5}$, and CO_2 benefits of Alternative 1 from 2024 through 2050 when compared to the Legal Baseline. The alternative generates fewer criteria emissions reductions than the proposed regulation, is less effective at meeting our SIP obligations, and does not make progress towards meeting the State's GHG reduction targets. In addition, this alternative is not projected to result in any additional near-term emissions reductions compared to the proposed regulation.

Table 56. Alternative 1 NOx, $PM_{2.5}$, and GHG Benefits Relative to the Legal Baseline

Calendar Year	NOx (tpd)	$PM_{2.5}$ (tpd)	CO_2 (MMT/year)
2024	0.4	0.0002	0
2025	1.4	0.0048	0
2026	2.9	0.011	0
2027	5.2	0.020	0
2028	7.6	0.027	0
2029	9.9	0.034	0
2030	12.2	0.040	0
2031	14.4	0.042	0
2032	16.6	0.042	0
2033	18.6	0.043	0
2034	20.7	0.046	0
2035	22.6	0.050	0
2036	24.4	0.053	0
2037	26.1	0.057	0
2038	27.7	0.062	0
2039	29.3	0.067	0
2040	30.8	0.073	0
2041	32.2	0.078	0
2042	33.7	0.083	0
2043	35.1	0.088	0
2044	36.4	0.093	0
2045	37.8	0.097	0
2046	39.2	0.10	0
2047	40.6	0.11	0
2048	41.9	0.11	0
2049	43.3	0.11	0
2050	44.7	0.12	0

Figure 28, Figure 29, and Figure 30 show the difference in GHG, NOx, and $PM_{2.5}$ emissions between Alternative 1, the Legal Baseline, and the proposed regulation. The cumulative emissions benefits for this alternative accounts for a negligible CO_2 reduction, 204,500 tons of NOx, and 518 tons of $PM_{2.5}$ from 2024 to 2050. In comparison, the proposed regulation has total emissions benefits that are approximately 316 MMT CO_2, 443,800 tons of NOx, and 9,300 tons of $PM_{2.5}$ reductions during the same time period. GHG emissions of this alternative are about the same as the baseline.

Figure 28. Projected GHG Emissions under Legal Baseline, Proposed Regulation, and Alternative 1

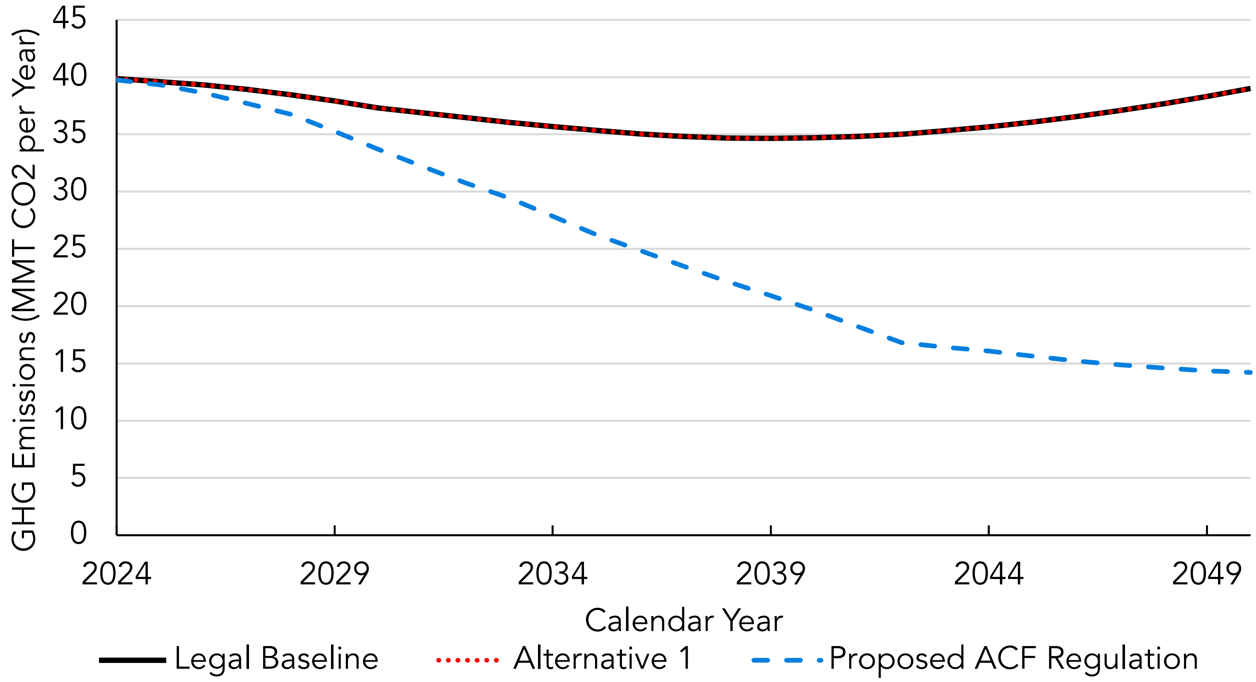


Figure 29. Projected NOx Emissions under Legal Baseline, Proposed Regulation, and Alternative 1

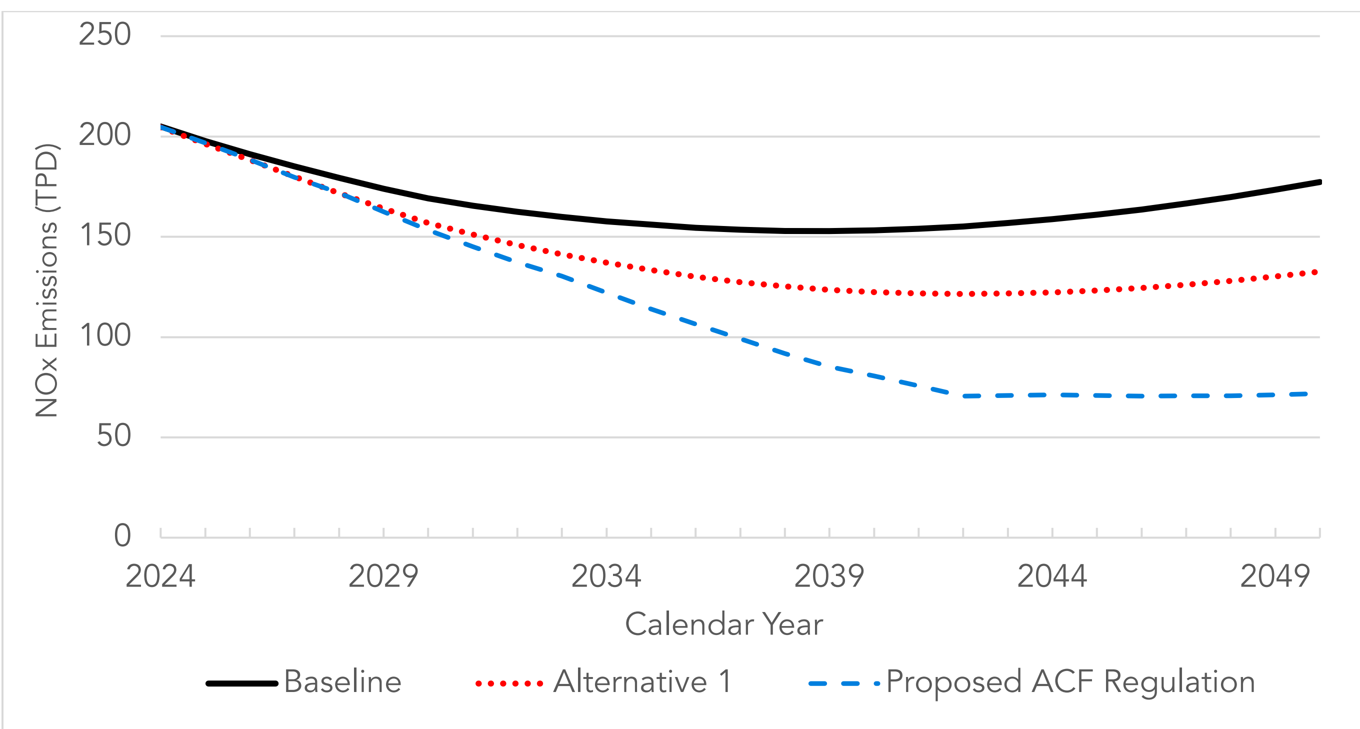
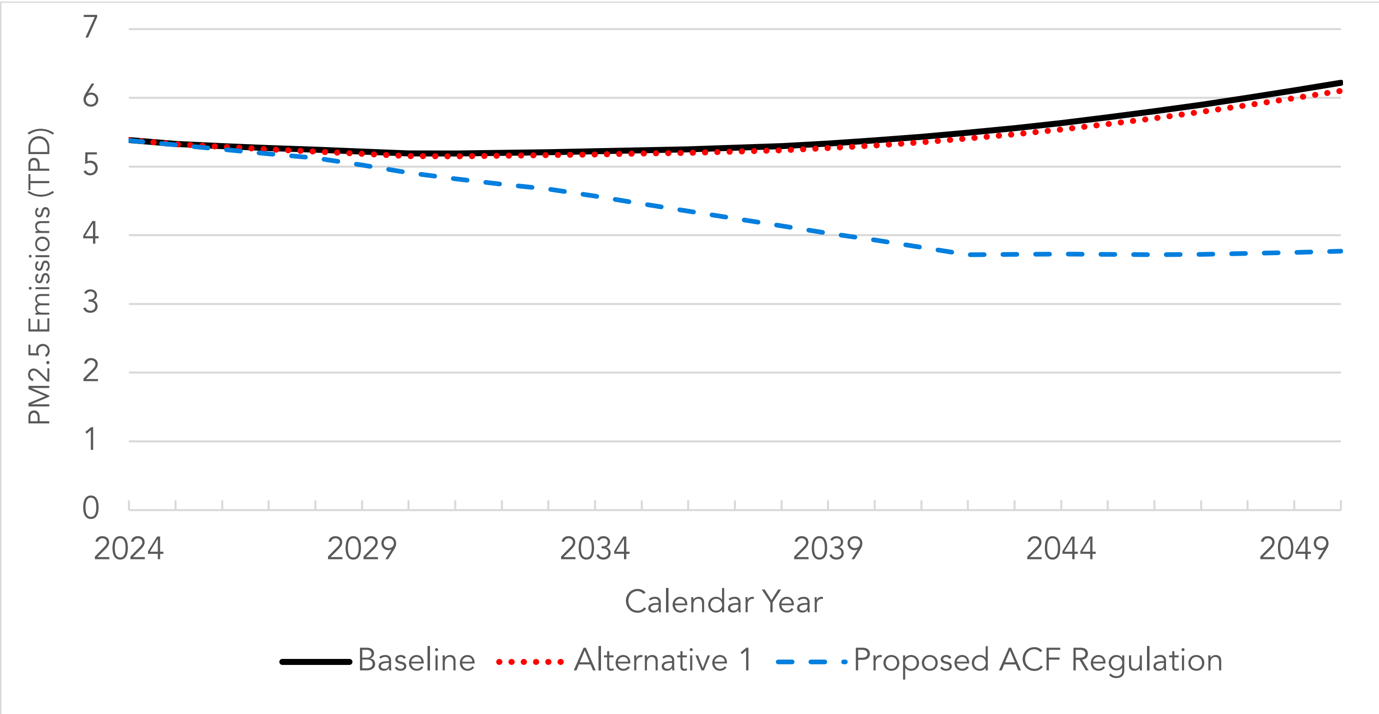


Figure 30. Projected $PM_{2.5}$ Emissions under Legal Baseline, Proposed Regulation, and Alternative 1



6.1.2.2 Health Benefits

Alternative 1 results in emissions reductions relative to the Legal Baseline leading to health benefits as shown in Table 57. The health benefits for Alternative 1 are less than those of the proposed ACF regulation due to less emissions reductions estimated. The total statewide valuation of health benefits of the less stringent alternative is estimated to be $22.7 billion as summarized in Table 57. Totals may not add up due to rounding.

Table 57. Statewide Valuation from Avoided Health Outcomes for Alternative 1 (Million 2021$)

Calendar Year	Avoided Cardiopulmonary Mortality	Avoided Hospitalizations for Cardiovascular Illness	Avoided Hospitalizations for Respiratory Illness	Avoided ER Visits	**Total Avoided Annual Valuation**
2024	1	0	0	1	**$10.5**
2025	4	1	1	2	**$41.9**
2026	8	1	1	4	**$83.8**
2027	15	2	3	7	**$157.1**
2028	23	3	4	11	**$240.9**
2029	30	4	5	14	**$314.1**
2030	37	5	6	18	**$387.4**

Calendar Year	Avoided Cardiopulmonary Mortality	Avoided Hospitalizations for Cardiovascular Illness	Avoided Hospitalizations for Respiratory Illness	Avoided ER Visits	**Total Avoided Annual Valuation**
2031	45	6	8	21	**$471.2**
2032	52	8	9	24	**$544.6**
2033	59	9	10	28	**$617.9**
2034	65	10	12	31	**$680.8**
2035	72	11	13	34	**$754.1**
2036	78	12	14	37	**$816.9**
2037	85	13	16	39	**$890.3**
2038	90	14	17	42	**$942.7**
2039	96	15	18	44	**$1,005.5**
2040	102	16	19	47	**$1,068.4**
2041	107	17	20	49	**$1,120.7**
2042	112	18	21	51	**$1,173.1**
2043	118	19	22	54	**$1,236.0**
2044	123	20	23	56	**$1,288.4**
2045	128	20	24	58	**$1,340.7**
2046	133	21	26	60	**$1,393.1**
2047	138	22	27	62	**$1,445.5**
2048	144	23	28	65	**$1,508.3**
2049	149	24	29	67	**$1,560.7**
2050	154	25	30	69	**$1,613.1**
Total Benefit*	**$22,664.0**	**$20.9**	**$21.9**	**$0.9**	**$22,707.7**

*Note: Totals may differ due to rounding

6.1.3 Economic Impacts

Alternative 1 imposes a less stringent ZEV purchase requirement in the near-term compared to the proposed regulation. This results in lower incremental vehicle cost as passed-through to fleets, but also results in fewer fuel costs savings and fewer total cost-savings during the analysis period. The macroeconomic impacts analysis indicates a very small change relative to the results of the proposed regulation, as shown in Table 58. Figure 31 and Figure 32 show the job impacts and output changes of Alternative 1, respectively.

Table 58. Change in Growth of Economic Indicators for Alternative 1

Indicator	Metric	2026	2030	2034	2038	2042	2046	2050
GSP	% Change	-0.01%	-0.02%	-0.01%	0.00%	-0.01%	-0.01%	0.00%
	Change (2021M$)	-291	-604	-312	-207	-382	-357	-250
Personal Income	% Change	-0.01%	-0.02%	-0.01%	-0.01%	-0.01%	-0.01%	-0.01%
	Change (2021M$)	-318	-599	-280	-265	-430	-373	-281
Employment	% Change	-0.01%	-0.02%	-0.01%	0.00%	-0.01%	-0.01%	-0.01%
	Change in Jobs	-2,303	-4,427	-2,235	-1,288	-2,415	-2,233	-1,484
Output	% Change	-0.01%	-0.02%	-0.01%	0.00%	-0.01%	-0.01%	0.00%
	Change (2021M$)	-502	-1,037	-535	-352	-644	-605	-424
Private Investment	% Change	-0.02%	-0.04%	-0.01%	0.00%	-0.01%	-0.01%	-0.01%
	Change (2021M$)	-115	-233	-52	-19	-100	-86	-45

Figure 31. Job Impacts of Alternative 1 by Major Sector

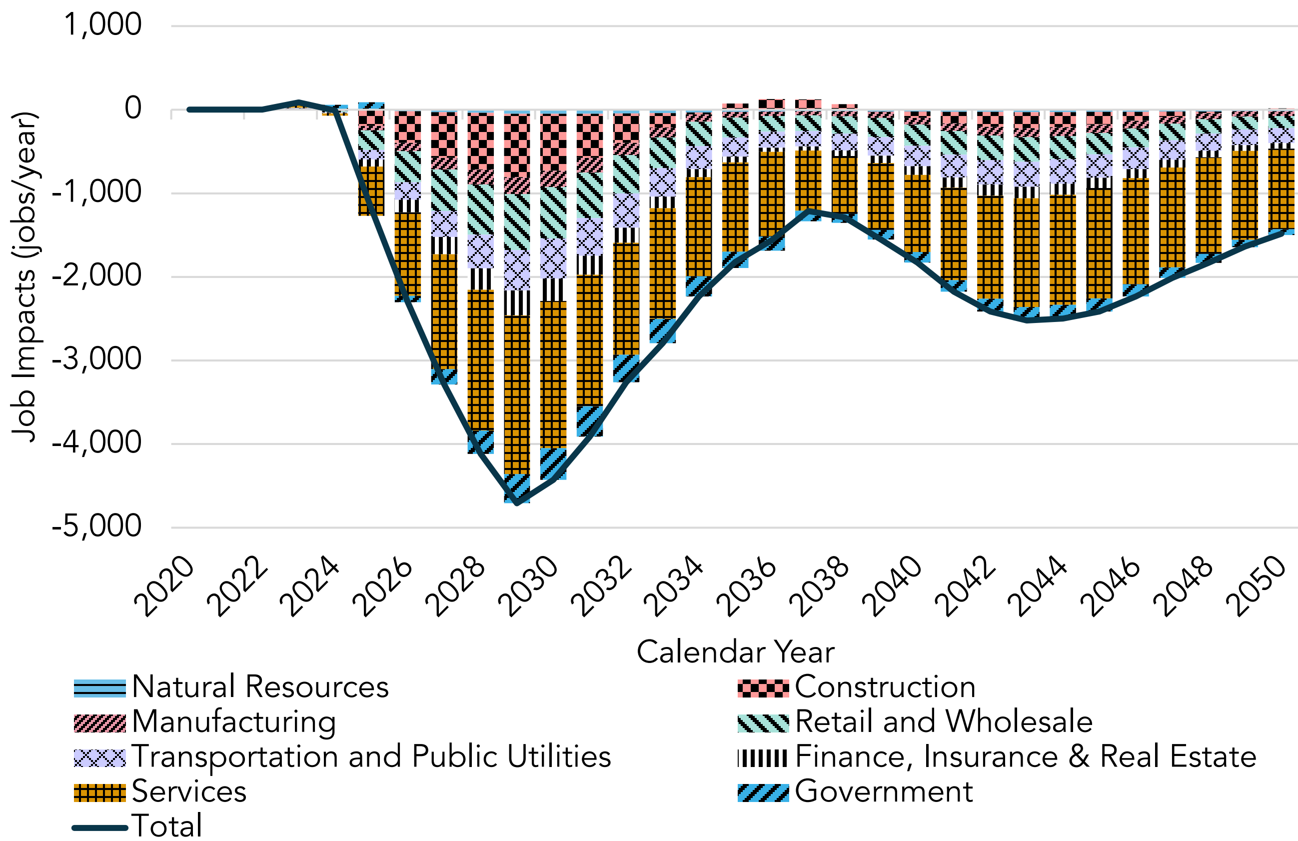
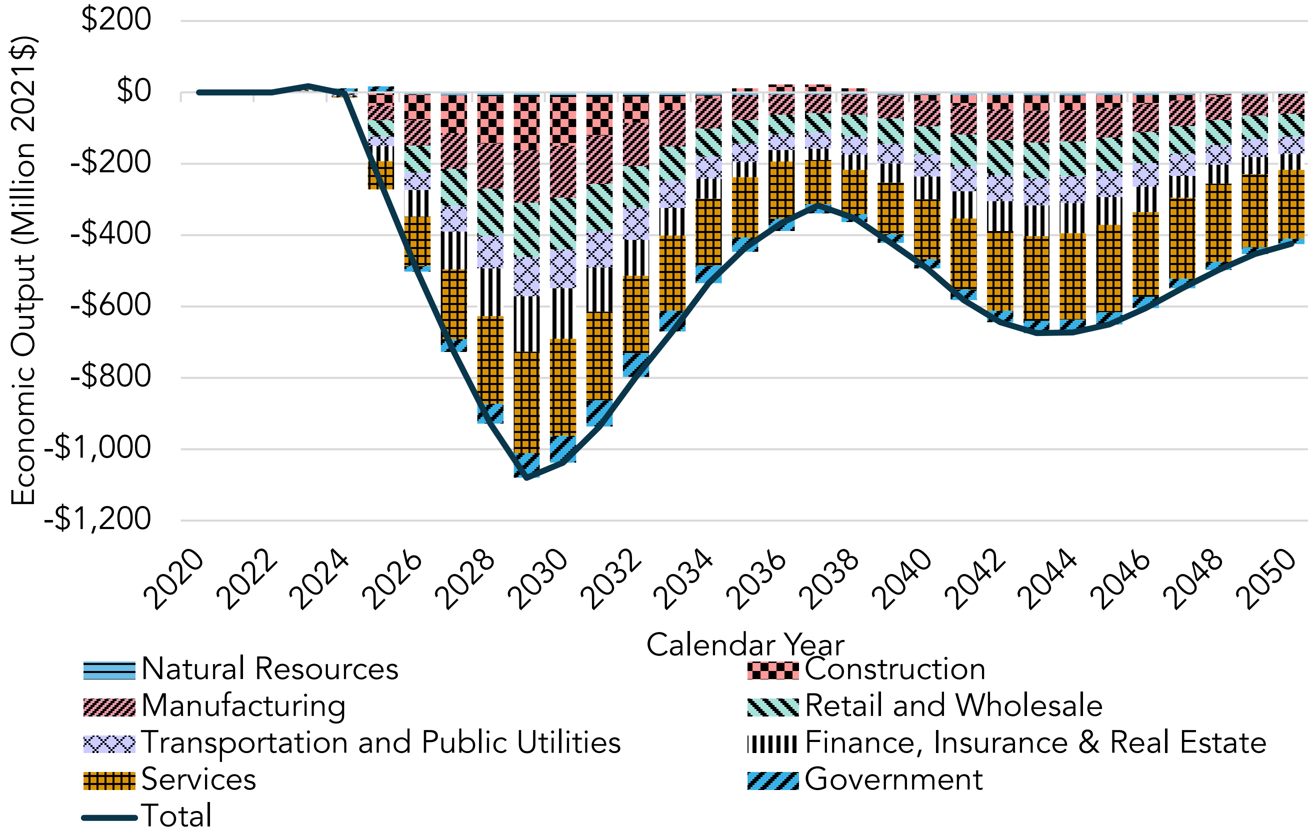


Figure 32. Changes in Output from Alternative 1 by Major Sector



6.1.4 Cost-Effectiveness

Cost-effectiveness is defined as the cost to achieve a ton of emissions reductions. However, like the proposed regulation, Alternative 1, has a lower net cost than the Legal Baseline and can be compared as a benefit-cost ratio. Table 59 shows the estimated benefit-cost ratio for Alternative 1. Alternative 1 has a benefit-cost ratio of 3.8 that is higher than the 1.5 benefit-cost ratio with the proposed regulation.

Table 59. Benefit-Cost Ratio of the Alternative 1 (billion $2021)

Alternative	Total Costs	Cost-Savings (benefit)	Health Benefits	Tax and Fee Revenue	Total Benefit	Net Benefit	Benefit-Cost Ratio
Alternative 1	$6.7	$2.9	$22.7	$0.0	$25.6	$18.8	3.8

6.1.5 Reason for Rejecting

Alternative 1 is rejected because it fails to adequately advance the adoption of medium- and heavy-duty ZEV technologies and is not as effective at reducing criteria emissions and achieving carbon neutrality goals. Alternative 1 achieves minimal $PM_{2.5}$ and GHG emissions reductions and is less effective at reducing NOx emissions. It is not as effective as the proposed regulation in meeting objectives to protect public health, achieve attainment, and to maximize benefits in disadvantage communities. Alternative 1 also does not effectively accelerate the deployment of ZEV deployments compared to the proposed regulation and is not consistent with the goals established by the Governor in multiple Executive Orders and by the Board. ZEV deployments are a key part of the State SIP Strategy, and the Climate Change Scoping Plan as a necessary component needed to improve California's air quality and achieve the State's climate protection goals. Therefore, this alternative is rejected because it would not advance CARB's Mobile Source Strategy, it would be less effective at meeting SIP targets, it would be less effective at reducing exposure to $PM_{2.5}$, and would be less effective at achieving California's carbon neutrality targets.

6.2 Alternative 2

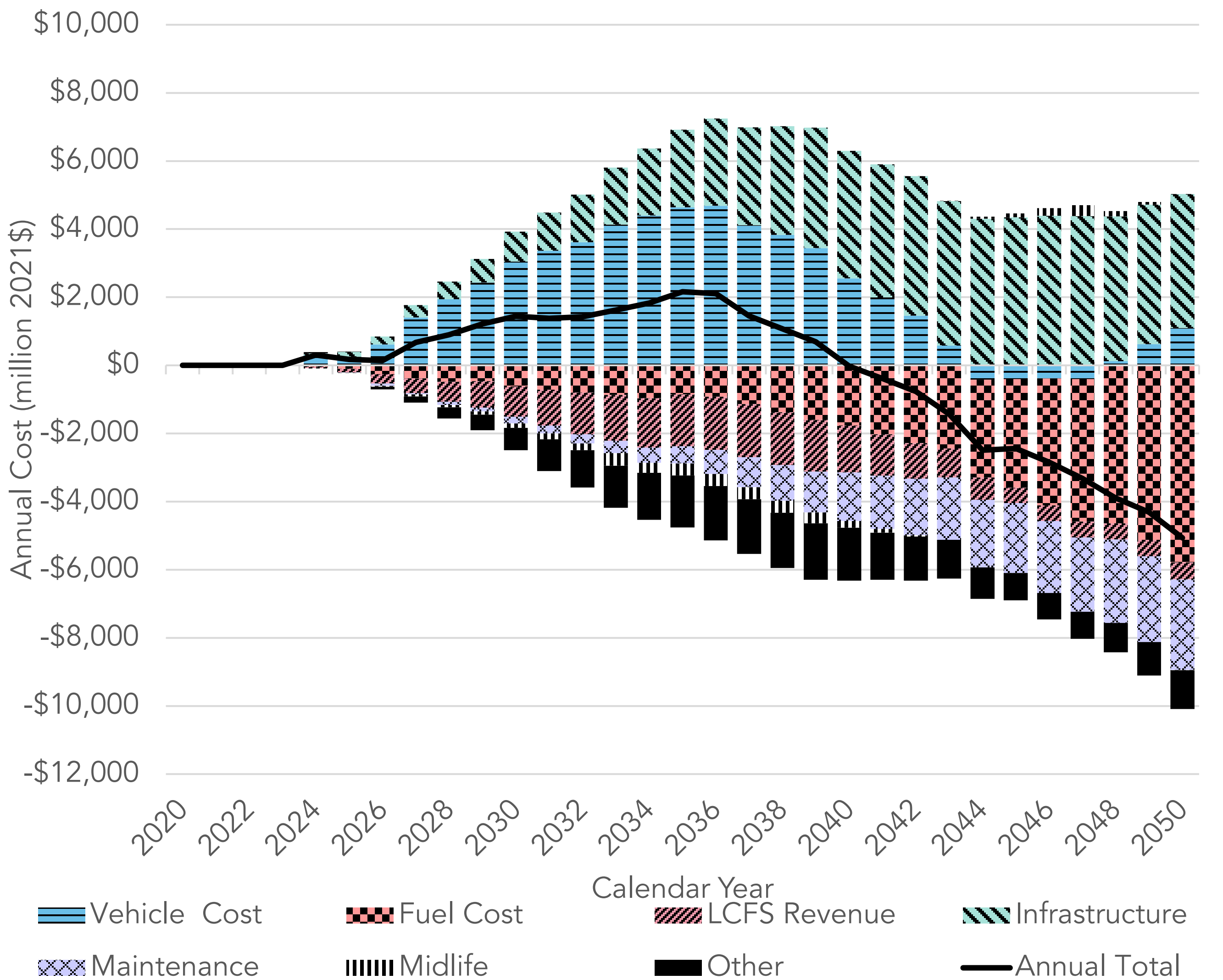
Alternative 2 is a more stringent medium- and heavy-duty ZEV purchase requirement than the proposed regulation. This alternative is based on a comment letter sent by the AMPLY, Los Angeles Cleantech Incubator, Itron, and PCS Energy. This alternative primarily recommends reducing the fleet size threshold for high priority and federal fleets to ten trucks and moves up the date for when all medium- and heavy-duty vehicle sales would need to be ZE.

This alternative is similar to the proposed regulation but includes modifications to the high priority and federal fleet requirements. In this alternative the fleet size threshold would be reduced from 50 vehicles to 10 vehicles. This alternative also includes a 100 percent sales requirement starting in 2036 rather than in 2040. Other aspects of the proposed regulation would stay the same. As such, the ZEV purchase requirement would apply to any entity that owns or controls 10 or more vehicles and to brokers that dispatch 10 or more vehicles per year. No changes would be made to the drayage truck requirement. Alternative 2 would increase the number of fleets affected and the number of medium- and heavy-duty ZEVs deployed.

6.2.1 Costs

Alternative 2 increases the number of medium- and heavy-duty ZEVs sold in California relative to the Legal Baseline. ZEV sales would also be higher than under the proposed regulation. This results in higher initial costs and lower net costs to California compared to the Legal Baseline. The cost to the California economy when assuming all costs occur in California would be -$8.5 billion between 2020 and 2050 in Alternative 2 versus the Legal Baseline scenario. In comparison, the cost of the proposed regulation is -$12.4 billion between 2020 and 2050 versus the Legal Baseline. The negative costs correspond to a net savings for the State. Figure 33 illustrates the incremental difference in cost between Alternative 2 and the Legal Baseline scenario.

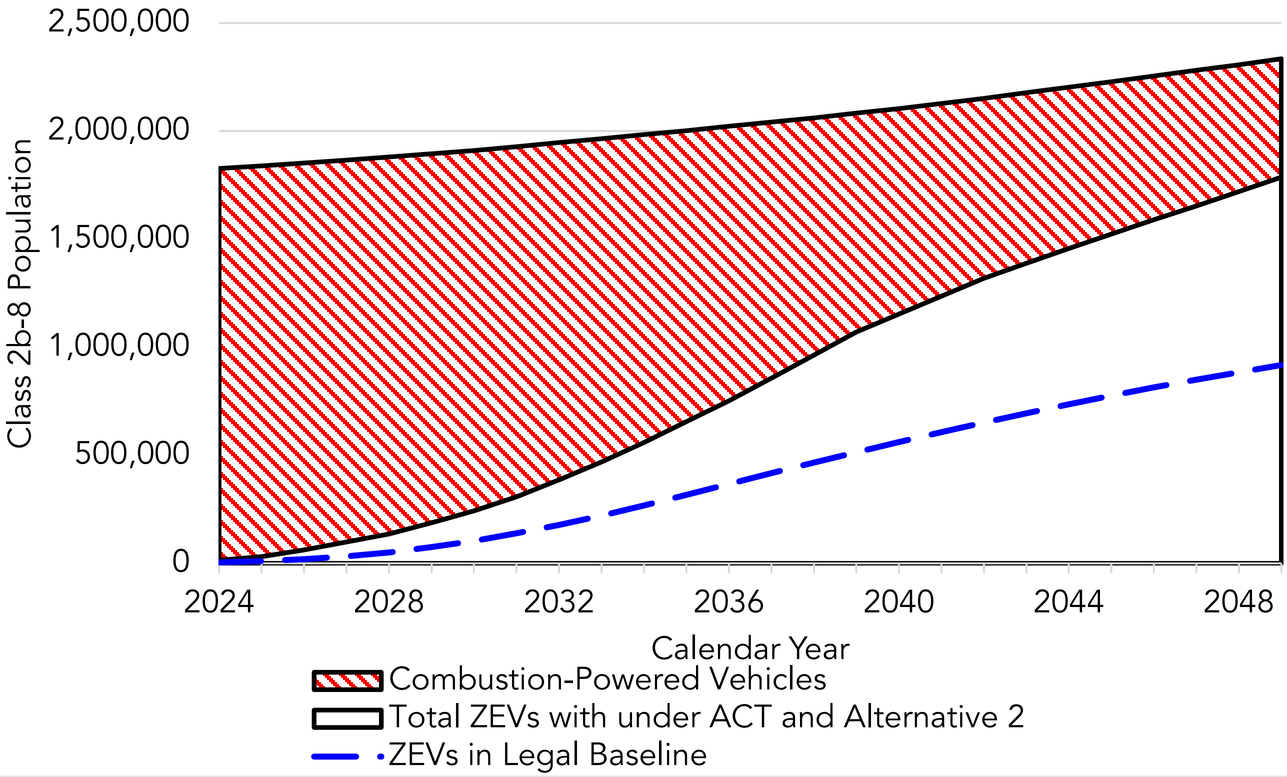
Figure 33. Total Estimated Direct Costs of Alternative 2 Relative to the Legal Baseline Scenario (million 2021$)



6.2.2 Benefits

Alternative 2 results in more medium- and heavy-duty ZEVs deployed than the Legal Baseline scenario and the proposed regulation and achieves more emissions benefits than the proposed regulation. Figure 34 illustrates the ZEV population over time under Alternative 2 in comparison to the proposed regulation. Alternative 2 results in roughly 520,000 ZEVs by 2035 and 1,260,000 ZEVs by 2050. This is an increase of 320,000 ZEVs by 2050 versus the Legal Baseline and 60,000 more ZEVs in 2050 than the proposed regulation.

Figure 34. Statewide Population Forecast over Time under Alternative 2



6.2.2.1 Emissions Benefits

Alternative 2 results in greater medium- and heavy-duty ZEV deployments compared to the Legal Baseline scenario and the proposed regulation. This Alternative provides more cumulative NOx, $PM_{2.5}$ and CO_2 benefits due to the more stringent ZEV purchase requirement for high priority fleets. The cumulative emissions benefits for the more stringent alternative relative to the Legal Baseline accounts for approximately 443 MMT of CO_2, 636,100 tons of NOx, and 12,800 tons of $PM_{2.5}$ from 2024 – 2050, whereas the proposed regulation relative to the Legal Baseline provides approximately 316 MMT CO_2, 443,800 tons of NOx, and 9,300 tons of $PM_{2.5}$ reductions during the same time period. Table 60 summarizes the expected annual NOx, $PM_{2.5}$, and CO_2 benefits in Alternative 2 from 2024 through 2050.

Table 60. Alternative 2 NOx, $PM_{2.5}$, and GHG Benefits Relative to the Legal Baseline

Calendar Year	NOx (tpd)	$PM_{2.5}$ (tpd)	CO_2 (MMT/year)
2024	0.5	0.009	0.2
2025	1.6	0.03	0.5
2026	4.6	0.08	1.2
2027	8.1	0.1	1.9
2028	11.1	0.2	2.6
2029	16.6	0.3	3.9
2030	22.1	0.4	5.0
2031	28.8	0.5	6.4
2032	35.6	0.6	7.9
2033	42.2	0.7	9.2
2034	51.3	0.9	11.1
2035	60.2	1.1	12.9
2036	68.7	1.2	14.8
2037	77.9	1.4	16.9
2038	87.7	1.7	19.0
2039	98.2	1.9	21.1
2040	105.8	2.1	22.8
2041	114.0	2.3	24.5
2042	122.9	2.5	26.3
2043	125.1	2.6	26.9
2044	127.5	2.7	27.6
2045	130.1	2.8	28.2
2046	133.0	2.8	28.9
2047	136.0	2.9	29.6
2048	139.5	3.0	30.4
2049	143.1	3.1	31.2
2050	146.8	3.2	32.0

Figure 35, Figure 36, and Figure 37 represent the difference in GHG, NOx, and $PM_{2.5}$ emissions between Legal Baseline and Alternative 2.

Figure 35. Projected GHG Emissions under Legal Baseline, Proposed Regulation, and Alternative 2

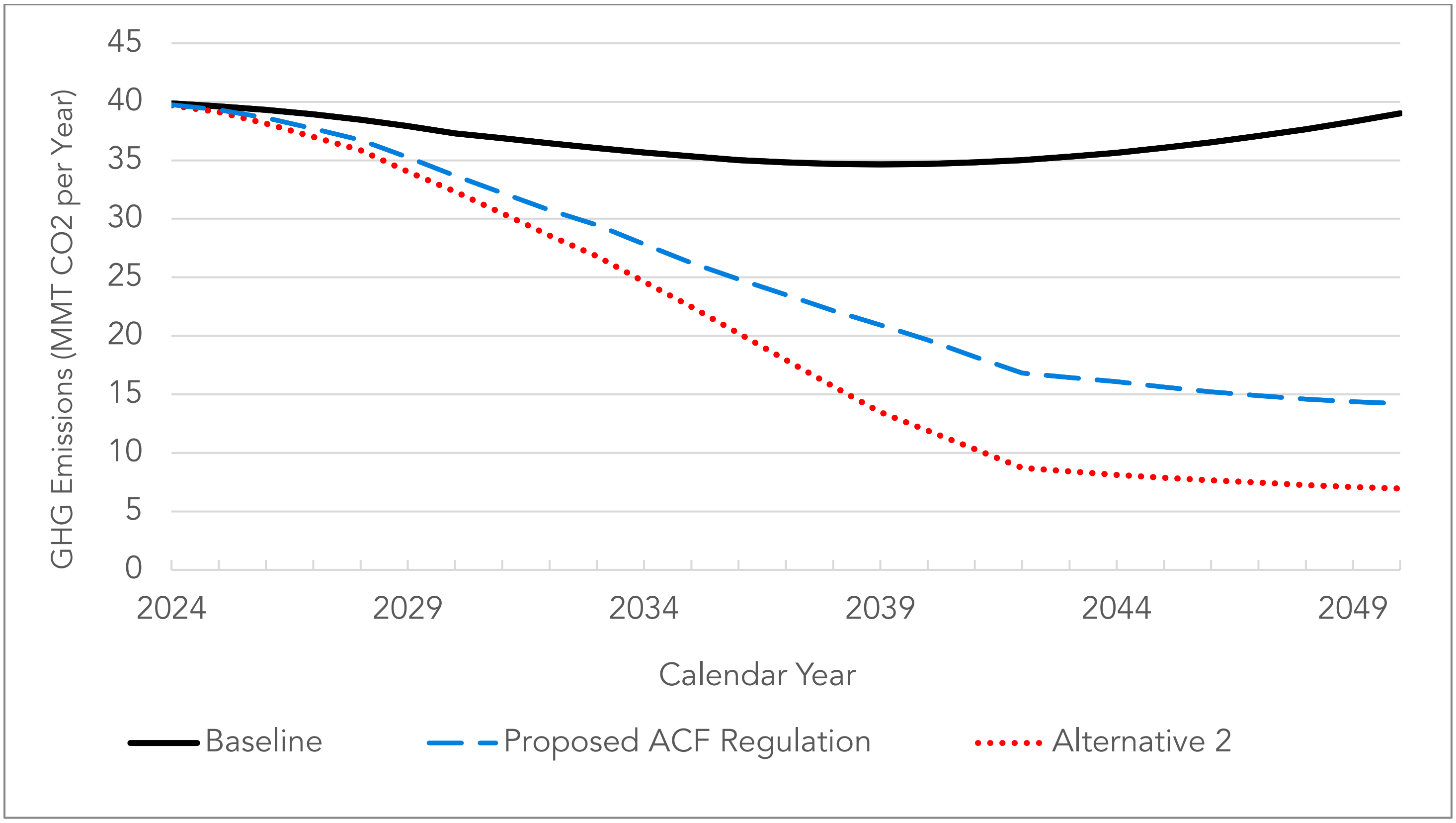


Figure 36. Projected NOx Emissions under Legal Baseline, Proposed Regulation, and Alternative 2

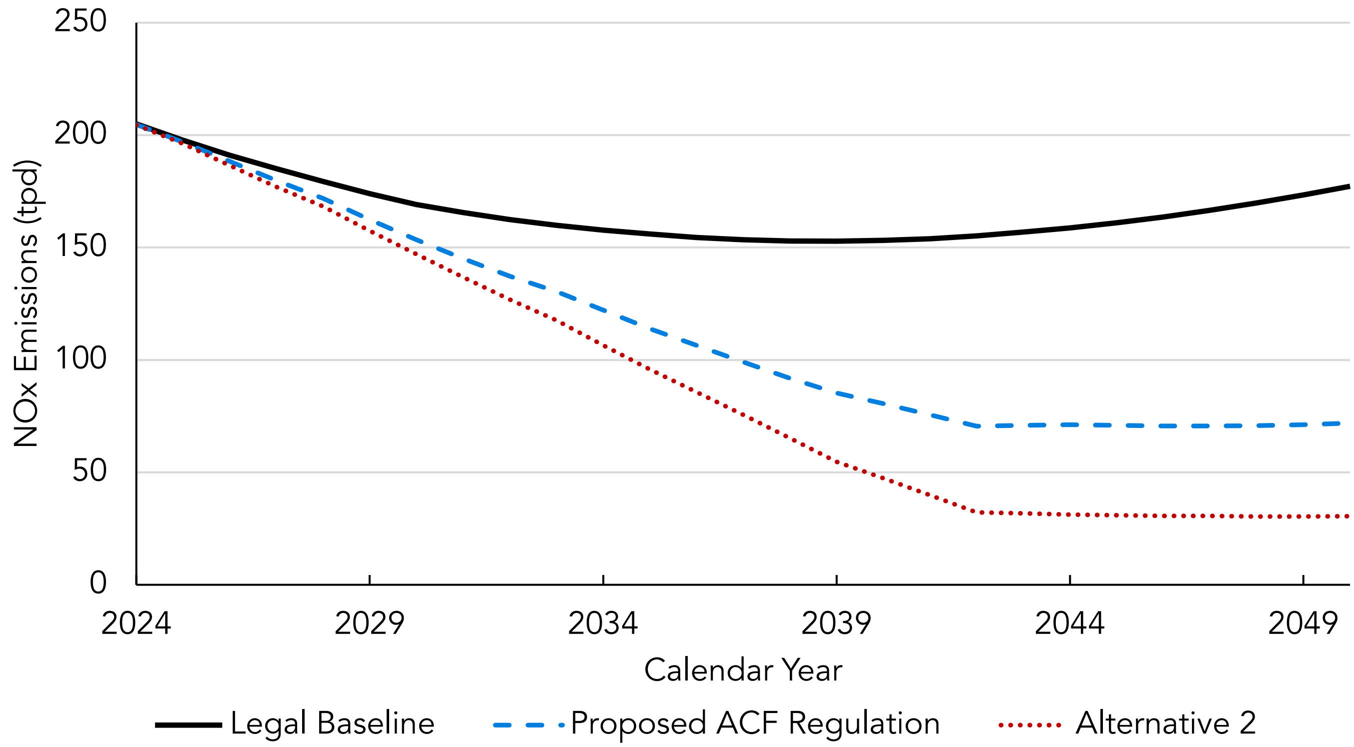
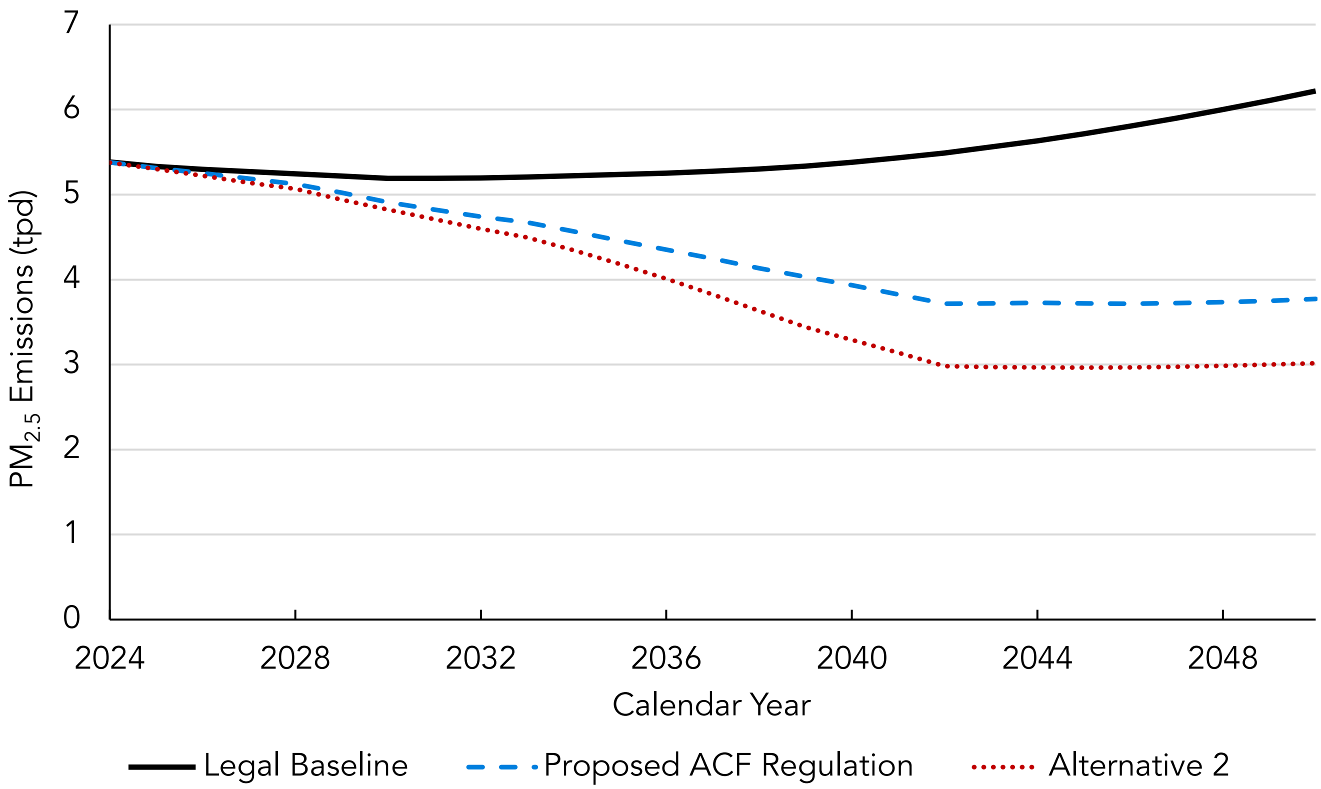


Figure 37. Projected $PM_{2.5}$ Emissions under Legal Baseline, Proposed Regulation, and Alternative 2



The cumulative GHG emissions reductions multiplied by the SC-CO_2 values gives a monetary estimate of the benefit of GHG emissions reductions from Alternative 2. These benefits range from about $13.5 billion to $54.4 billion through 2050, depending on the chosen discount rate.

6.2.2.2 Health Benefits

Alternative 2 results in emissions reductions relative to the Legal Baseline leading to health benefits as shown in Table 61. The health benefits for Alternative 2 are greater than those of the proposed regulation due to higher estimated emissions reductions. The total statewide valuation of health benefits of the more stringent alternative is estimated to be $87.6 billion.

Table 61. Statewide Valuation from Avoided Health Outcomes for Alternative 2 (million 2021$)

Calendar Year	Avoided Cardiopulmonary Mortality	Avoided Hospitalizations for Cardiovascular Illness	Avoided Hospitalizations for Respiratory Illness	Avoided ER Visits	Total Avoided Annual Valuation*
2024	2	0	0	1	**$20.9**

Calendar Year	Avoided Cardiopulmonary Mortality	Avoided Hospitalizations for Cardiovascular Illness	Avoided Hospitalizations for Respiratory Illness	Avoided ER Visits	Total Avoided Annual Valuation*
2025	6	1	1	3	**$62.8**
2026	16	2	3	8	**$167.6**
2027	28	4	5	14	**$293.2**
2028	39	5	6	19	**$408.4**
2029	59	8	10	28	**$617.8**
2030	80	11	14	38	**$837.8**
2031	105	15	18	50	**$1,099.6**
2032	132	19	23	63	**$1,382.4**
2033	158	24	28	75	**$1,654.8**
2034	194	29	35	92	**$2,031.8**
2035	231	35	42	109	**$2,419.4**
2036	267	41	49	125	**$2,796.5**
2037	307	48	57	143	**$3,215.5**
2038	349	55	65	162	**$3,655.5**
2039	394	62	74	183	**$4,126.8**
2040	429	68	81	198	**$4,493.5**
2041	467	74	88	215	**$4,891.5**
2042	507	80	96	233	**$5,310.4**
2043	520	83	99	238	**$5,446.7**
2044	534	85	102	244	**$5,593.3**
2045	549	88	105	250	**$5,750.5**
2046	564	91	108	256	**$5,907.7**
2047	579	94	112	263	**$6,064.9**
2048	597	97	116	270	**$6,253.5**
2049	614	100	119	278	**$6,431.5**
2050	633	103	123	286	**$6,630.6**
Total Benefit*	**$87,394.6**	**$81.6**	**$85.0**	**$3.4**	**$87,564.7**

*Note: Totals may differ due to rounding

6.2.3 Economic Impacts

Alternative 2 would impose a more stringent medium- and heavy-duty ZEVs sales requirement compared to the proposed regulation. This results in a greater incremental vehicle cost as passed-through to fleets, but also more Phase 2 GHG cost offsets and more fuel savings. The macroeconomic impacts analysis results show that this alternative would result in similar impacts to the proposal on employment and output but of a greater magnitude as displayed in Table 62.

Table 62. Change in Growth of Economic Indicators for Alternative 2

Indicator	Metric	2026	2030	2034	2038	2042	2046	2050
GSP	% Change	-0.01%	-0.09%	-0.16%	-0.18%	-0.17%	-0.11%	-0.13%
	Change (2021M$)	-300	-3,658	-6,738	-8,088	-7,964	-5,571	-7,538
Personal Income	% Change	-0.04%	-0.17%	-0.27%	-0.27%	-0.21%	-0.11%	-0.10%
	Change (2021M$)	-1,377	-5,763	-9,955	-10,840	-9,020	-5,302	-5,003
Employment	% Change	-0.01%	-0.11%	-0.20%	-0.25%	-0.25%	-0.19%	-0.24%
	Change in Jobs	-1,867	-28,367	-53,220	-66,612	-68,490	-52,800	-69,149
Output	% Change	-0.01%	-0.10%	-0.18%	-0.20%	-0.19%	-0.14%	-0.17%
	Change (2021M$)	-546	-6,404	-11,841	-14,590	-15,077	-11,483	-15,402
Private Investment	% Change	-0.06%	-0.28%	-0.32%	-0.11%	0.20%	0.42%	0.41%
	Change (2021M$)	-344	-1,594	-1,951	-706	1,364	3,124	3,260

Figure 38. Job Impacts of Alternative 2 by Major Sector

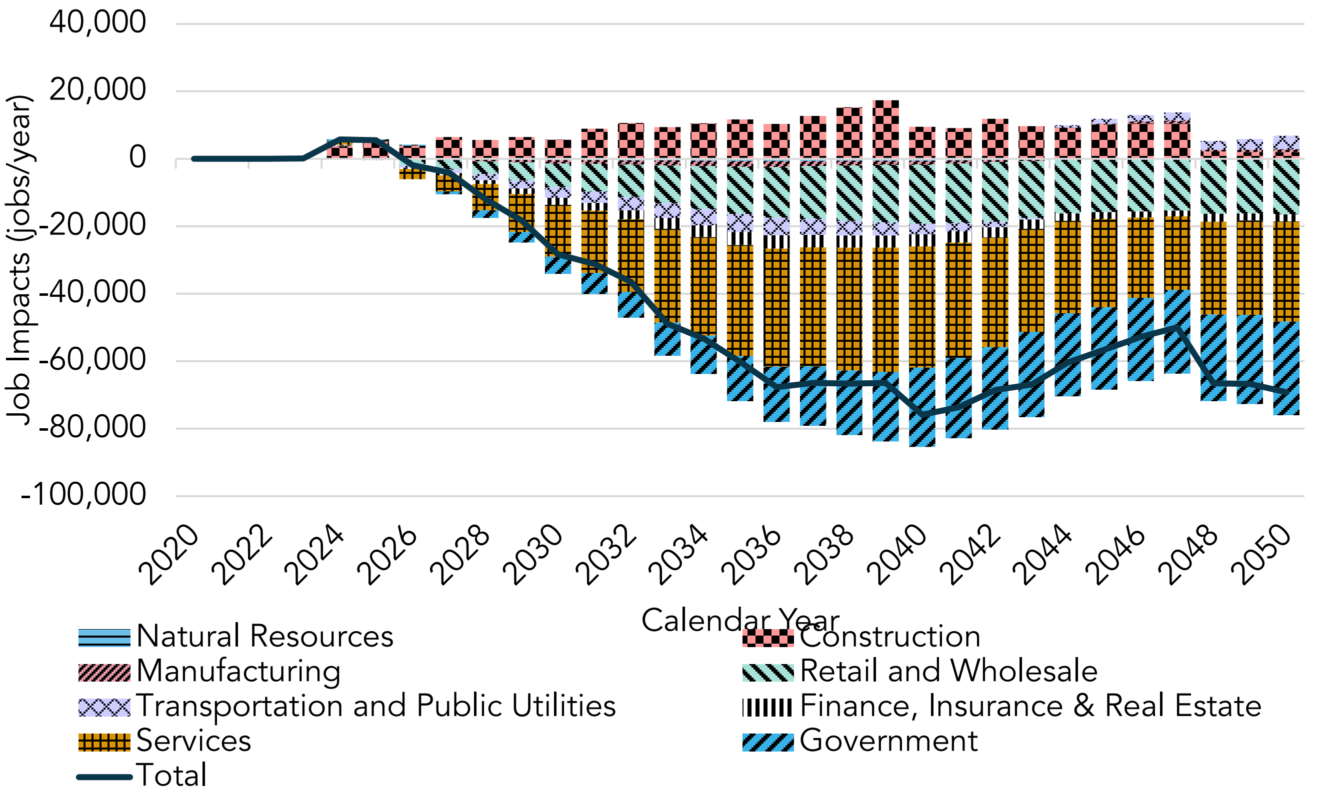
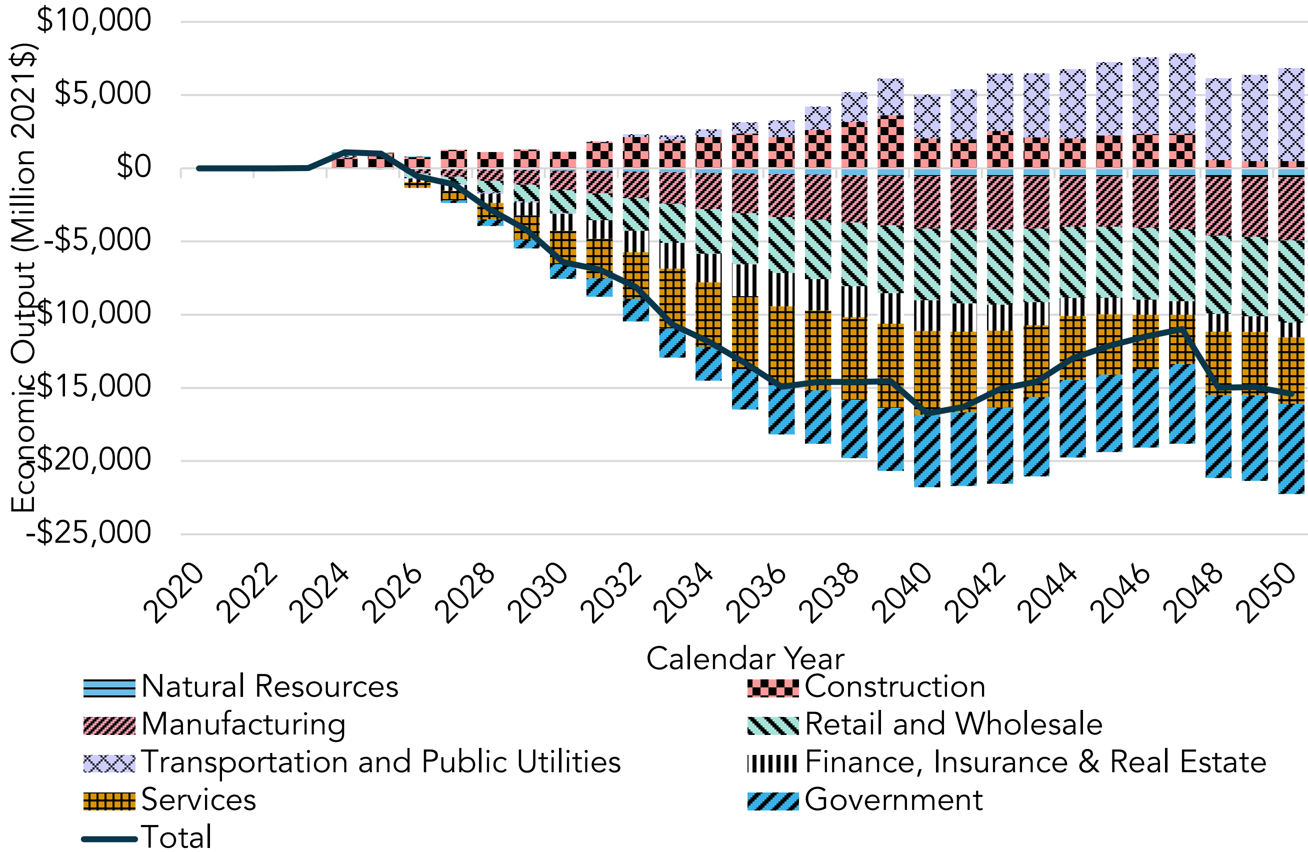


Figure 39. Changes in Output from Alternative 2 by Major Sector



6.2.4 Cost-Effectiveness

Cost-effectiveness is defined as the cost to achieve a ton of emissions reductions. However, like the proposed regulation, Alternative 2, has a lower net cost than the Legal Baseline and can be evaluated as a benefit-cost ratio.

For Alternative 2, the total cost from 2020 to 2050 results in higher initial costs due to the increase in ZEVs and a larger total net savings than the proposed regulation. Alternative 2 also achieves greater emissions reductions for criteria pollutants and GHG emissions. Table 63 illustrates the benefit-cost ratio of Alternative 2. Alternative 2 has a benefit-cost ratio of 1.3 that is lower than the 1.5 benefit-cost ratio with the proposed regulation.

Table 63. Benefit-Cost Ratio of the Alternative 2 (billion $2021)

Alternative	Total Costs	Cost-Savings (benefit)	Health Benefits	Tax and Fee Revenue	Total Benefit	Net Benefit	Benefit-Cost Ratio
Alternative 2	$124.9	$133.2	$87.6	-$59	$161.8	$36.9	1.3

6.2.5 Reason for Rejecting

Alternative 2 substantially increases the number of affected fleets and nearly doubles the number of medium- and heavy-duty ZEVs required. The increase in ZEVs is primarily in the Class 2b-3 and Class 7-8 tractor categories. Alternative 2 is rejected as the more aggressive timeframe raises questions about feasibility for certain fleets in the near-term while the ZEV market is still developing. Increasing the purchase requirements further by regulating more fleets would introduce potential market imbalances between required ZEV sales and purchases and more issues on the learning curve in deploying these new technologies in more fleets that could slow progress of the ZEV market in early implementation. This alternative would immediately bring in a wide range of smaller fleets operating statewide that may not operate in major transportation corridors where infrastructure is more likely to be sited in the early years. This alternative also proposes an earlier end date for combustion technologies which increases risks about feasibility for trucks with more challenging use cases, although the 2036 timeframe does provide time for zero-emission solutions to be identified.

With an accelerated timeframe, smaller fleets would not have the opportunity to learn from the experiences of early adopters and larger fleets. For a smooth transition to ZEV technologies, sufficient time is needed to build out maintenance, supply, and infrastructure networks to make a full transition to ZEVs. Smaller fleets are more likely to rely on publicly available charging infrastructure that is still in the process of being developed and may not be available where needed in all cases. Additionally, small fleets are more likely to purchase used vehicles, which may not be available as ZEVs due to the Alternative's accelerated timeframe. This could result in holding ICE vehicles longer as well as an administrative burden for fleets and CARB staff with potential increases in exemption requests as well as other unintended consequences.

Additionally, market forces need to be considered in expanding the early ZEV market. The ACT regulation guarantees a supply of ZEVs in the California market. However, Alternative 2 would result in a fast ramp-up of additional ZEV demand significantly above the expected supply of ZEVs, that may result put upward pressure on vehicle prices. Market dynamics concentrated in the hands of consumer fleets would help maintain downward price pressures and would bring ZEV costs in line with other technologies sooner.

Alternative 2 is rejected because it raises additional questions about timing, introduces additional uncertainty associated with the feasibility of successfully deploying ZEVs in the early market, and results in imbalanced market forces that could slow ZEV deployment. Alternative 2 has a lower cost-benefit ratio but greater emissions benefits and number of ZEVs deployed than the proposed regulation. Staff will continue to analyze the rapidly evolving technical progress of these categories to determine if additional stringency or future regulation is warranted.

7 Modified Baseline Analysis Appendix

As previously discussed, the Legal Baseline used for impact analysis did not include implementation of the HDIM regulation. Therefore, staff is including an additional analysis here that compares the proposed regulation to a Modified Baseline. The Modified Baseline accounts for the effects of the HDIM regulation, which was heard by the Board in December 2021 but has not yet been approved by OAL. The HDIM regulation would reduce statewide PM and NOx emissions from heavy-duty engines by ensuring that the emission control systems are operating as designed and are repaired in a timely manner if they malfunction. The HDIM regulation is anticipated to be fully approved into the California Code of Regulations by the time the proposed regulation would be implemented in 2023. In addition, the Modified Baseline accounts for the potential effects of the proposed Advanced Clean Cars II (ACC II) regulation that is expected to lower criteria emissions standards for Class 2b-3 vehicles that would be included in the proposed regulation. ACC II is anticipated to be presented to the Board in the summer of 2022. ACC II impacts on the proposed regulation's emissions benefits are negligible, accounting for less than 0.1 tons per day for vehicles over 8500 lbs. GVWR. In general, staff used the same benefit and cost impact analysis methodologies as described above for the Legal Baseline to analyze the scenario including the proposed HDIM and ACC II regulations in the baseline. Broadly, the Modified Baseline has lower criteria pollutant emissions and higher costs than the Legal Baseline which change both the costs and benefits of the proposed regulation. The Modified Baseline does not substantially change the alternatives analysis nor the conclusions drawn when using the Legal Baseline.

7.1 Benefits

7.1.1 Criteria Emissions Benefits

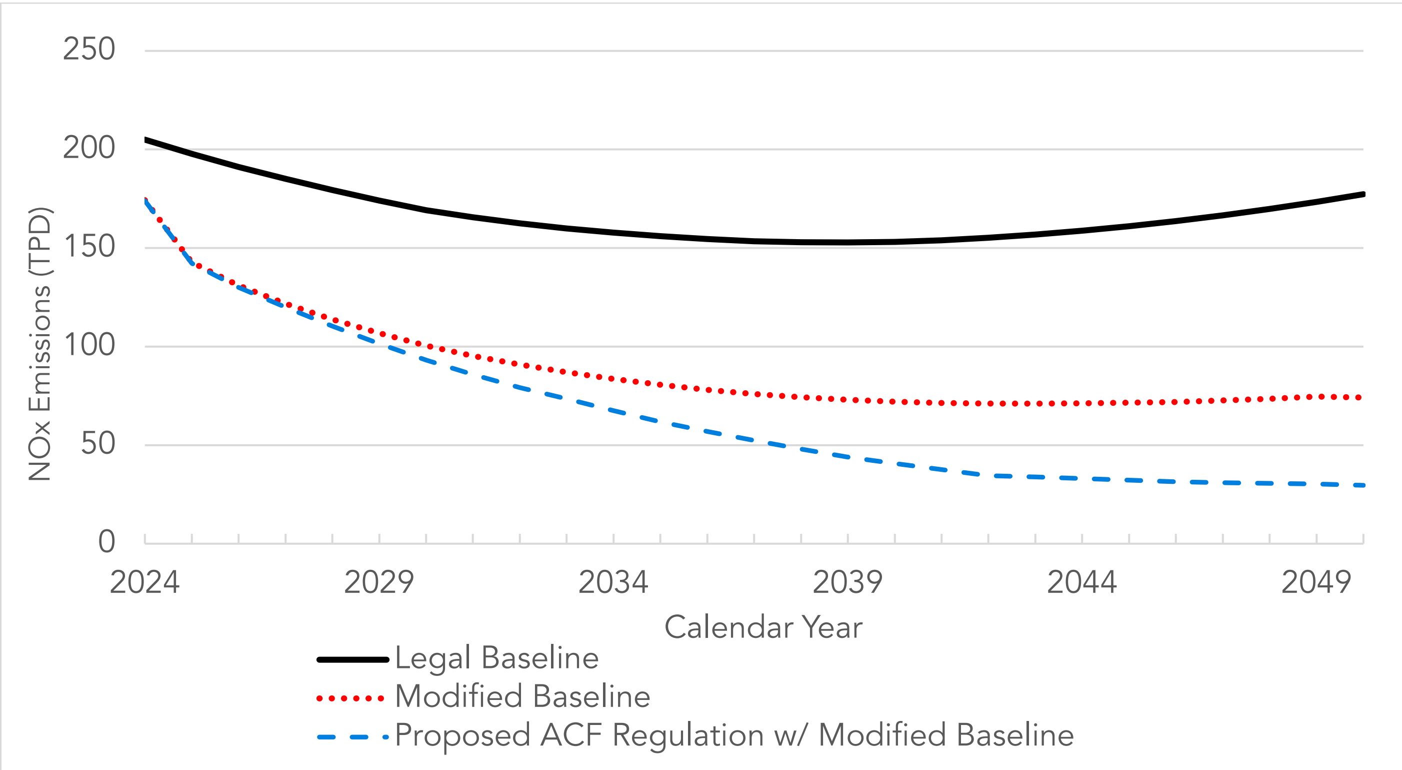
The emissions benefits for the proposed regulation with the Modified Baseline are shown in Table 64. The cumulative NOx and PM emissions benefits of the proposed regulation with Modified Baseline are projected to be about 55 percent and 25 percent lower respectively, compared to the analysis using the Legal Baseline because the HDIM program will ensure that heavy-duty engine emissions standards continue to be met throughout the vehicles' operating life through implementation of more comprehensive vehicle inspection and maintenance. This change lowers both the NOx and PM emissions benefits expected from the proposed regulation when a ZEV is purchased instead of an ICE vehicle.

Table 64. Projected Statewide TTW NOx and $PM_{2.5}$ Emissions Benefits of the Proposed Regulation with the Modified Baseline

Calendar Year	NOx (tpd)	$PM_{2.5}$ (tpd)
2024	0.3	0.0061
2025	0.4	0.011
2026	0.9	0.027
2027	1.9	0.049
2028	3.4	0.078
2029	5.3	0.14
2030	7.2	0.20
2031	9.5	0.27
2032	11.7	0.33
2033	13.5	0.39
2034	16.1	0.48
2035	18.8	0.57
2036	21.1	0.66
2037	23.6	0.75
2038	26.3	0.85
2039	29.1	0.96
2040	31.4	1.1
2041	33.9	1.20
2042	36.6	1.34
2043	37.3	1.40
2044	38.1	1.46
2045	39.3	1.53
2046	40.5	1.61
2047	41.7	1.67
2048	43.0	1.75
2049	44.3	1.82
2050	44.6	1.88

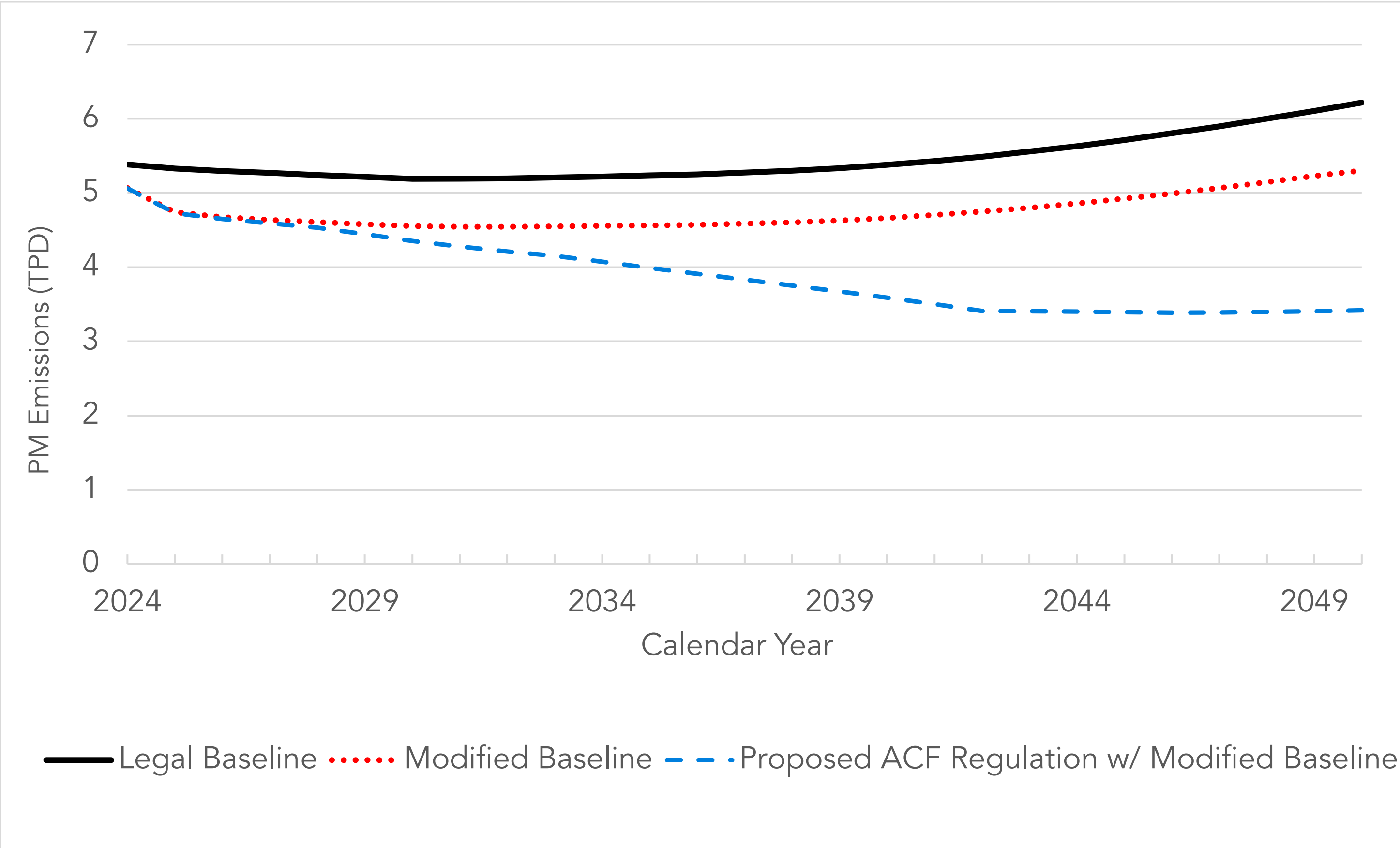
Figure 40 compares the NOx emissions for the proposed regulation with the Modified Baseline, the Legal Baseline, and the Proposed ACF Regulation with Modified Baseline scenarios. The cumulative NOx emissions benefits of the proposed regulation with the Modified Baseline compared to the Legal Baseline and Modified Baseline from 2024-2050 are approximately 843,800 tons and 193,400 tons, respectively.

Figure 40. Projected TTW NOx Emissions Benefits for the Proposed Regulation with Modified Baseline relative to the Legal Baseline and Modified Baseline (tpd)



Similarly, Figure 41 compares the PM emissions for the proposed regulation with the Modified Baseline, Legal Baseline, and Modified Baseline. The cumulative PM emissions benefits of the proposed regulation with the Modified Baseline compared to the Legal Baseline and Modified Baseline from 2024-2050 are approximately 12,900 tons and 7,000 tons, respectively.

Figure 41. Projected TTW PM Emissions Benefits for the Proposed Regulation with Modified Baseline relative to the Legal Baseline and Modified Baseline (tpd)



7.1.2 GHG Emissions Benefits

The HDIM regulation does not change the GHG emissions of heavy-duty vehicles, so there are no changes in the GHG emissions reductions or SC-CO_2 between the Modified Baseline and the Legal Baseline. All calculations from Chapter “2 Benefits”, in Section “2.1 – Emissions Benefits" are identical between the two Baseline scenarios.

7.1.3 Health Benefits

Table 65 summarizes staff’s estimated avoided statewide and regional premature mortality, hospitalizations, and ER visits associated with the proposed regulation relative to the Modified Baseline for 2024 through 2050.

Table 65. Regional and Statewide Avoided Mortality and Morbidity Incidents from 2024 to 2050 under the Proposed Regulation versus the Modified Baseline

Air Basin	Avoided Cardiopulmonary Deaths	Avoided Hospitalizations for cardiovascular illness	Avoided Hospitalizations for respiratory illness	Avoided ER visits for asthma
Great Basin Valleys	2 (2 - 2)	0 (0 - 0)	0 (0 - 1)	1 (0 - 1)
Lake County	2 (1 - 2)	0 (0 - 0)	0 (0 - 0)	1 (0 - 1)
Lake Tahoe	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Mojave Desert	49 (39 - 61)	7 (0 - 15)	9 (2 - 16)	19 (12 - 26)
Mountain Counties	28 (21 - 34)	3 (0 - 5)	3 (1 - 5)	9 (6 - 12)
North Central Coast	13 (10 - 16)	2 (0 - 5)	3 (1 - 5)	7 (5 - 10)
North Coast	5 (4 - 7)	1 (0 - 1)	1 (0 - 1)	2 (1 - 3)
Northeast Plateau	2 (1 - 2)	0 (0 - 0)	0 (0 - 0)	1 (0 - 1)
Sacramento Valley	137 (107 - 168)	18 (0 - 35)	21 (5 - 37)	51 (32 - 70)
Salton Sea	37 (28 - 45)	6 (0 - 11)	7 (2 - 12)	17 (11 - 23)
San Diego County	135 (105 - 166)	20 (0 - 40)	24 (6 - 43)	53 (34 - 73)
San Francisco Bay	255 (199 - 312)	41 (0 - 81)	49 (11 - 87)	137 (86 - 187)
San Joaquin Valley	519 (406 - 633)	66 (0 - 130)	79 (18 - 139)	183 (116 - 250)
South Central Coast	37 (29 - 46)	6 (0 - 12)	7 (2 - 12)	16 (10 - 22)
South Coast	1807 (1413 - 2209)	312 (0 - 611)	372 (87 - 657)	906 (573 - 1239)
Statewide	3029 (2368 - 3703)	482 (0 - 945)	575 (135 - 1015)	1403 (888 - 1919)

The total statewide valuation of health benefits for the proposed regulation with the Modified Baseline are estimated to be $31.6 billion as summarized in Table 66. The health benefit valuation is about 48 percent lower relative to the analysis using the Legal Baseline, due to the lower projected NOx and PM emissions benefits.

Table 66. Statewide Valuation from Avoided Health Outcomes for the Proposed Regulation versus the Modified Baseline (million 2021$)

Year	Avoided cardiopulmonary mortality	Avoided hospitalizations for cardiovascular illness	Avoided hospitalizations for respiratory illness	Avoided ER visits for asthma	Avoided annual total valuation*
2024	1	0	0	0	**$10.5**
2025	2	0	0	1	**$20.9**
2026	4	0	1	2	**$41.9**
2027	7	1	1	4	**$73.3**
2028	13	2	2	6	**$136.1**
2029	21	3	4	10	**$219.9**
2030	30	4	5	14	**$314.1**
2031	40	6	7	19	**$418.9**

Year	Avoided cardiopulmonary mortality	Avoided hospitalizations for cardiovascular illness	Avoided hospitalizations for respiratory illness	Avoided ER visits for asthma	Avoided annual total valuation*
2032	49	7	9	24	$513.2
2033	58	9	10	28	$607.4
2034	70	11	13	33	$733.2
2035	83	13	15	39	$869.3
2036	95	15	18	45	$995.0
2037	108	17	20	51	$1,131.2
2038	121	19	23	57	$1,267.4
2039	136	21	26	63	$1,424.5
2040	149	24	28	69	$1,560.7
2041	164	26	31	76	$1,717.8
2042	180	29	34	83	$1,885.4
2043	186	30	35	86	$1,948.3
2044	192	31	37	89	$2,011.1
2045	200	32	38	92	$2,094.9
2046	208	34	40	95	$2,178.7
2047	216	35	42	99	$2,262.6
2048	225	37	44	103	$2,356.9
2049	233	38	45	106	$2,440.6
2050	237	39	46	108	$2,482.6
Total Benefit *	$31,654.4	$29.8	$30.9	$1.2	$31,716.4

*Note: Totals may differ due to rounding

7.2 Costs

7.2.1 Direct Costs

The Modified Baseline has higher costs than the Legal Baseline due to the costs associated with the HDIM regulation which affects non-gasoline Class 4-8 vehicles operating within California. ZEVs are not subject to many provisions of the HDIM regulation and as a result can avoid many of the costs associated with the regulation.[198] Costs associated with the HDIM regulation are derived from the Staff Report and are summarized in Table 67. These

[198] California Air Resources Board, *Proposed Heavy-Duty Inspection and Maintenance Regulation – Appendix F: Further Details on Costs and Economic Analysis*, 2021 (web link: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2021/hdim2021/appf.pdf, last accessed January 2022).

costs differ depending on whether the vehicle is based in-state or out-of-state, and whether the vehicle is equipped with on-board diagnostics (OBD).

Table 67. Annual Heavy-Duty Inspection and Maintenance Costs per Vehicle

Cost	Non-OBD In-State	Non-OBD Out-of-State	OBD In-State	OBD Out-of-State	ZEV
Inspection Result Reporting	$5.70	$5.70	$0	$0	$0
Periodic Testing and Follow-up Testing	$41	$401	$24	$24	$0
Repair Costs	$279	$211	$228	$172	$0

The cost of the proposed regulation, assuming all cost increases would be borne by fleets operating in California, is -$13.4 billion between 2020 and 2050 compared to the Modified Baseline. These savings are $0.9 billion greater than when the proposed regulation is compared to Legal Baseline. Figure 42 and Table 68 illustrate the incremental difference in cost between the proposed regulation and the Modified Baseline scenario. For simplicity, all costs which are identical to the legal baseline have been lumped together into one group, titled "Cost Versus Legal Baseline", which are identical to the costs displayed in Table 39. The benefit-cost ratio of the proposed regulation versus the modified baseline is shown in Table 69.

Figure 42. Total Estimated Direct Costs of Proposed Regulation Relative to the Legal Baseline Scenario (million 2021$)

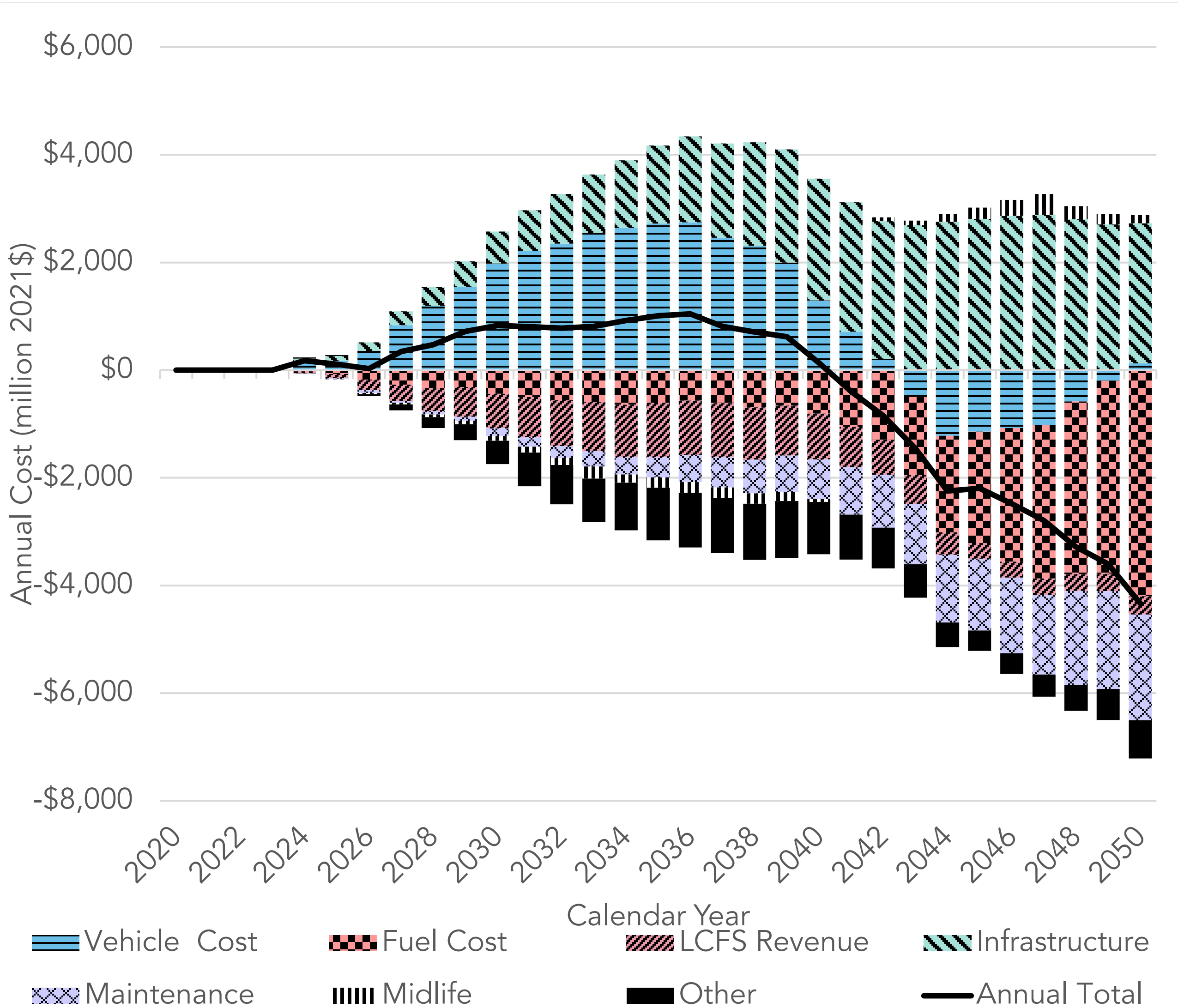


Table 68. Total Incremental Direct Costs of Proposed Regulation Relative to Modified Baseline Scenario (million 2021$)

Year	Cost Versus Legal Baseline	Heavy-Duty Inspection and Maintenance Program	Total *
2024	$174	-$1	$173
2025	$108	-$2	$106
2026	$28	-$3	$25
2027	$345	-$5	$340
2028	$475	-$7	$468
2029	$727	-$10	$717
2030	$837	-$12	$825
2031	$819	-$15	$803
2032	$795	-$19	$776
2033	$830	-$22	$808
2034	$945	-$26	$919
2035	$1,037	-$31	$1,006
2036	$1,074	-$34	$1,040
2037	$843	-$37	$806
2038	$744	-$40	$705
2039	$658	-$43	$615
2040	$179	-$45	$134
2041	-$352	-$47	-$399
2042	-$798	-$50	-$847
2043	-$1,407	-$51	-$1,458
2044	-$2,199	-$53	-$2,252
2045	-$2,148	-$54	-$2,203
2046	-$2,426	-$57	-$2,483
2047	-$2,742	-$59	-$2,801
2048	-$3,224	-$62	-$3,286
2049	-$3,541	-$64	-$3,605
2050	-$4,271	-$68	-$4,339
Total*	-$12,384	-$916	-$13,301

*Note: Totals may differ due to rounding

Table 69. Benefit-Cost Ratio of the Proposed Regulation Versus the Modified Baseline (billion $2021)

Category	Total Costs	Cost-Savings (benefit)	Health Benefits	Tax and Fee Revenue	Total Benefit	Net Benefit	Benefit-Cost Ratio
Proposal	$84.6	$107.5	$31.7	-$37	$102.2	-$16.5	1.2

7.2.2 Macroeconomics

Table 70, Table 71, Figure 43, and Figure 44 shows the impact of the proposed regulation relative to the Modified Baseline on select macroeconomic indicators in the economy. The macroeconomic analysis of the proposed regulation using the Modified Baseline shows that the major macroeconomic indicators would have a similar range of impact as using the Legal Baseline from 2024 to 2050, though they vary by year.

Table 70. Change in the Growth of Economic Indicators relative to the Modified Baseline

Indicator	Metric	2026	2030	2034	2038	2042	2046	2050
GSP	% Change	0.00%	-0.06%	-0.10%	-0.12%	-0.08%	-0.04%	-0.08%
	Change (2021M$)	-43	-2,420	-4,168	-5,276	-3,796	-2,293	-4,276
Personal Income	% Change	-0.02%	-0.11%	-0.17%	-0.18%	-0.11%	-0.05%	-0.04%
	Change (2021M$)	-764	-3,854	-6,195	-7,140	-4,744	-2,180	-2,070
Employment	% Change	0.00%	-0.07%	-0.13%	-0.16%	-0.13%	-0.09%	-0.15%
	Change in Jobs	21	-18,836	-33,107	-43,138	-34,578	-25,573	-41,992
Output	% Change	0.00%	-0.07%	-0.11%	-0.13%	-0.10%	-0.06%	-0.10%
	Change (2021M$)	-99	-4,256	-7,379	-9,506	-7,440	-5,253	-9,117
Private Investment	% Change	-0.03%	-0.18%	-0.19%	-0.07%	0.17%	0.33%	0.31%
	Change (2021M$)	-172	-1,040	-1,141	-453	1,200	2,437	2,492

Figure 43. Job Impacts by Major Sector relative to the Modified Baseline

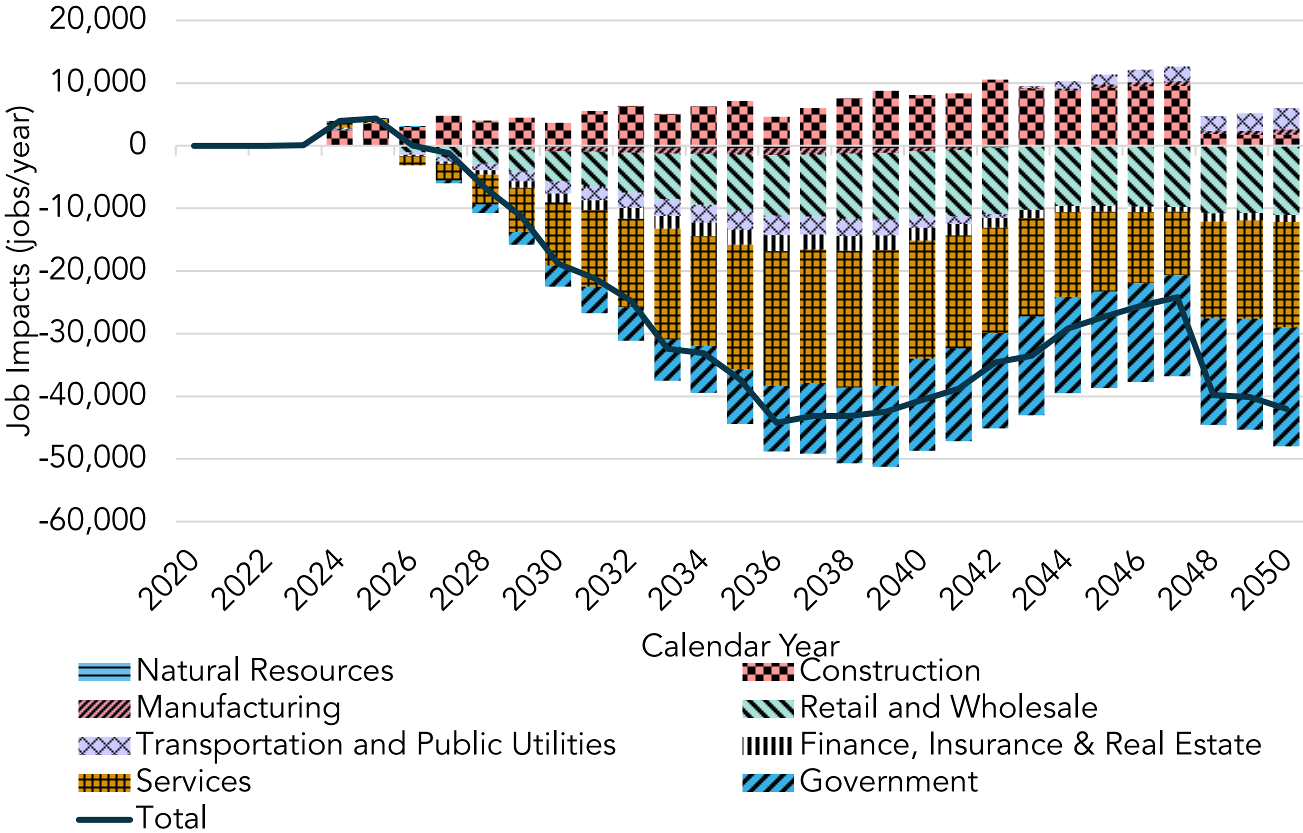


Figure 44. Change in Output by Major Sector relative to the Modified Baseline

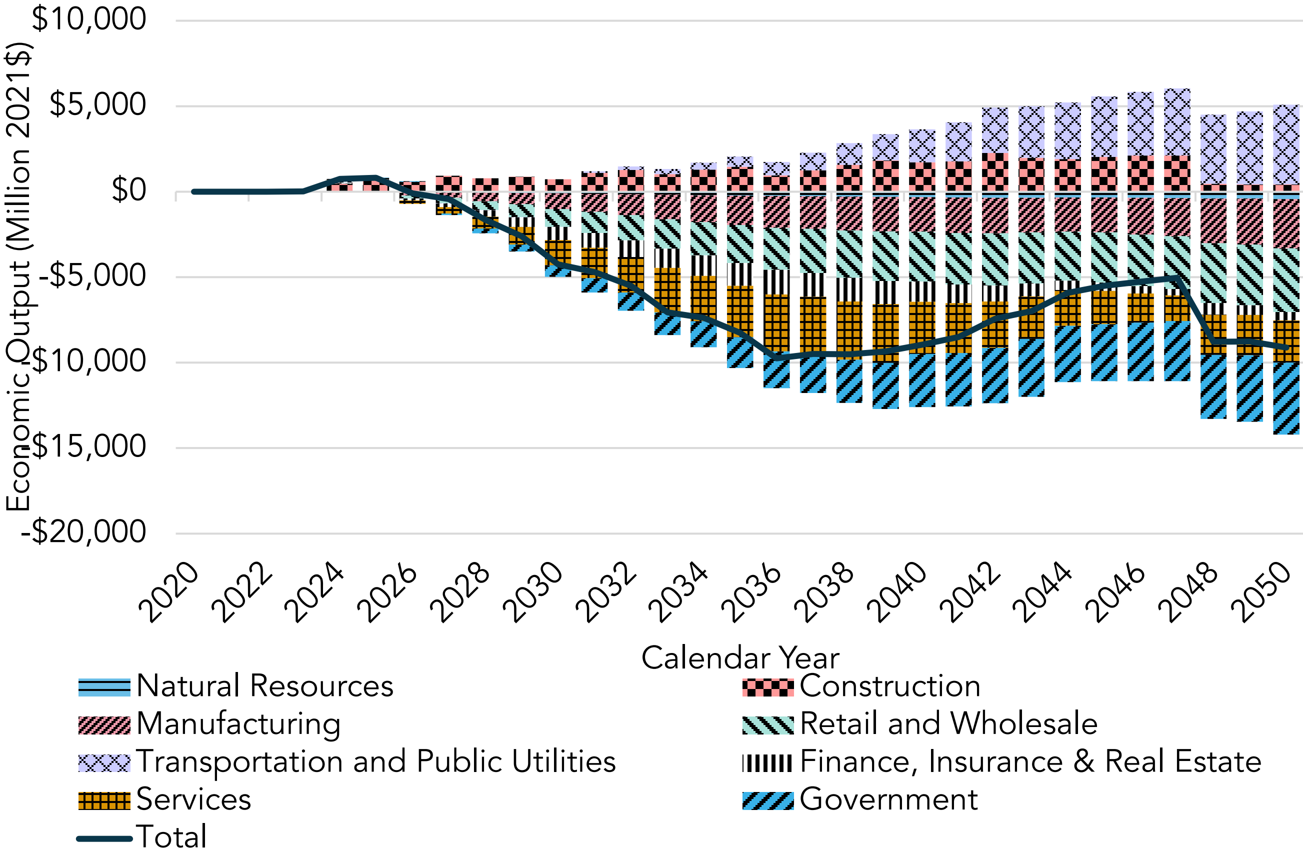


Table 71. Change in Growth of Economic Indicators for the Proposed Regulation Relative to the Modified Baseline

Indicator	GSP		Personal Income		Employment		Output		Private Investment	
Calendar Year	Total Change (2021M$)	% Change	Total Change (2021M$)	% Change	Total Jobs	% Change	Total Change (2021M$)	% Change	Total Change (2021M$)	% Change
2023	-55.26	0.00%	-48.17	0.00%	-568	0.00%	-103.58	0.00%	-18.73	-0.01%
2024	-165.73	-0.01%	-153.63	0.00%	-1734	-0.01%	-315.05	-0.01%	-68.97	-0.02%
2025	-115.28	0.00%	-123.83	0.00%	-1118	0.00%	-221.71	0.00%	-58.87	-0.01%
2026	-99.41	0.00%	-115.90	0.00%	-947	0.00%	-192.99	0.00%	-45.63	-0.01%
2027	-76.91	0.00%	-100.05	0.00%	-728	0.00%	-153.02	0.00%	-28.57	-0.01%
2028	-64.04	0.00%	-90.63	0.00%	-604	0.00%	-129.73	0.00%	-16.32	0.00%
2029	-56.15	0.00%	-84.17	0.00%	-528	0.00%	-115.12	0.00%	-8.27	0.00%
2030	-51.40	0.00%	-80.92	0.00%	-481	0.00%	-106.07	0.00%	-3.41	0.00%
2031	-49.35	0.00%	-80.06	0.00%	-459	0.00%	-101.82	0.00%	-1.00	0.00%
2033	-48.39	0.00%	-82.50	0.00%	-448	0.00%	-98.89	0.00%	-0.11	0.00%
2034	-49.36	0.00%	-85.63	0.00%	-454	0.00%	-100.05	0.00%	-0.81	0.00%

Indicator	GSP		Personal Income		Employment		Output		Private Investment	
Calendar Year	Total Change (2021M$)	% Change	Total Change (2021M$)	% Change	Total Jobs	% Change	Total Change (2021M$)	% Change	Total Change (2021M$)	% Change
2035	-50.49	0.00%	-89.25	0.00%	-461	0.00%	-101.60	0.00%	-1.79	0.00%
2036	-51.89	0.00%	-93.49	0.00%	-470	0.00%	-103.75	0.00%	-2.88	0.00%
2037	-53.21	0.00%	-97.96	0.00%	-479	0.00%	-105.87	0.00%	-3.91	0.00%
2038	-53.90	0.00%	-102.05	0.00%	-483	0.00%	-107.02	0.00%	-4.69	0.00%
2039	-54.45	0.00%	-106.15	0.00%	-485	0.00%	-107.93	0.00%	-5.25	0.00%
2040	-55.26	0.00%	-110.76	0.00%	-490	0.00%	-109.39	0.00%	-5.72	0.00%
2041	-56.24	0.00%	-115.57	0.00%	-494	0.00%	-111.26	0.00%	-6.29	0.00%
2042	-57.32	0.00%	-120.81	0.00%	-500	0.00%	-113.35	0.00%	-6.81	0.00%
2043	-58.42	0.00%	-126.39	0.00%	-506	0.00%	-115.58	0.00%	-7.27	0.00%
2044	-59.53	0.00%	-132.23	0.00%	-512	0.00%	-117.86	0.00%	-7.66	0.00%
2045	-61.01	0.00%	-138.84	0.00%	-520	0.00%	-120.88	0.00%	-8.09	0.00%
2046	-11.86	0.00%	-67.24	0.00%	-117	0.00%	-32.50	0.00%	-1.94	0.00%

Indicator	GSP		Personal Income		Employment		Output		Private Investment	
Calendar Year	Total Change (2021M$)	% Change	Total Change (2021M$)	% Change	Total Jobs	% Change	Total Change (2021M$)	% Change	Total Change (2021M$)	% Change
2047	-65.41	0.00%	-146.64	0.00%	-537	0.00%	-129.35	0.00%	-7.44	0.00%
2048	-65.96	0.00%	-156.60	0.00%	-546	0.00%	-131.16	0.00%	-8.82	0.00%
2049	-68.96	0.00%	-168.21	0.00%	-565	0.00%	-137.13	0.00%	-9.93	0.00%
2050	-71.45	0.00%	-179.44	0.00%	-580	0.00%	-142.28	0.00%	-10.71	0.00%

7.3 Fiscal Impacts

7.3.1 Local Government

Table 72 shows the estimated fiscal cost to local governments due to the proposed regulation relative to the Modified Baseline scenario. The fiscal impact to local government is estimated to be $4.4 billion over the regulatory analysis period.

Table 72. Estimated Fiscal Impacts to Local Government versus Modified Baseline (million 2021$)

Year	Local Government Fleet Cost Pass-Through	Utility User Tax Revenue	Local Gasoline and Diesel Fuel Taxes	Local Sales Tax	Total Fiscal Impact*
2024	-$75	$2	$64	$16	$7
2025	-$47	$4	$59	$17	$33
2026	-$30	$11	$50	$64	$94
2027	-$57	$18	$39	$81	$80
2028	-$15	$25	$28	$64	$102
2029	$32	$39	$10	$98	$179
2030	$48	$54	-$10	$98	$190
2031	$76	$72	-$32	$123	$239
2032	$94	$91	-$53	$127	$258
2033	$105	$110	-$72	$105	$248
2034	$110	$133	-$97	$127	$272
2035	$114	$159	-$123	$125	$275
2036	$128	$182	-$147	$70	$233
2037	$126	$206	-$173	$79	$237
2038	$124	$231	-$201	$87	$241
2039	$140	$256	-$225	$81	$253
2040	$134	$280	-$251	-$44	$119
2041	$126	$304	-$280	-$27	$124
2042	$120	$329	-$309	-$9	$131
2043	$114	$344	-$323	-$69	$67
2044	$117	$352	-$335	-$49	$85
2045	$119	$365	-$350	-$28	$106
2046	$129	$376	-$369	-$13	$124
2047	$147	$387	-$386	$0	$148
2048	$168	$398	-$402	$13	$177
2049	$185	$409	-$420	$22	$196
2050	$203	$431	-$456	$32	$210
Total	$2,438	$5,568	-$4,764	$1,187	$4,429

*Note: Totals may differ due to rounding

7.3.2 State Government

Table 73 shows the estimated fiscal impacts to the State government due to the proposed regulation relative to Legal Baseline conditions. The fiscal impact to local government is estimated to be -$38.2 billion over the regulatory analysis period.

Table 73. Estimated Fiscal Impacts on State Government (million 2021$)

Year	CARB Staffing and Resources	State Fleet Cost Pass-Through	State Fuel Taxes	Energy Resources Fees	Registration Fees	State Sales Taxes	Depreciation	Total Fiscal Impact*
2023	-$2	$0	$0	$0	$0	$0	$0	**-$2**
2024	-$3	-$18	-$15	$0	$0	$14	-$6	**-$29**
2025	-$3	-$11	-$27	$0	-$2	$14	-$24	**-$53**
2026	-$3	-$7	-$59	$0	-$8	$54	-$80	**-$104**
2027	-$3	-$13	-$101	$0	-$17	$68	-$177	**-$242**
2028	-$3	-$3	-$139	$1	-$24	$54	-$266	**-$381**
2029	-$3	$7	-$209	$1	-$35	$83	-$365	**-$521**
2030	-$3	$11	-$286	$1	-$52	$83	-$487	**-$733**
2031	-$3	$18	-$370	$1	-$72	$104	-$595	**-$918**
2032	-$3	$22	-$454	$2	-$90	$107	-$683	**-$1,099**
2033	-$3	$25	-$524	$2	-$108	$88	-$732	**-$1,252**
2034	-$3	$26	-$623	$2	-$136	$107	-$778	**-$1,405**
2035	-$3	$27	-$725	$3	-$164	$106	-$829	**-$1,586**
2036	-$3	$30	-$817	$3	-$193	$59	-$827	**-$1,748**
2037	-$3	$30	-$918	$3	-$226	$66	-$788	**-$1,837**
2038	-$3	$29	-$1,026	$4	-$259	$73	-$762	**-$1,944**
2039	-$3	$33	-$1,121	$4	-$286	$69	-$731	**-$2,035**
2040	-$3	$31	-$1,223	$4	-$309	-$37	-$584	**-$2,120**
2041	-$3	$30	-$1,338	$5	-$340	-$23	-$385	**-$2,054**
2042	-$3	$28	-$1,458	$5	-$369	-$8	-$254	**-$2,059**
2043	-$3	$27	-$1,507	$5	-$379	-$58	-$81	**-$1,997**
2044	-$3	$27	-$1,556	$5	-$394	-$42	$121	**-$1,840**
2045	-$3	$28	-$1,617	$6	-$409	-$24	$221	**-$1,800**
2046	-$3	$30	-$1,688	$6	-$421	-$11	$239	**-$1,849**
2047	-$3	$35	-$1,755	$6	-$431	$0	$225	**-$1,925**
2048	-$3	$39	-$1,823	$6	-$442	$11	$174	**-$2,038**
2049	-$3	$43	-$1,892	$6	-$451	$18	$85	**-$2,193**
2050	-$3	$48	-$2,042	$7	-$483	$27	-$8	**-$2,456**
Total*	**-$92**	**$572**	**-$25,313**	**$89**	**-$6,102**	**$1,004**	**-$8,378**	**-$38,220**

*Note: Totals may differ due to rounding

8 Vehicle Cost Attributes Appendix

8.1 Vehicle Prices

Table 74. Vehicle Prices, 2024-2029

Model Year	2024	2025	2026	2027	2028	2029
Class 2B Cargo Van - Diesel	$40,137	$40,137	$40,137	$40,611	$40,611	$40,611
Class 2B Pickup - Diesel	$47,137	$47,137	$47,137	$47,611	$47,611	$47,611
Class 3 Service - Diesel	$57,137	$57,137	$57,137	$57,611	$57,611	$57,611
Class 5 Cutaway - Diesel	$91,621	$91,621	$91,621	$95,176	$95,176	$95,176
Class 5 Walk-in Van - Diesel	$90,935	$90,935	$90,935	$94,490	$94,490	$94,490
Class 5 Service - Diesel	$68,935	$68,935	$68,935	$72,490	$72,490	$72,490
Class 6 Box Truck - Diesel	$89,622	$89,622	$89,622	$93,705	$93,705	$93,705
Class 6 Bucket Truck - Diesel	$130,622	$130,622	$130,622	$134,705	$134,705	$134,705
Class 8 Box Truck - Diesel	$125,886	$125,886	$125,886	$129,192	$129,192	$129,192
Class 8 Dump Truck - Diesel	$180,886	$180,886	$180,886	$184,192	$184,192	$184,192
Class 8 Refuse Packer - Diesel	$231,886	$231,886	$231,886	$235,192	$235,192	$235,192
Class 8 Transit Bus - Diesel	$440,886	$440,886	$440,886	$444,192	$444,192	$444,192
Class 8 Day Cab - Diesel	$145,396	$145,396	$145,396	$150,688	$150,688	$150,688
Class 8 Sleeper Cab - Diesel	$153,494	$153,494	$153,494	$157,399	$157,399	$157,399
Class 8 Specialty - Diesel	$277,386	$277,386	$277,386	$280,692	$280,692	$280,692
Class 8 Yard Tractor - Diesel	$120,886	$120,886	$120,886	$124,192	$124,192	$124,192
Class 8 Motor Coach - Diesel	$634,419	$634,419	$634,419	$637,725	$637,725	$637,725
Class 2B Cargo Van - Gasoline	$36,137	$36,137	$36,137	$36,611	$36,611	$36,611
Class 2B Pickup - Gasoline	$37,137	$37,137	$37,137	$37,611	$37,611	$37,611
Class 3 Service - Gasoline	$47,137	$47,137	$47,137	$47,611	$47,611	$47,611
Class 5 Cutaway - Gasoline	$76,247	$76,247	$76,247	$77,288	$77,288	$77,288
Class 2B Cargo Van - Battery-Electric	$57,659	$54,835	$52,448	$50,420	$48,389	$46,687
Class 2B Pickup - Battery-Electric	$74,010	$69,786	$66,216	$63,185	$60,146	$57,599
Class 3 Service - Battery-Electric	$75,942	$72,592	$69,792	$67,364	$64,964	$62,903
Class 5 Cutaway - Battery-Electric	$109,378	$105,826	$102,773	$100,262	$97,688	$95,612
Class 5 Walk-in Van - Battery-Electric	$110,856	$107,074	$103,816	$101,142	$98,394	$96,182
Class 5 Service - Battery-Electric	$94,990	$90,806	$87,236	$84,259	$81,236	$78,756
Class 6 Box Truck - Battery-Electric	$130,358	$124,527	$119,516	$115,394	$111,168	$107,758
Class 6 Bucket Truck - Battery-Electric	$171,358	$165,527	$160,516	$156,394	$152,168	$148,758

Model Year	2024	2025	2026	2027	2028	2029
Class 8 Box Truck - Battery-Electric	$174,269	$166,150	$159,174	$153,433	$147,550	$142,800
Class 8 Dump Truck - Battery-Electric	$229,356	$221,235	$214,257	$208,514	$202,629	$197,877
Class 8 Refuse Packer - Battery-Electric	$304,729	$293,965	$284,660	$277,093	$269,273	$263,049
Class 8 Transit Bus - Battery-Electric	$489,425	$481,293	$474,305	$468,554	$462,661	$457,903
Class 8 Day Cab - Battery-Electric	$216,451	$204,579	$194,297	$185,964	$177,332	$170,490
Class 8 Sleeper Cab - Battery-Electric	$317,605	$295,597	$276,385	$261,050	$244,991	$232,495
Class 8 Specialty - Battery-Electric	$355,453	$344,182	$334,428	$326,508	$318,312	$311,800
Class 8 Yard Tractor - Battery-Electric	$156,979	$149,807	$143,576	$138,558	$133,337	$129,231
Class 8 Motor Coach - Battery-Electric	$714,355	$702,702	$692,593	$684,428	$675,950	$669,257
Class 2B Cargo Van - Fuel Cell Electric	$96,456	$89,469	$83,750	$78,307	$73,132	$68,224
Class 2B Pickup - Fuel Cell Electric	$127,898	$117,681	$109,303	$101,317	$93,738	$86,542
Class 3 Service - Fuel Cell Electric	$137,898	$127,681	$119,303	$111,317	$103,738	$96,542
Class 5 Cutaway - Fuel Cell Electric	$134,212	$128,530	$123,935	$119,556	$115,377	$111,408
Class 5 Walk-in Van - Fuel Cell Electric	$133,524	$127,842	$123,247	$118,869	$114,689	$110,720
Class 5 Service - Fuel Cell Electric	$138,101	$129,836	$123,115	$116,704	$110,602	$104,803
Class 6 Box Truck - Fuel Cell Electric	$162,419	$153,485	$146,212	$139,276	$132,676	$126,406
Class 6 Bucket Truck - Fuel Cell Electric	$203,679	$194,713	$187,414	$180,450	$173,826	$167,530
Class 8 Box Truck - Fuel Cell Electric	$213,194	$201,033	$191,102	$181,622	$172,623	$164,066
Class 8 Dump Truck - Fuel Cell Electric	$282,290	$269,500	$259,154	$249,257	$239,837	$230,857
Class 8 Refuse Packer - Fuel Cell Electric	$332,686	$319,922	$309,592	$299,712	$290,309	$281,346
Class 8 Transit Bus - Fuel Cell Electric	$541,611	$528,852	$518,526	$508,650	$499,251	$490,291
Class 8 Day Cab - Fuel Cell Electric	$234,111	$221,352	$211,026	$201,150	$191,751	$182,791
Class 8 Sleeper Cab - Fuel Cell Electric	$268,770	$254,774	$243,624	$232,923	$222,699	$212,915
Class 8 Specialty - Fuel Cell Electric	$378,111	$365,352	$355,026	$345,150	$335,751	$326,791
Class 8 Yard Tractor - Fuel Cell Electric	$167,617	$160,670	$155,131	$149,832	$144,759	$139,920
Class 8 Motor Coach - Fuel Cell Electric	$722,868	$711,400	$702,138	$693,279	$684,841	$676,798
Class 8 Refuse Packer - Natural Gas	$259,135	$259,135	$259,135	$260,172	$260,172	$260,172
Class 8 Day Cab - Natural Gas	$192,376	$192,376	$192,376	$195,419	$195,419	$195,419
Class 8 Sleeper Cab - Natural Gas	$242,130	$242,130	$242,130	$245,020	$245,020	$245,020

Table 75. Vehicle Prices, 2030-2035

Age	2030	2031	2032	2033	2034	2035
Class 2B Cargo Van - Diesel	$40,611	$40,611	$40,611	$40,611	$40,611	$40,611
Class 2B Pickup - Diesel	$47,611	$47,611	$47,611	$47,611	$47,611	$47,611
Class 3 Service - Diesel	$57,611	$57,611	$57,611	$57,611	$57,611	$57,611
Class 5 Cutaway - Diesel	$95,176	$96,081	$96,081	$96,081	$96,081	$96,081
Class 5 Walk-in Van - Diesel	$94,490	$95,395	$95,395	$95,395	$95,395	$95,395
Class 5 Service - Diesel	$72,490	$73,395	$73,395	$73,395	$73,395	$73,395
Class 6 Box Truck - Diesel	$93,705	$93,917	$93,917	$93,917	$93,917	$93,917
Class 6 Bucket Truck - Diesel	$134,705	$134,917	$134,917	$134,917	$134,917	$134,917
Class 8 Box Truck - Diesel	$129,192	$128,581	$128,581	$128,581	$128,581	$128,581
Class 8 Dump Truck - Diesel	$184,192	$183,581	$183,581	$183,581	$183,581	$183,581
Class 8 Refuse Packer - Diesel	$235,192	$234,581	$234,581	$234,581	$234,581	$234,581
Class 8 Transit Bus - Diesel	$444,192	$443,581	$443,581	$443,581	$443,581	$443,581
Class 8 Day Cab - Diesel	$150,688	$150,083	$150,083	$150,083	$150,083	$150,083
Class 8 Sleeper Cab - Diesel	$157,399	$157,126	$157,126	$157,126	$157,126	$157,126
Class 8 Specialty - Diesel	$280,692	$280,081	$280,081	$280,081	$280,081	$280,081
Class 8 Yard Tractor - Diesel	$124,192	$123,581	$123,581	$123,581	$123,581	$123,581
Class 8 Motor Coach - Diesel	$637,725	$637,114	$637,114	$637,114	$637,114	$637,114
Class 2B Cargo Van - Gasoline	$36,611	$36,611	$36,611	$36,611	$36,611	$36,611
Class 2B Pickup - Gasoline	$37,611	$37,611	$37,611	$37,611	$37,611	$37,611
Class 3 Service - Gasoline	$47,611	$47,611	$47,611	$47,611	$47,611	$47,611
Class 5 Cutaway - Gasoline	$77,288	$77,190	$77,190	$77,190	$77,190	$77,190
Class 2B Cargo Van - Battery-Electric	$45,167	$44,068	$43,010	$42,096	$41,213	$40,361
Class 2B Pickup - Battery-Electric	$55,326	$53,685	$52,103	$50,739	$49,421	$48,150
Class 3 Service - Battery-Electric	$61,037	$59,784	$58,573	$57,509	$56,479	$55,482
Class 5 Cutaway - Battery-Electric	$93,805	$92,344	$90,943	$89,768	$88,639	$87,556
Class 5 Walk-in Van - Battery-Electric	$94,260	$92,694	$91,185	$89,918	$88,707	$87,552
Class 5 Service - Battery-Electric	$76,575	$74,896	$73,283	$71,912	$70,591	$69,193
Class 6 Box Truck - Battery-Electric	$104,791	$102,396	$100,099	$98,167	$96,310	$94,526
Class 6 Bucket Truck - Battery-Electric	$145,791	$149,946	$147,649	$145,717	$143,860	$142,076
Class 8 Box Truck - Battery-Electric	$138,666	$135,333	$132,135	$129,446	$126,860	$124,377
Class 8 Dump Truck - Battery-Electric	$193,741	$195,908	$192,710	$190,021	$187,435	$184,952
Class 8 Refuse Packer - Battery-Electric	$257,685	$253,179	$248,861	$245,262	$241,808	$238,496
Class 8 Transit Bus - Battery-Electric	$453,762	$450,423	$447,219	$444,525	$441,934	$439,447

Age	2030	2031	2032	2033	2034	2035
Class 8 Day Cab - Battery-Electric	$164,611	$159,611	$154,821	$150,844	$147,027	$143,371
Class 8 Sleeper Cab - Battery-Electric	$221,901	$212,404	$203,325	$195,863	$188,716	$181,883
Class 8 Specialty - Battery-Electric	$306,195	$316,618	$312,090	$308,321	$304,703	$301,236
Class 8 Yard Tractor - Battery-Electric	$125,723	$122,670	$119,749	$117,332	$115,015	$112,797
Class 8 Motor Coach - Battery-Electric	$663,523	$658,589	$653,865	$649,949	$646,192	$642,594
Class 2B Cargo Van - Fuel Cell Electric	$63,567	$60,493	$56,592	$53,171	$50,944	$48,115
Class 2B Pickup - Fuel Cell Electric	$79,710	$75,252	$69,549	$64,559	$61,358	$58,015
Class 3 Service - Fuel Cell Electric	$89,710	$85,252	$79,549	$74,559	$71,358	$68,015
Class 5 Cutaway - Fuel Cell Electric	$107,631	$105,044	$101,837	$98,994	$97,048	$92,743
Class 5 Walk-in Van - Fuel Cell Electric	$106,944	$104,356	$101,149	$98,307	$96,361	$92,056
Class 5 Service - Fuel Cell Electric	$99,288	$95,594	$90,947	$86,850	$84,126	$79,411
Class 6 Box Truck - Fuel Cell Electric	$120,445	$116,463	$111,445	$107,026	$104,099	$99,273
Class 6 Bucket Truck - Fuel Cell Electric	$161,543	$164,096	$159,054	$154,615	$151,678	$146,852
Class 8 Box Truck - Fuel Cell Electric	$155,930	$150,566	$143,750	$137,763	$133,862	$128,523
Class 8 Dump Truck - Fuel Cell Electric	$222,299	$222,009	$214,766	$208,352	$204,025	$195,054
Class 8 Refuse Packer - Fuel Cell Electric	$272,805	$267,034	$259,811	$253,416	$249,108	$240,309
Class 8 Transit Bus - Fuel Cell Electric	$481,754	$475,984	$468,763	$462,369	$458,063	$449,265
Class 8 Day Cab - Fuel Cell Electric	$174,254	$168,484	$161,263	$154,869	$150,563	$141,765
Class 8 Sleeper Cab - Fuel Cell Electric	$203,552	$196,958	$188,911	$181,693	$176,562	$160,833
Class 8 Specialty - Fuel Cell Electric	$318,254	$327,634	$320,413	$314,019	$309,713	$300,915
Class 8 Yard Tractor - Fuel Cell Electric	$135,297	$132,020	$128,040	$124,471	$121,918	$114,045
Class 8 Motor Coach - Fuel Cell Electric	$669,130	$663,914	$657,413	$651,647	$647,730	$639,138
Class 8 Refuse Packer - Natural Gas	$260,172	$260,076	$260,076	$260,076	$260,076	$260,076
Class 8 Day Cab - Natural Gas	$195,419	$195,324	$195,324	$195,324	$195,324	$195,324
Class 8 Sleeper Cab - Natural Gas	$245,020	$244,977	$244,977	$244,977	$244,977	$244,977

8.2 Accrual Rate

Table 76. Accrual Rate Years 0 – 9

Age	0	1	2	3	4	5	6	7	8	9
Class 2B Cargo Van - Diesel	24,451	20,834	18,712	17,203	16,030	15,069	14,254	13,546	12,919	12,356
Class 2B Pickup - Diesel	24,451	20,834	18,712	17,203	16,030	15,069	14,254	13,546	12,919	12,356
Class 3 Service - Diesel	23,167	19,844	17,893	16,505	15,426	14,542	13,792	13,141	12,563	12,045
Class 5 Cutaway - Diesel	28,514	27,411	26,314	25,220	24,139	23,068	22,011	20,969	19,946	18,939
Class 5 Walk-in Van - Diesel	16,398	15,787	15,210	14,668	14,160	13,685	13,245	12,840	12,468	12,131
Class 5 Service - Diesel	16,253	16,211	16,136	16,029	15,890	15,719	15,515	15,280	15,012	14,712
Class 6 Box Truck - Diesel	16,398	15,787	15,210	14,668	14,160	13,685	13,245	12,840	12,468	12,131
Class 6 Bucket Truck - Diesel	16,253	16,211	16,136	16,029	15,890	15,719	15,515	15,280	15,012	14,712
Class 8 Box Truck - Diesel	23,077	22,248	21,431	20,614	19,806	19,007	18,211	17,402	16,579	15,745
Class 8 Dump Truck - Diesel	28,588	27,514	26,440	25,367	24,295	23,225	22,157	21,090	20,023	18,956
Class 8 Refuse Packer - Diesel	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220
Class 8 Transit Bus - Diesel	20,874	20,872	20,729	20,414	19,952	19,369	18,688	17,937	17,134	16,296
Class 8 Day Cab - Diesel	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940
Class 8 Sleeper Cab - Diesel	100,672	97,261	94,127	91,241	88,589	86,167	84,366	82,762	81,378	80,227
Class 8 Specialty - Diesel	28,588	27,514	26,440	25,367	24,295	23,225	22,157	21,090	20,023	18,956
Class 8 Yard Tractor - Diesel	3,034	3,012	2,840	2,643	2,566	2,490	2,425	2,343	2,297	2,257
Class 8 Motor Coach - Diesel	45,912	45,911	45,910	45,910	45,909	45,908	45,908	45,907	45,907	41,316
Class 2B Cargo Van - Gasoline	24,451	20,834	18,712	17,203	16,030	15,069	14,254	13,546	12,919	12,356
Class 2B Pickup - Gasoline	24,451	20,834	18,712	17,203	16,030	15,069	14,254	13,546	12,919	12,356
Class 3 Service - Gasoline	23,167	19,844	17,893	16,505	15,426	14,542	13,792	13,141	12,563	12,045
Class 5 Cutaway - Gasoline	28,514	27,411	26,314	25,220	24,139	23,068	22,011	20,969	19,946	18,939
Class 2B Cargo Van - Battery-Electric	24,451	20,834	18,712	17,203	16,030	15,069	14,254	13,546	12,919	12,356
Class 2B Pickup - Battery-Electric	24,451	20,834	18,712	17,203	16,030	15,069	14,254	13,546	12,919	12,356
Class 3 Service - Battery-Electric	23,167	19,844	17,893	16,505	15,426	14,542	13,792	13,141	12,563	12,045
Class 5 Cutaway - Battery-Electric	28,514	27,411	26,314	25,220	24,139	23,068	22,011	20,969	19,946	18,939
Class 5 Walk-in Van - Battery-Electric	16,398	15,787	15,210	14,668	14,160	13,685	13,245	12,840	12,468	12,131
Class 5 Service - Battery-Electric	16,253	16,211	16,136	16,029	15,890	15,719	15,515	15,280	15,012	14,712
Class 6 Box Truck - Battery-Electric	16,398	15,787	15,210	14,668	14,160	13,685	13,245	12,840	12,468	12,131
Class 6 Bucket Truck - Battery-Electric	16,253	16,211	16,136	16,029	15,890	15,719	15,515	15,280	15,012	14,712
Class 8 Box Truck - Battery-Electric	23,077	22,248	21,431	20,614	19,806	19,007	18,211	17,402	16,579	15,745
Class 8 Dump Truck - Battery-Electric	28,588	27,514	26,440	25,367	24,295	23,225	22,157	21,090	20,023	18,956

Age	0	1	2	3	4	5	6	7	8	9
Class 8 Refuse Packer - Battery-Electric	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220
Class 8 Transit Bus - Battery-Electric	20,874	20,872	20,729	20,414	19,952	19,369	18,688	17,937	17,134	16,296
Class 8 Day Cab - Battery-Electric	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940
Class 8 Sleeper Cab - Battery-Electric	100,672	97,261	94,127	91,241	88,589	86,167	84,366	82,762	81,378	80,227
Class 8 Specialty - Battery-Electric	28,588	27,514	26,440	25,367	24,295	23,225	22,157	21,090	20,023	18,956
Class 8 Yard Tractor - Battery-Electric	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Class 8 Motor Coach - Battery-Electric	45,912	45,911	45,910	45,910	45,909	45,908	45,908	45,907	45,907	41,316
Class 2B Cargo Van - Fuel Cell Electric	24,451	20,834	18,712	17,203	16,030	15,069	14,254	13,546	12,919	12,356
Class 2B Pickup - Fuel Cell Electric	24,451	20,834	18,712	17,203	16,030	15,069	14,254	13,546	12,919	12,356
Class 3 Service - Fuel Cell Electric	23,167	19,844	17,893	16,505	15,426	14,542	13,792	13,141	12,563	12,045
Class 5 Cutaway - Fuel Cell Electric	28,514	27,411	26,314	25,220	24,139	23,068	22,011	20,969	19,946	18,939
Class 5 Walk-in Van - Fuel Cell Electric	16,398	15,787	15,210	14,668	14,160	13,685	13,245	12,840	12,468	12,131
Class 5 Service - Fuel Cell Electric	16,253	16,211	16,136	16,029	15,890	15,719	15,515	15,280	15,012	14,712
Class 6 Box Truck - Fuel Cell Electric	16,398	15,787	15,210	14,668	14,160	13,685	13,245	12,840	12,468	12,131
Class 6 Bucket Truck - Fuel Cell Electric	16,253	16,211	16,136	16,029	15,890	15,719	15,515	15,280	15,012	14,712
Class 8 Box Truck - Fuel Cell Electric	23,077	22,248	21,431	20,614	19,806	19,007	18,211	17,402	16,579	15,745
Class 8 Dump Truck - Fuel Cell Electric	28,588	27,514	26,440	25,367	24,295	23,225	22,157	21,090	20,023	18,956
Class 8 Refuse Packer - Fuel Cell Electric	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220
Class 8 Transit Bus - Fuel Cell Electric	20,874	20,872	20,729	20,414	19,952	19,369	18,688	17,937	17,134	16,296
Class 8 Day Cab - Fuel Cell Electric	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940
Class 8 Sleeper Cab - Fuel Cell Electric	100,672	97,261	94,127	91,241	88,589	86,167	84,366	82,762	81,378	80,227
Class 8 Specialty - Fuel Cell Electric	28,588	27,514	26,440	25,367	24,295	23,225	22,157	21,090	20,023	18,956
Class 8 Yard Tractor - Fuel Cell Electric	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Class 8 Motor Coach - Fuel Cell Electric	45,912	45,911	45,910	45,910	45,909	45,908	45,908	45,907	45,907	41,316
Class 8 Refuse Packer - Natural Gas	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220
Class 8 Day Cab - Natural Gas	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940
Class 8 Sleeper Cab - Natural Gas	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940

Table 77. Accrual Rates Years 10 - 19+

Age	10	11	12	13	14	15	16	17	18	19
Class 2B Cargo Van - Diesel	11,846	11,379	10,950	10,553	10,183	9,838	9,514	9,208	8,920	8,646
Class 2B Pickup - Diesel	11,846	11,379	10,950	10,553	10,183	9,838	9,514	9,208	8,920	8,646
Class 3 Service - Diesel	11,575	11,144	10,749	10,382	10,041	9,723	9,423	9,141	8,875	8,623
Class 5 Cutaway - Diesel	17,953	16,984	16,037	15,110	14,207	13,328	12,476	11,654	10,859	10,097
Class 5 Walk-in Van - Diesel	11,828	11,559	11,324	11,124	10,957	10,825	10,727	10,664	10,664	10,664
Class 5 Service - Diesel	14,380	14,016	13,619	13,191	12,730	12,237	11,712	11,155	10,565	10,565
Class 6 Box Truck - Diesel	11,828	11,559	11,324	11,124	10,957	10,825	10,727	10,664	10,664	10,664
Class 6 Bucket Truck - Diesel	14,380	14,016	13,619	13,191	12,730	12,237	11,712	11,155	10,565	10,565
Class 8 Box Truck - Diesel	14,899	14,040	13,173	12,298	11,418	10,535	9,649	8,762	8,766	8,770
Class 8 Dump Truck - Diesel	17,890	16,825	15,761	14,697	13,633	12,569	11,505	10,442	10,442	10,442
Class 8 Refuse Packer - Diesel	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220
Class 8 Transit Bus - Diesel	15,439	14,577	13,719	12,878	12,060	11,276	11,279	11,282	11,284	11,287
Class 8 Day Cab - Diesel	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940
Class 8 Sleeper Cab - Diesel	79,330	78,682	78,262	78,061	78,085	78,337	78,819	79,555	79,466	79,368
Class 8 Specialty - Diesel	17,890	16,825	15,761	14,697	13,633	12,569	11,505	10,442	10,442	10,442
Class 8 Yard Tractor - Diesel	2,214	2,169	2,124	2,079	2,032	1,984	1,936	1,936	1,936	1,936
Class 8 Motor Coach - Diesel	37,185	33,467	30,120	27,108	24,398	21,958	21,958	21,958	21,958	21,958
Class 2B Cargo Van - Gasoline	11,846	11,379	10,950	10,553	10,183	9,838	9,514	9,208	8,920	8,646
Class 2B Pickup - Gasoline	11,846	11,379	10,950	10,553	10,183	9,838	9,514	9,208	8,920	8,646
Class 3 Service - Gasoline	11,575	11,144	10,749	10,382	10,041	9,723	9,423	9,141	8,875	8,623
Class 5 Cutaway - Gasoline	17,953	16,984	16,037	15,110	14,207	13,328	12,476	11,654	10,859	10,097
Class 2B Cargo Van - Battery-Electric	11,846	11,379	10,950	10,553	10,183	9,838	9,514	9,208	8,920	8,646
Class 2B Pickup - Battery-Electric	11,846	11,379	10,950	10,553	10,183	9,838	9,514	9,208	8,920	8,646
Class 3 Service - Battery-Electric	11,575	11,144	10,749	10,382	10,041	9,723	9,423	9,141	8,875	8,623
Class 5 Cutaway - Battery-Electric	17,953	16,984	16,037	15,110	14,207	13,328	12,476	11,654	10,859	10,097
Class 5 Walk-in Van - Battery-Electric	11,828	11,559	11,324	11,124	10,957	10,825	10,727	10,664	10,664	10,664
Class 5 Service - Battery-Electric	14,380	14,016	13,619	13,191	12,730	12,237	11,712	11,155	10,565	10,565
Class 6 Box Truck - Battery-Electric	11,828	11,559	11,324	11,124	10,957	10,825	10,727	10,664	10,664	10,664
Class 6 Bucket Truck - Battery-Electric	14,380	14,016	13,619	13,191	12,730	12,237	11,712	11,155	10,565	10,565
Class 8 Box Truck - Battery-Electric	14,899	14,040	13,173	12,298	11,418	10,535	9,649	8,762	8,766	8,770
Class 8 Dump Truck - Battery-Electric	17,890	16,825	15,761	14,697	13,633	12,569	11,505	10,442	10,442	10,442
Class 8 Refuse Packer - Battery-Electric	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220
Class 8 Transit Bus - Battery-Electric	15,439	14,577	13,719	12,878	12,060	11,276	11,279	11,282	11,284	11,287

Age	10	11	12	13	14	15	16	17	18	19
Class 8 Day Cab - Battery-Electric	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940
Class 8 Sleeper Cab - Battery-Electric	79,330	78,682	78,262	78,061	78,085	78,337	78,819	79,555	79,466	79,368
Class 8 Specialty - Battery-Electric	17,890	16,825	15,761	14,697	13,633	12,569	11,505	10,442	10,442	10,442
Class 8 Yard Tractor - Battery-Electric	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Class 8 Motor Coach - Battery-Electric	37,185	33,467	30,120	27,108	24,398	21,958	21,958	21,958	21,958	21,958
Class 2B Cargo Van - Fuel Cell Electric	11,846	11,379	10,950	10,553	10,183	9,838	9,514	9,208	8,920	8,646
Class 2B Pickup - Fuel Cell Electric	11,846	11,379	10,950	10,553	10,183	9,838	9,514	9,208	8,920	8,646
Class 3 Service - Fuel Cell Electric	11,575	11,144	10,749	10,382	10,041	9,723	9,423	9,141	8,875	8,623
Class 5 Cutaway - Fuel Cell Electric	17,953	16,984	16,037	15,110	14,207	13,328	12,476	11,654	10,859	10,097
Class 5 Walk-in Van - Fuel Cell Electric	11,828	11,559	11,324	11,124	10,957	10,825	10,727	10,664	10,664	10,664
Class 5 Service - Fuel Cell Electric	14,380	14,016	13,619	13,191	12,730	12,237	11,712	11,155	10,565	10,565
Class 6 Box Truck - Fuel Cell Electric	11,828	11,559	11,324	11,124	10,957	10,825	10,727	10,664	10,664	10,664
Class 6 Bucket Truck - Fuel Cell Electric	14,380	14,016	13,619	13,191	12,730	12,237	11,712	11,155	10,565	10,565
Class 8 Box Truck - Fuel Cell Electric	14,899	14,040	13,173	12,298	11,418	10,535	9,649	8,762	8,766	8,770
Class 8 Dump Truck - Fuel Cell Electric	17,890	16,825	15,761	14,697	13,633	12,569	11,505	10,442	10,442	10,442
Class 8 Refuse Packer - Fuel Cell Electric	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220
Class 8 Transit Bus - Fuel Cell Electric	15,439	14,577	13,719	12,878	12,060	11,276	11,279	11,282	11,284	11,287
Class 8 Day Cab - Fuel Cell Electric	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940
Class 8 Sleeper Cab - Fuel Cell Electric	79,330	78,682	78,262	78,061	78,085	78,337	78,819	79,555	79,466	79,368
Class 8 Specialty - Fuel Cell Electric	17,890	16,825	15,761	14,697	13,633	12,569	11,505	10,442	10,442	10,442
Class 8 Yard Tractor - Fuel Cell Electric	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000	10,000
Class 8 Motor Coach - Fuel Cell Electric	37,185	33,467	30,120	27,108	24,398	21,958	21,958	21,958	21,958	21,958
Class 8 Refuse Packer - Natural Gas	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220	24,220
Class 8 Day Cab - Natural Gas	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940
Class 8 Sleeper Cab - Natural Gas	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940	49,940

8.3 Fuel Economy/Fuel-Efficiency

Table 78. Fuel Economy/Fuel Efficiency

Model Year	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Unit
Class 2B Cargo Van - Diesel	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.3	19.4	19.4	19.3	mpg
Class 2B Pickup - Diesel	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.4	19.3	19.4	19.4	19.3	mpg
Class 3 Service - Diesel	16.7	16.7	16.7	16.7	16.7	16.7	16.7	16.6	16.6	16.7	16.6	16.6	mpg
Class 5 Cutaway - Diesel	10.4	10.4	10.4	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	10.7	mpg
Class 5 Walk-in Van - Diesel	9.4	9.4	9.4	9.5	9.5	9.5	9.5	9.5	9.6	9.6	9.6	9.6	mpg
Class 5 Service - Diesel	8.8	8.8	8.8	8.9	8.9	8.9	8.9	8.9	8.9	9.0	9.0	9.0	mpg
Class 6 Box Truck - Diesel	9.4	9.4	9.4	9.5	9.5	9.5	9.5	9.5	9.6	9.6	9.6	9.7	mpg
Class 6 Bucket Truck - Diesel	8.9	8.9	8.9	8.9	8.9	8.9	9.0	9.0	9.0	9.0	9.0	9.1	mpg
Class 8 Box Truck - Diesel	6.5	6.5	6.5	6.5	6.6	6.6	6.6	6.6	6.6	6.6	6.7	6.7	mpg
Class 8 Dump Truck - Diesel	6.6	6.5	6.5	6.6	6.6	6.6	6.6	6.6	6.7	6.7	6.7	6.7	mpg
Class 8 Refuse Packer - Diesel	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.2	3.3	mpg
Class 8 Transit Bus - Diesel	7.2	7.0	6.8	6.9	6.5	6.2	5.8	5.5	5.5	5.5	5.5	5.5	mpg
Class 8 Day Cab - Diesel	6.9	6.9	6.9	6.9	6.9	6.9	7.0	7.0	7.0	7.0	7.0	7.0	mpg
Class 8 Sleeper Cab - Diesel	7.1	7.1	7.1	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	mpg
Class 8 Specialty - Diesel	6.5	6.5	6.5	6.5	6.6	6.6	6.6	6.6	6.6	6.6	6.7	6.7	mpg
Class 8 Yard Tractor - Diesel	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	3.7	mpg
Class 8 Motor Coach - Diesel	6.3	6.3	6.3	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	mpg
Class 2B Cargo Van - Gasoline	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.0	14.0	14.1	14.1	14.0	mpg
Class 2B Pickup - Gasoline	14.1	14.1	14.1	14.1	14.1	14.1	14.1	14.0	14.0	14.1	14.1	14.0	mpg
Class 3 Service - Gasoline	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.4	12.4	12.5	12.5	12.4	mpg
Class 5 Cutaway - Gasoline	5.7	5.7	5.7	5.7	5.7	5.8	5.8	5.8	5.8	5.8	5.8	5.8	mpg
Class 2B Cargo Van - Battery-Electric	1.9	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	mi./kWh
Class 2B Pickup - Battery-Electric	1.9	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	mi./kWh
Class 3 Service - Battery-Electric	1.9	1.9	1.9	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	mi./kWh
Class 5 Cutaway - Battery-Electric	1.2	1.2	1.2	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	mi./kWh
Class 5 Walk-in Van - Battery-Electric	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	mi./kWh
Class 5 Service - Battery-Electric	1.1	1.1	1.1	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	mi./kWh
Class 6 Box Truck - Battery-Electric	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	mi./kWh
Class 6 Bucket Truck - Battery-Electric	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	mi./kWh
Class 8 Box Truck - Battery-Electric	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	mi./kWh
Class 8 Dump Truck - Battery-Electric	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	mi./kWh

Model Year	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	Unit
Class 8 Refuse Packer - Battery-Electric	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	mi./kWh
Class 8 Transit Bus - Battery-Electric	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	mi./kWh
Class 8 Day Cab - Battery-Electric	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	mi./kWh
Class 8 Sleeper Cab - Battery-Electric	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	mi./kWh
Class 8 Specialty - Battery-Electric	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	mi./kWh
Class 8 Yard Tractor - Battery-Electric	0.5	0.5	0.5	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	mi./kWh
Class 8 Motor Coach - Battery-Electric	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	mi./kWh
Class 2B Cargo Van - Fuel Cell Electric	42.5	42.5	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4	mi./kg
Class 2B Pickup - Fuel Cell Electric	42.5	42.5	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4	42.4	mi./kg
Class 3 Service - Fuel Cell Electric	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	36.5	mi./kg
Class 5 Cutaway - Fuel Cell Electric	16.2	16.2	16.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2	17.2	mi./kg
Class 5 Walk-in Van - Fuel Cell Electric	16.1	16.1	16.1	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	mi./kg
Class 5 Service - Fuel Cell Electric	15.0	15.0	15.0	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	mi./kg
Class 6 Box Truck - Fuel Cell Electric	16.0	16.0	16.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	17.0	mi./kg
Class 6 Bucket Truck - Fuel Cell Electric	15.1	15.1	15.1	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	15.9	mi./kg
Class 8 Box Truck - Fuel Cell Electric	10.7	10.7	10.7	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	mi./kg
Class 8 Dump Truck - Fuel Cell Electric	10.7	10.7	10.7	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	mi./kg
Class 8 Refuse Packer - Fuel Cell Electric	5.2	5.2	5.2	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	mi./kg
Class 8 Transit Bus - Fuel Cell Electric	11.2	11.2	11.2	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	11.8	mi./kg
Class 8 Day Cab - Fuel Cell Electric	10.9	10.9	10.9	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	mi./kg
Class 8 Sleeper Cab - Fuel Cell Electric	11.0	11.0	11.0	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	11.6	mi./kg
Class 8 Specialty - Fuel Cell Electric	10.7	10.7	10.7	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	11.4	mi./kg
Class 8 Yard Tractor - Fuel Cell Electric	6.9	6.9	6.9	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	7.3	mi./kg
Class 8 Motor Coach - Fuel Cell Electric	9.9	9.9	9.9	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	10.5	mi./kg
Class 8 Refuse Packer - Natural Gas	6.6	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.6	6.6	mpg
Class 8 Day Cab - Natural Gas	6.7	6.7	6.7	6.7	6.7	6.8	6.8	6.8	6.9	6.9	6.9	6.9	mpg
Class 8 Sleeper Cab - Natural Gas	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	6.5	mpg

8.4 Maintenance Cost

Table 79. Maintenance Cost

Model Year	Cost per mile	Sources
Class 2B Cargo Van - Diesel	$0.337	Argonne NL AFLEET 2019[199,]
Class 2B Pickup - Diesel	$0.248	Argonne NL AFLEET 2019, Utilimarc[200]
Class 3 Service - Diesel	$0.248	Argonne NL AFLEET 2019, Utilimarc
Class 5 Cutaway - Diesel	$0.657	Access LA Report[201], Argonne NL AFLEET 2019
Class 5 Walk-in Van - Diesel	$0.210	NREL Reports[202,203,204]
Class 5 Service - Diesel	$0.315	Argonne NL AFLEET 2019
Class 6 Box Truck - Diesel	$0.247	Argonne NL AFLEET 2019, NREL Report[205]
Class 6 Bucket Truck - Diesel	$0.199	Argonne NL AFLEET 2019
Class 8 Box Truck - Diesel	$0.276	Argonne NL AFLEET 2019, NREL Report[206]
Class 8 Dump Truck - Diesel	$0.199	Argonne NL AFLEET 2019
Class 8 Refuse Packer - Diesel	$0.943	M.J. Bradley and Associates[207]
Class 8 Day Cab - Diesel	$0.198	Argonne NL AFLEET 2019, Bloomberg, 2018 ATRI Report[208,209]

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Model Year	Cost per mile	Sources
Class 8 Sleeper Cab - Diesel	$0.159	Argonne NL AFLEET 2019, Fleet Advantage[210], 2018 ATRI Report
Class 8 Specialty - Diesel	$0.199	Argonne NL AFLEET 2019
Class 8 Yard Tractor - Diesel	$0.199	Argonne NL AFLEET 2019
Class 8 Motor Coach - Diesel	$0.838	ICT Staff Report
Class 2B Cargo Van - Gasoline	$0.337	Argonne NL AFLEET 2019
Class 2B Pickup - Gasoline	$0.248	Argonne NL AFLEET 2019, Utilimarc
Class 3 Service - Gasoline	$0.248	Argonne NL AFLEET 2019, Utilimarc
Class 5 Cutaway - Gasoline	$0.657	Access LA Report, Argonne NL AFLEET 2019
Class 2B Cargo Van - Battery-Electric	$0.202	40 percent reduction from diesel
Class 2B Pickup - Battery-Electric	$0.149	40 percent reduction from diesel
Class 3 Service - Battery-Electric	$0.149	40 percent reduction from diesel
Class 5 Cutaway - Battery-Electric	$0.394	40 percent reduction from diesel
Class 5 Walk-in Van - Battery-Electric	$0.126	40 percent reduction from diesel
Class 5 Service - Battery-Electric	$0.189	40 percent reduction from diesel
Class 6 Box Truck - Battery-Electric	$0.148	40 percent reduction from diesel
Class 6 Bucket Truck - Battery-Electric	$0.119	40 percent reduction from diesel
Class 8 Box Truck - Battery-Electric	$0.165	40 percent reduction from diesel
Class 8 Dump Truck - Battery-Electric	$0.119	40 percent reduction from diesel
Class 8 Refuse Packer - Battery-Electric	$0.566	40 percent reduction from diesel
Class 8 Day Cab - Battery-Electric	$0.119	40 percent reduction from diesel
Class 8 Sleeper Cab - Battery-Electric	$0.095	40 percent reduction from diesel
Class 8 Specialty - Battery-Electric	$0.119	40 percent reduction from diesel
Class 8 Yard Tractor - Battery-Electric	$0.119	40 percent reduction from diesel
Class 8 Motor Coach - Battery-Electric	$0.503	40 percent reduction from diesel
Class 2B Cargo Van - Fuel Cell Electric	$0.202	40 percent reduction from diesel
Class 2B Pickup - Fuel Cell Electric	$0.149	40 percent reduction from diesel
Class 3 Service - Fuel Cell Electric	$0.149	40 percent reduction from diesel
Class 5 Cutaway - Fuel Cell Electric	$0.394	40 percent reduction from diesel
Class 5 Walk-in Van - Fuel Cell Electric	$0.126	40 percent reduction from diesel
Class 5 Service - Fuel Cell Electric	$0.189	40 percent reduction from diesel
Class 6 Box Truck - Fuel Cell Electric	$0.148	40 percent reduction from diesel

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Model Year	Cost per mile	Sources
Class 6 Bucket Truck - Fuel Cell Electric	$0.119	40 percent reduction from diesel
Class 8 Box Truck - Fuel Cell Electric	$0.165	40 percent reduction from diesel
Class 8 Dump Truck - Fuel Cell Electric	$0.119	40 percent reduction from diesel
Class 8 Refuse Packer - Fuel Cell Electric	$0.566	40 percent reduction from diesel
Class 8 Day Cab - Fuel Cell Electric	$0.119	40 percent reduction from diesel
Class 8 Sleeper Cab - Fuel Cell Electric	$0.095	40 percent reduction from diesel
Class 8 Specialty - Fuel Cell Electric	$0.119	40 percent reduction from diesel
Class 8 Yard Tractor - Fuel Cell Electric	$0.119	40 percent reduction from diesel
Class 8 Motor Coach - Fuel Cell Electric	$0.503	40 percent reduction from diesel
Class 8 Refuse Packer - Natural Gas	$0.943	M.J. Bradley and Associates
Class 8 Day Cab - Natural Gas	$0.198	Argonne NL AFLEET 2019, Bloomberg, 2018 ATRI Report
Class 8 Sleeper Cab - Natural Gas	$0.159	Argonne NL AFLEET 2019, Fleet Advantage, 2018 ATRI Report

9 Macroeconomic Appendix

Table 80. Macroeconomic Modeling Inputs

REMI Policy Variable	REMI Industry /Spending Category	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038
Production Costs	Natural Resources	8.6	9.9	21.3	35.8	37.1	57.9	64.0	70.0	72.7	68.1	86.3	92.7	77.7	69.9	69.1
Production Costs	Construction	15.8	18.1	39.0	65.4	67.8	105.8	116.9	127.8	132.8	124.5	157.7	169.3	142.0	127.6	126.3
Production Costs	Manufacturing	7.4	8.4	18.2	30.5	31.7	49.4	54.5	59.7	62.0	58.1	73.6	79.0	66.3	59.6	58.9
Production Costs	Retail and Wholesale	26.1	29.8	64.3	107.9	112.0	174.6	192.9	211.0	219.1	205.5	260.2	279.4	234.4	210.7	208.5
Production Costs	Transportation and Public Utilities	85.1	97.4	210.0	352.1	365.6	570.1	629.7	688.8	715.4	670.7	849.6	912.2	765.2	687.8	680.5
Production Costs	Finance, Insurance & Real Estate	1.9	2.2	4.7	7.9	8.2	12.8	14.2	15.5	16.1	15.1	19.1	20.5	17.2	15.5	15.3
Production Costs	Services	23.9	27.3	58.9	98.8	102.6	160.0	176.7	193.3	200.8	188.2	238.4	256.0	214.7	193.0	191.0
Exogenous Final Demand	Electricity costs	21.4	53.6	146.5	236.5	339.1	523.8	707.2	944.9	1201.0	1446.6	1746.5	2098.9	2400.0	2714.9	3040.6
Exogenous Final Demand	Natural Gas	-0.6	-1.7	-4.8	-8.7	-12.4	-19.0	-26.5	-34.6	-42.7	-49.5	-59.0	-68.8	-77.5	-87.5	-98.1
Exogenous Final Demand	Construction	464.8	690.8	736.9	1248.3	1273.4	1564.1	1588.4	2062.8	2289.2	2093.9	2354.3	2546.7	2016.4	2175.2	2398.3
Exogenous Final Demand	Basic Chemical mfg.	-7.4	-13.7	-8.7	64.4	130.6	381.2	542.6	759.0	953.9	1108.0	1348.6	1641.8	1913.7	2177.6	2440.8
Exogenous Final Demand	Agricultural Chemical mfg.	-0.4	-1.3	-3.7	-6.8	-9.6	-14.9	-20.5	-26.8	-32.9	-38.1	-45.4	-53.1	-59.9	-67.2	-75.0
Exogenous Final Demand	Retail	-0.5	-0.6	1.7	11.8	21.5	54.2	76.4	106.2	133.8	156.6	190.3	231.4	269.0	305.8	342.8
Exogenous Final Demand	Insurance	3.1	6.6	19.1	34.1	42.5	56.6	67.2	81.3	92.0	94.9	101.8	106.7	101.3	98.4	97.6
Exogenous Final Demand	Private education and training	25.9	32.9	32.2	60.6	57.0	71.4	67.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exogenous Final Demand	Motor Vehicle repair	-13.0	-32.8	-94.9	-160.0	-215.0	-302.6	-407.9	-516.1	-618.7	-853.1	-770.2	-907.6	-968.6	-1027.9	-1098.3
Consumer Spending	Motor Vehicle Fuels	-31.6	-91.2	-260.5	-476.3	-677.4	-1041.4	-1448.1	-1894.3	-2339.4	-2711.9	-3228.5	-3765.9	-4240.5	-4789.8	-5370.8
Gas Prices	All Industries	34.3	79.2	197.8	310.1	425.5	555.5	634.9	748.1	851.1	916.9	969.1	1009.8	1008.1	992.3	967.6
Government Spending	State & Local Government	23.1	-0.2	16.7	-49.7	-151.6	-195.7	-328.3	-413.3	-528.5	-653.0	-744.3	-895.0	-1103.8	-1199.5	-1318.5

Table 81: Macroeconomic Modeling Inputs (continued)

REMI Policy Variable	REMI Industry /Spending Category	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050
Production Costs	Natural Resources	67.5	14.8	-1.9	-17.3	-64.7	-95.7	-85.9	-94.1	-105.0	-126.2	-145.5	-185.6
Production Costs	Construction	123.2	27.0	-3.4	-31.7	-118.3	-174.8	-156.8	-171.8	-191.8	-230.6	-265.9	-339.0
Production Costs	Manufacturing	57.5	12.6	-1.6	-14.8	-55.2	-81.6	-73.2	-80.2	-89.5	-107.6	-124.1	-158.2
Production Costs	Retail and Wholesale	203.4	44.6	-5.7	-52.3	-195.2	-288.5	-258.8	-283.6	-316.6	-380.6	-438.8	-559.5
Production Costs	Transportation and Public Utilities	663.9	145.7	-18.5	-170.7	-637.2	-941.8	-845.0	-925.9	-1033.6	-1242.4	-1432.5	-1826.4
Production Costs	Finance, Insurance & Real Estate	14.9	3.3	-0.4	-3.8	-14.3	-21.2	-19.0	-20.8	-23.3	-28.0	-32.2	-41.1
Production Costs	Services	186.3	40.9	-5.2	-47.9	-178.8	-264.3	-237.1	-259.9	-290.1	-348.7	-402.0	-512.5
Exogenous Final Demand	Electricity costs	3383.5	3695.8	4014.5	4360.9	4554.9	4649.5	4829.0	4975.0	5115.2	5267.0	5424.0	5734.6
Exogenous Final Demand	Natural Gas	-107.2	-117.8	-129.6	-141.6	-147.3	-152.4	-158.4	-166.3	-173.4	-180.3	-187.6	-202.1
Exogenous Final Demand	Construction	2551.0	2191.1	2019.6	2301.4	1790.7	1492.6	1564.8	1636.0	1679.2	192.1	203.6	213.5
Exogenous Final Demand	Basic Chemical mfg.	2695.6	2903.0	3090.3	3273.8	3287.6	3188.0	3142.9	3106.8	3066.7	3023.2	2971.6	3015.2
Exogenous Final Demand	Agricultural Chemical mfg.	-82.0	-88.4	-95.8	-103.6	-106.2	-109.0	-113.0	-117.1	-121.2	-125.6	-129.9	-140.4
Exogenous Final Demand	Retail	379.2	409.5	437.4	465.5	470.9	461.0	459.1	457.5	455.3	452.9	449.7	460.3
Exogenous Final Demand	Insurance	94.4	62.1	39.0	25.1	2.4	-11.8	-16.5	-16.9	-14.3	-9.6	-4.3	1.9
Exogenous Final Demand	Private education and training	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Exogenous Final Demand	Motor Vehicle repair	-1121.5	-983.0	-1007.2	-1042.6	-1096.5	-1083.8	-1027.9	-931.7	-835.7	-1176.4	-1328.6	-1547.3
Consumer Spending	Motor Vehicle Fuels	-5867.5	-6449.2	-7094.2	-7752.7	-8062.8	-8341.2	-8672.2	-9106.4	-9491.3	-9869.9	-10268.5	-11066.8
Gas Prices	All Industries	930.0	847.2	751.2	650.5	536.4	413.8	288.6	296.0	304.3	314.1	324.1	340.6
Government Spending	State & Local Government	-1441.3	-1730.3	-1768.1	-1871.3	-1998.9	-1983.3	-2031.6	-2122.1	-2213.1	-2299.4	-2392.2	-2590.8

Table 82. Gas Price Policy Variable Industry Distribution

Category	Commodity or Industry	Spread Weight
Consumer	Motor vehicle fuels, lubricants, and fluids	65.08%
Business	Forestry and Logging	0.00%
Business	Fishing, hunting and trapping	0.01%
Business	Support activities for agriculture and forestry	0.01%
Business	Oil and gas extraction	0.00%
Business	Coal mining	0.00%
Business	Metal ore mining	0.02%
Business	Nonmetallic mineral mining and quarrying	0.02%
Business	Support activities for mining	0.02%
Business	Electric power generation, transmission and distribution	0.00%
Business	Natural gas distribution	0.00%
Business	Water, sewage, and other systems	0.01%
Business	Construction	1.31%
Business	Sawmills and wood preservation	0.01%
Business	Veneer, plywood, and engineered wood product manufacturing	0.02%
Business	Other wood product manufacturing	0.05%
Business	Clay product and refractory manufacturing	0.01%
Business	Glass and glass product manufacturing	0.06%
Business	Cement and concrete product manufacturing	0.07%
Business	Lime, gypsum and other nonmetallic mineral product manufacturing	0.04%
Business	Iron and steel mills and ferroalloy manufacturing	0.07%
Business	Steel product manufacturing from purchased steel	0.01%
Business	Alumina and aluminum production and processing	0.01%
Business	Nonferrous metal (except aluminum) production and processing	0.02%
Business	Foundries	0.01%
Business	Forging and stamping	0.02%
Business	Cutlery and handtool manufacturing	0.00%
Business	Architectural and structural metals manufacturing	0.03%
Business	Boiler, tank, and shipping container manufacturing	0.01%
Business	Hardware manufacturing	0.00%
Business	Spring and wire product manufacturing	0.00%
Business	Machine shops; turned product; and screw, nut, and bolt manufacturing	0.05%
Business	Coating, engraving, heat treating, and allied activities	0.05%
Business	Other fabricated metal product manufacturing	0.03%
Business	Agriculture, construction, and mining machinery manufacturing	0.01%
Business	Industrial machinery manufacturing	0.01%
Business	Commercial and service industry machinery manufacturing, including digital camera manufacturing	0.11%
Business	Ventilation, heating, air-conditioning, and commercial refrigeration equipment manufacturing	0.01%
Business	Metalworking machinery manufacturing	0.01%
Business	Engine, turbine, and power transmission equipment manufacturing	0.03%
Business	Other general purpose machinery manufacturing	0.03%
Business	Computer and peripheral equipment manufacturing, excluding digital camera manufacturing	0.04%
Business	Communications equipment manufacturing	0.01%
Business	Audio and video equipment manufacturing	0.00%
Business	Semiconductor and other electronic component manufacturing	0.05%

Category	Commodity or Industry	Spread Weight
Business	Navigational, measuring, electromedical, and control instruments manufacturing	0.02%
Business	Manufacturing and reproducing magnetic and optical media	0.00%
Business	Electric lighting equipment manufacturing	0.02%
Business	Household appliance manufacturing	0.00%
Business	Electrical equipment manufacturing	0.01%
Business	Other electrical equipment and component manufacturing	0.05%
Business	Motor vehicle manufacturing	0.02%
Business	Motor vehicle body and trailer manufacturing	0.00%
Business	Motor vehicle parts manufacturing	0.03%
Business	Aerospace product and parts manufacturing	0.05%
Business	Railroad rolling stock manufacturing	0.00%
Business	Ship and boat building	0.00%
Business	Other transportation equipment manufacturing	0.00%
Business	Household and institutional furniture and kitchen cabinet manufacturing	0.02%
Business	Office furniture (including fixtures) manufacturing; Other furniture related product manufacturing	0.02%
Business	Medical equipment and supplies manufacturing	0.08%
Business	Other miscellaneous manufacturing	0.05%
Business	Animal food manufacturing	0.02%
Business	Grain and oilseed milling	0.09%
Business	Sugar and confectionery product manufacturing	0.11%
Business	Fruit and vegetable preserving and specialty food manufacturing	0.08%
Business	Dairy product manufacturing	0.11%
Business	Animal slaughtering and processing	0.03%
Business	Seafood product preparation and packaging	0.00%
Business	Bakeries and tortilla manufacturing	0.06%
Business	Other food manufacturing	0.09%
Business	Beverage manufacturing	0.27%
Business	Tobacco manufacturing	0.01%
Business	Textile mills and textile product mills	0.03%
Business	Apparel, leather and allied product manufacturing	0.02%
Business	Pulp, paper, and paperboard mills	0.06%
Business	Converted paper product manufacturing	0.05%
Business	Printing and related support activities	0.13%
Business	Petroleum and coal products manufacturing	0.00%
Business	Basic chemical manufacturing	0.99%
Business	Resin, synthetic rubber, and artificial synthetic fibers and filaments manufacturing	0.21%
Business	Pesticide, fertilizer, and other agricultural chemical manufacturing	0.17%
Business	Pharmaceutical and medicine manufacturing	0.21%
Business	Paint, coating, and adhesive manufacturing	0.03%
Business	Soap, cleaning compound, and toilet preparation manufacturing	0.08%
Business	Other chemical product and preparation manufacturing	0.07%
Business	Plastics product manufacturing	0.13%
Business	Rubber product manufacturing	0.02%
Business	Wholesale trade	0.39%
Business	Retail trade	0.58%
Business	Air transportation	4.62%
Business	Rail transportation	0.94%
Business	Water transportation	0.57%
Business	Truck transportation	7.61%
Business	Couriers and messengers	4.12%
Business	Transit and ground passenger transportation	1.11%

Category	Commodity or Industry	Spread Weight
Business	Pipeline transportation	0.01%
Business	Scenic and sightseeing transportation and support activities for transportation	3.53%
Business	Warehousing and storage	1.77%
Business	Newspaper, periodical, book, and directory publishers	0.00%
Business	Software publishers	0.02%
Business	Motion picture, video, and sound recording industries	0.03%
Business	Data processing, hosting, related services	0.05%
Business	Other information services	0.04%
Business	Radio and television broadcasting; Cable and other subscription programming	0.01%
Business	Telecommunications	0.06%
Business	Monetary authorities, credit intermediation, and related activities	0.15%
Business	Securities, commodity contracts, funds, trusts and other financial investments and related activities	0.12%
Business	Insurance carriers	0.00%
Business	Agencies, brokerages, and other insurance related activities	0.00%
Business	Real estate	2.00%
Business	Automotive equipment rental and leasing	0.04%
Business	Consumer goods rental and general rental centers	0.01%
Business	Commercial and industrial machinery and equipment rental and leasing	0.03%
Business	Lessors of nonfinancial intangible assets (except copyrighted works)	0.00%
Business	Legal services	0.00%
Business	Accounting, tax preparation, bookkeeping, and payroll services	0.00%
Business	Architectural, engineering, and related services	0.06%
Business	Specialized design services	0.00%
Business	Computer systems design and related services	0.04%
Business	Management, scientific, and technical consulting services	0.01%
Business	Scientific research and development services	0.06%
Business	Advertising, public relations, and related services	0.01%
Business	Other professional, scientific, and technical services	0.01%
Business	Management of companies and enterprises	0.13%
Business	Office administrative services; Facilities support services	0.01%
Business	Employment services	0.00%
Business	Business support services; Investigation and security services; Other support services	0.03%
Business	Travel arrangement and reservation services	0.00%
Business	Services to buildings and dwellings	0.12%
Business	Waste management and remediation services	0.05%
Business	Educational services; private	0.08%
Business	Offices of health practitioners	0.03%
Business	Outpatient, laboratory, and other ambulatory care services	0.03%
Business	Home health care services	0.00%
Business	Hospitals; private	0.12%
Business	Nursing and residential care facilities	0.03%
Business	Individual and family services; Community and vocational rehabilitation services	0.03%
Business	Child day care services	0.01%
Business	Performing arts companies; Promoters of events, and agents and managers	0.00%
Business	Spectator sports	0.00%
Business	Independent artists, writers, and performers	0.00%
Business	Museums, historical sites, and similar institutions	0.00%
Business	Amusement, gambling, and recreation industries	0.04%
Business	Accommodation	0.06%
Business	Food services and drinking places	0.31%
Business	Automotive repair and maintenance	0.03%

Category	Commodity or Industry	Spread Weight
Business	Electronic and precision equipment repair and maintenance	0.00%
Business	Commercial and industrial machinery and equipment (except automotive and electronic) repair and maintenance	0.00%
Business	Personal and household goods repair and maintenance	0.00%
Business	Personal care services	0.01%
Business	Death care services	0.00%
Business	Drycleaning and laundry services	0.01%
Business	Other personal services	0.00%
Business	Religious organizations; Grantmaking and giving services and social advocacy organizations	0.04%
Business	Civic, social, professional, and similar organizations	0.02%
Business	Private households	0.00%

POLICY UPDATE

SEPTEMBER 2024

SUMMARIZES REGULATORY AND OTHER DEVELOPMENTS RELATED TO CLEAN TRANSPORTATION WORLDWIDE

U.S. EPA Phase 3 greenhouse gas emission standards for heavy-duty vehicles

Yihao Xie

INTRODUCTION

On April 22, 2024, the U.S. Environmental Protection Agency (EPA) published the Phase 3 greenhouse gas (GHG) emission standards for heavy-duty vehicles (HDVs) final rule, which set CO_2 emission limits for Class 2b–8 vehicles of model years (MYs) 2027 to 2032.[1] The Phase 3 standards require CO_2 emission reductions per ton-mile of freight moved by up to 60% for vocational trucks and up to 40% for tractor trucks in MY 2032 compared with the Phase 2 MY 2027 levels. Importantly, the new standards follow the same technology-neutral principle as the previous standards and do not mandate the sales of zero-emission vehicles (ZEVs), such as battery electric or hydrogen fuel-cell vehicles.

As in previous phases, the Phase 3 standards retain the same fleet-average regulatory scheme. This does not require individual vehicles to meet the standards but instead allows manufacturers to meet the standards based on the average emissions within each weight class. The regulation retained the non-CO_2 GHG emission standards from Phase 2, including nitrous oxide (N_2O), methane (CH_4), and hydrofluorocarbon (HFC). The heavy-duty engine CO_2 emission standards are also unchanged. The new standards also largely retained the existing compliance provisions, flexibilities, and testing procedures for HDVs.

HDVs are a major source of greenhouse gas emissions in the United States, contributing to 25% of transportation emissions. According to EPA, the new standards will reduce approximately 1 billion metric tons of HDV CO_2 emissions from 2027

1 Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles—Phase 3, 89 F.R. 29440 (April 22, 2024) (to be codified at 40 C.F.R. § 86, 1036, 1037, 1039, 1054, and 1065), https://www.govinfo.gov/content/pkg/FR-2024-04-22/pdf/2024-06809.pdf; Only Class 2b-3 vocational vehicles are subject to the HDV regulation. Other Class 2b–3 vehicles are regulated by the Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles.

This policy update was revised on September 27, 2024 to correct the values in Table 2.

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through 2055. This will lessen air pollution for the 72 million people who live close to major truck freight routes and who are disproportionately more likely to be people of color or reside in low-income households.[2]

With the promulgation of the Phase 3 HDV GHG standards, EPA has completed the final regulatory piece of the Clean Trucks Plan announced in 2021, which also includes the Control of Air Pollution from New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards, finalized in December 2022, and the Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles, finalized in March 2024.[3]

KEY ELEMENTS

EMISSION STANDARDS

The Phase 2 MY 2027 emission standards are used as the baseline for the new Phase 3 standards. EPA modeled a potential compliance pathway from MY 2027 to MY 2032, projecting a production mix of internal combustion engine (ICE) vehicles and ZEVs. Phase 3 CO_2 limits are determined based on the projected ZEV adoption rates in this potential compliance pathway. To arrive at the projected ZEV adoption rates, EPA developed the Heavy-Duty Technology Resource Use Case Scenario (HD TRUCS), a tool that projects technology feasibility and payback of zero-emission HDV technologies for more than a hundred vehicle types in MYs 2027, 2030, and 2032.[4] Payback periods were then converted to ZEV adoption rates using an adoption rate curve based on National Renewable Energy Laboratory's TEMPO model.[5] EPA capped the maximum ZEV technology penetration at 20% in MY 2027 and 70% in MY 2032. The final adoption rates for all model years were then calculated by linearly interpolating between MY 2027 and MY 2030, and between MY 2030 and MY 2032.[6] Figure 1 summarizes the key steps in EPA's determination of the new standards. The ZEV adoption rates in the modeled potential compliance pathway are also the percentage of CO_2 emission reductions from HDVs, presented in Table 1.

2 U.S. Environmental Protection Agency, *Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles: Phase 3 Regulatory Impact Analysis*, March 2024, https://www.epa.gov/system/files/documents/2024-03/420r24006.pdf.

3 Yihao Xie, *U.S. Heavy-Duty Vehicle NO_x Standards: Updates to Emission Limits, Testing Requirements, and Compliance Procedures* (International Council on Clean Transportation, 2023), https://theicct.org/publication/us-nox-standards-update-jul23/; Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles, 89 F.R. 27842 (April 18, 2024) (to be codified at 40 C.F.R. § 85, 86, 600, 1036, 1037, 1066, and 1068), https://www.govinfo.gov/content/pkg/FR-2024-04-18/pdf/2024-06214.pdf.

4 Eastern Research Group, *External Peer Review of Report: Heavy-Duty Technology Resource Use Case Scenario (HD TRUCS) Tool—Final Peer Review Summary Report* (U.S. Environmental Protection Agency, 2023), https://cfpub.epa.gov/si/si_public_file_download.cfm?p_download_id=548983&Lab=OTAQ.

5 Matteo Muratori et al., "Exploring the Future Energy-Mobility Nexus: The Transportation Energy & Mobility Pathway Options (TEMPO) Model," *Transportation Research Part D: Transport and Environment* 98, (September 2021): 102967, https://doi.org/10.1016/j.trd.2021.102967.

6 The exception is sleeper cab tractors, where the percentage of ZEVs in MY 2031 is not a linear interpolation but 33% of the difference between MY 2030 and MY 2032.

Figure 1

A simplified illustration of EPA's Phase 3 emission standard setting

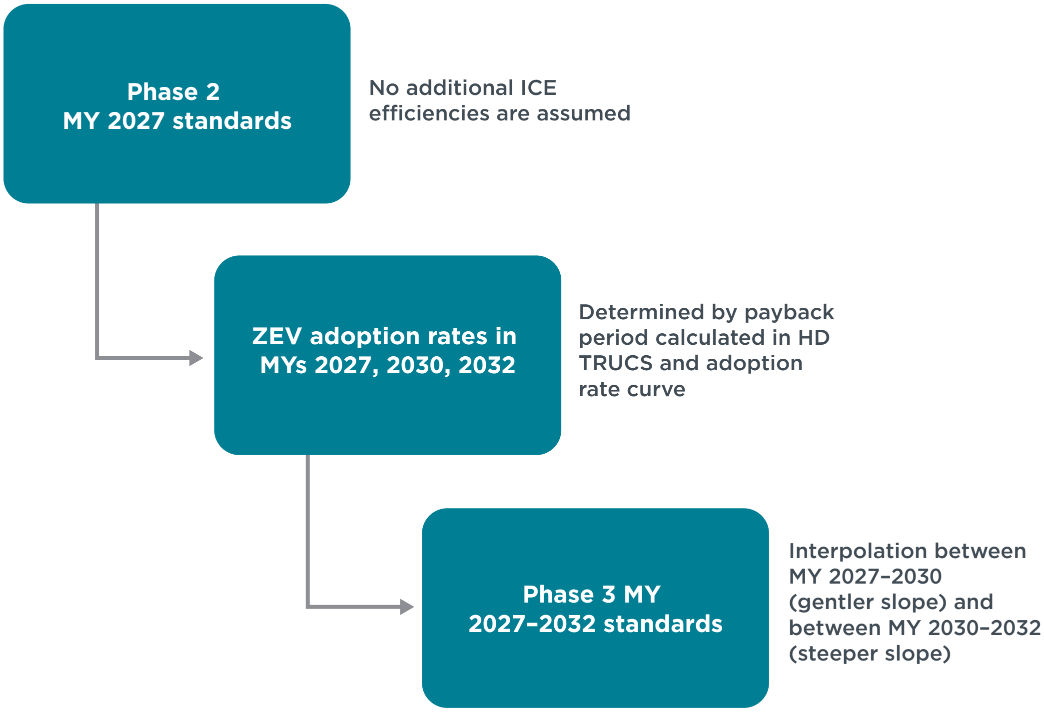

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Table 1

EPA's projected zero-emission vehicle shares for the modeled potential compliance pathway

Regulatory group	MY 2027	MY 2028	MY 2029	MY 2030	MY 2031	MY 2032
Light heavy-duty vocational	17%	22%	27%	32%	46%	60%
Medium heavy-duty vocational	13%	16%	19%	22%	31%	40%
Heavy heavy-duty vocational	—	—	13%	15%	23%	30%
Medium heavy-duty all cab and heavy heavy-duty day cab tractors	—	8%	12%	16%	28%	40%
Sleeper cab tractors	—	—	—	6%	12%	25%
Heavy-haul tractors	—	—	1%	1%	3%	5%

The Phase 3 CO_2 limits between MY 2027 and MY 2032 were set for 10 subcategories of tractors based on weight rating, cab configuration, and roof height; 15 subcategories of vocational vehicles; and 8 optional custom chassis vocational vehicle categories. The numerical emission limits—in terms of g/ton-mile, for each category of vocational trucks powered by compression ignition (CI) and spark ignition (SI) engines and tractors in MY 2032, when Phase 3 standards are fully phased in—are shown in Table 2 and Table 3.

Table 2

Phase 3 MY 2032 and later vocational vehicle CO_2 limits by vehicle service class in g/ton·mile

Subcategory	Light heavy-duty compression ignition	Medium heavy-duty compression ignition	Heavy heavy-duty compression ignition	Light heavy-duty spark ignition	Medium heavy-duty spark ignition
Urban	147	155	188	193	194
Multipurpose	132	141	161	174	174
Regional	116	131	132	144	160

Table 3

Phase 3 MY 2032 and later tractor CO_2 limits in g/ton·mile

Roof height	Class 7 all cab styles	Class 8 day cab	Class 8 sleeper cab	Heavy-haul tractor
Low	57.7	44	48.1	45.9
Mid	62	46.8	52.2	
High	60	45.4	48.2	

The ICE technology packages developed for the Phase 2 were used the Phase 3 rulemaking. Therefore, the Phase 3 standards did not assume any improvements in engine efficiency or efficiency gains from other features, such as improved aerodynamics or low rolling-resistance tires, for example. Manufacturers can choose to deploy these technologies to reduce emissions of their ICE vehicle fleet toward compliance and thus may not sell as many ZEVs as the modeled potential compliance pathway suggests.

UPDATES TO CREDIT AVERAGING, BANKING, AND TRADING SYSTEM

Credit generation and usage

Under the Phase 3 rule, manufacturers can continue to generate advanced technology credit multipliers through MY 2027 for sales of plug-in hybrid electric, battery electric, and hydrogen fuel-cell vehicles. These multipliers are set at 3.5 for plug-in hybrid electric vehicles, 4.5 for battery electric vehicles, and 5.5 for hydrogen fuel-cell electric vehicles. Manufacturers can use these multiplier credits to offset existing Phase 2 deficits through MY 2029, and toward Phase 3 compliance after exhausting any normally accumulated credits, or base credits, from prior years. Multiplier credits for advanced technology will expire in MY 2030 while base credits previously earned from plug-in hybrid, battery electric, or fuel-cell electric vehicle sales that are still within the 5-year credit life will be retained.

In the standards, HDV production that occurs in states that have emission standards different from federal standards are now considered part of the “U.S.-directed production volume.” This means that between MY 2024 and MY 2027, manufacturers can generate federal advanced technology credit multipliers by complying with state-level regulations—such as the Advanced Clean Trucks (ACT) regulations adopted by multiple states—and using these credits to count toward federal compliance of the Phase 3 emission standards. This change effectively increases the number of advanced technology credits available for averaging, banking, and trading during that period.

Averaging sets

In the Phase 3 standards, several changes were made to the existing averaging, banking, and trading system, giving more flexibility to manufacturers to facilitate compliance with the emission limits. In the Phase 1 and 2 standards, credit trading could only occur within averaging sets, which are HDV regulatory groups aggregated based on vehicle weight class.[7] Between MY 2027 to MY 2032, emission credits can be averaged, traded, and banked across HDV averaging sets, with no limitations on the direction or volume of credits. EPA further extends the interim flexibility to allow one-way credit transfers from averaging sets of medium-duty vehicles certified to the light and medium-duty vehicle standards, to averaging sets of Class 2b–5 and Class 6–7 HDVs (i.e. light HDVs and medium HDVs). In other words, between MY 2027 and MY 2032, manufacturers can trade and use CO_2 credits generated from the production of Class 2b–3 pickups and vans, which are subject to the light- and medium-duty standards, to offset emissions deficits in their Class 6–7 vocational vehicles or tractor trucks. They can also use credits from the production of Class 4–5 vocational vehicles to offset deficits in Class 8 vocational vehicles and tractors.

To mitigate any dilution of the Phase 3 emission benefits, EPA has created a priority list for manufacturers to use credits within an averaging set to count toward Phase 3 compliance. Specifically, manufactures can use credits in the following order:

- Base credits banked or traded within the same averaging set
- Base credits earned in the same model year from other averaging sets
- Base credits banked or traded in other averaging sets and used across averaging sets
- Multiplier credits within the same averaging set for the same model year
- Multiplier credits banked or traded within the same averaging set.
- Multiplier credits earned in the same model year from other averaging sets
- Multiplier credits banked or traded in other averaging sets

HYDROGEN INTERNAL COMBUSTION ENGINE VEHICLES

Hydrogen internal combustion engine (H_2-ICE) vehicles are a nascent technology being explored by manufacturers. H_2-ICE vehicles can either run on pure, or neat, hydrogen or via dual-fuel, which is when diesel fuel is also involved in the combustion process. Both types of H_2-ICE vehicles have tailpipe emissions of air pollutants and GHGs because NO_x and particulate matter (PM) are formed during the combustion process, thus requiring an aftertreatment system. CO_2 emissions from dual-fuel H_2-ICE vehicles come predominantly from the diesel fuel. H_2-ICE vehicles fueled by neat H_2 still produce trace amounts of tailpipe CO_2 stemming from urea decomposition and engine lubricant oil in the selective catalytic reduction system.

Consistent with the existing treatment emissions from urea decomposition in diesel vehicles, trace CO_2 emissions from H_2-ICE vehicles operating on neat hydrogen are not counted when determining compliance with the Phase 3 GHG standards. Dual-fuel H_2-

7 The three averaging sets in the HDV GHG standards are light heavy-duty (Class 2b–5), medium heavy-duty (Class 6–7), and heavy heavy-duty (Class 8).

ICE vehicles are to be certified to the GHG emission levels resulting from the existing testing provisions.

BATTERY HEALTH, DURABILITY, AND WARRANTY

Given that the Phase 3 standards are expected to drive the production and sales of zero-emission HDVs, the rule includes new requirements for batteries; degraded batteries affect life-cycle mileage and are therefore an important component in vehicle emissions performance.

The rule requires manufacturers to provide a customer-facing battery state-of-health (SOH) monitor which tracks and displays battery energy capacity for all battery electric and plug-in electric vehicles. This SOH expresses a vehicle's usable battery energy as a percentage of the original energy when the battery is new. The rule does not mandate a specific testing procedure for determining the usable battery energy. It instead provides specific requirements for a test procedure to ensure accurate results that represent in-use operation.

The rule includes the high-voltage battery in battery electric and hydrogen fuel-cell electric vehicles as emission-related components that must be covered by warranty, along with other powertrain components such as the fuel-cell stack, electric motors, and inverters. The emissions warranty periods in the Phase 2 standards—5 years or 50,000 miles for light HDVs and 5 years or 100,000 miles for medium HDVs and heavy HDVs—apply to these components.

PROJECTED BENEFITS

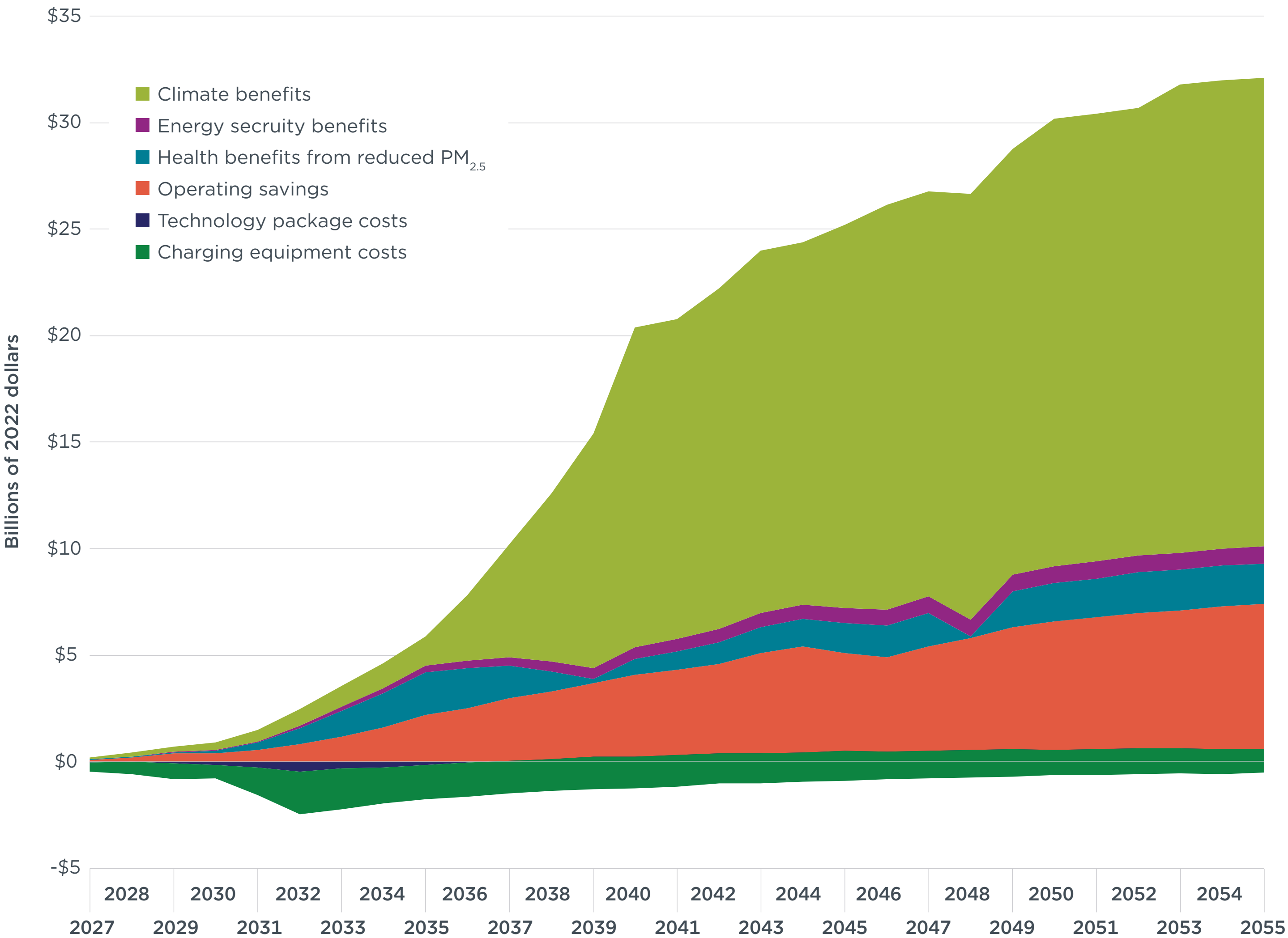
According to EPA, the Phase 3 standards will reduce cumulative CO_2 emissions from the HDV sector by over 1 billion metric tons between 2027 and 2055 compared to the reference case.8 EPA's reference case in the final standards includes higher ZEV adoption levels to account for the production and sales of zero-emission HDVs in states that have adopted the Advanced Clean Trucks regulation. It is worth noting that EPA's analysis finds an increase in upstream GHG emissions from electricity generation related to operating HD ZEVs, but the emission increases are more than offset by GHG emission reductions from upstream refineries and downstream HDV activities.

Figure 2 shows EPA's calculations of Phase 3 vehicle and infrastructure technology costs, health and climate benefits, operating savings, and energy security benefits from 2027 to 2055. Except in the first few years, benefits brought by the Phase 3 standards are projected to far outweigh the costs. Overall, EPA estimates that the Phase 3 standards will bring $13 billion in annualized net benefits through the year 2055, at a 2% discount rate. The total includes around $10 billion in annualized climate benefits from reduced greenhouse gas emissions, and up to $300 million in annualized health benefits from reduced fine particulate matter ($PM_{2.5}$) precursor emissions. The annualized cost of production to the industry is expected to be about $1.1 billion while operating savings are valued at $3.5 billion. An additional $450 million in annualized benefits are expected from reduced dependency on oil imports.

8 Greenhouse Gas Emissions Standards for Heavy-Duty Vehicles—Phase 3; U.S. Environmental Protection Agency, *Phase 3 Regulatory Impact Analysis*.

Figure 2

Costs and benefits of EPA's Phase 3 GHG standards for heavy-duty trucks through 2055, relative to the reference case



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2026 ASSESSMENT

EPA plans to collaborate with the Department of Energy and the Department of Transportation to review charging and refueling infrastructure growth and issue regular status reports beginning as early as 2026. EPA has identified several areas for data collection, including the number, size, location and growth rate of public and depot charging sites, the sales of electric vehicle service equipment, charging facility installation timelines, electric distribution system upgrades, and hydrogen fuel production and fueling station developments. Based on findings of the reports, EPA may decide to issue guidance documents or modify the Phase 3 rule to give more lead time to manufacturers.

POLICY CONTEXT IN OTHER MARKETS

On May 13, 2024, the Council of the European Union ratified the agreement on the revision of HDV CO_2 standards.[9] Compared to the original standards adopted in 2019, the revision ramps up the stringency of targets and widens the scope of vehicles covered to include more types of trucks, buses, coaches, trailers, and vocational vehicles.

At a high level, the European Union's revised CO_2 standards kept the 2025 CO_2 reduction target of 15%, raised the 2030 target to 45%, and added a 65% reduction target for 2035 and a 90% reduction target for 2040 relative to a baseline reporting period. The reduction targets are further broken down to vehicle bins and groups based on type, axel configuration, and weight.

With the exception of urban buses in the European Union, both the EU and U.S. standards are performance based and do not mandate sales numbers for zero-emission vehicles. Compared to the U.S. Phase 3 standards, the European Union's revised GHG standards for HDVs have a longer temporal scope and a higher stringency. Table 4 compares the key differences between the two regulations.

Table 4

Comparison of the most recent EU and U.S. CO_2/GHG emission standards for HDVs

	Revised EU standards	U.S. EPA Phase 3 standards
Level of stringency	45% CO_2 reduction in 2030, 65% in 2035 and 90% in 2040 across all new HDVs relative to respective baseline	Stringency varies by segment, ranging from 5% to 60% reduction by 2032 relative to 2027 baseline.
Regulatory period	2025, 2030, 2035, 2040; no interim targets between those years.	2027–2032, with annual targets
ICE efficiency improvements	Considers low-cost ICE efficiency technologies available to manufacturers to meet the standards	No consideration of improvements beyond Phase 2 ICE vehicle efficiency technologies
Trailers	Includes targets for semitrailers, drawbar trailers, and center-axle trailers with box body configurations	No trailer targets

The Advanced Clean Trucks (ACT) regulation is the other important supply-side HDV regulation in the United States that will drive manufacturers' production of zero-emission trucks. Adopted by the California Air Resources Board in 2020, it requires manufacturers to sell increasing percentages of zero-emission Class 2b–8 trucks.[10] EPA granted a waiver for preemption regarding the ACT regulation in April 2023.[11] ACT has gone into effect in California, with nine additional states poised to begin implementation in the next few years. As mentioned previously, manufacturers' compliance with ACT can generate multiplier credits between MY 2024 and MY 2027 that will also aid their compliance with the federal Phase 3 standards.

9 Eammon Mulholland, The Revised CO_2 Standards for Heavy-Duty Vehicles in the European Union (International Council on Clean Transportation, 2024), https://theicct.org/publication/revised-co2-standards-hdvs-eu-may24/.

10 Claire Buysse and Ben Sharpe, California's Advanced Clean Trucks Regulation: Sales Requirements for Zero-Emission Heavy-Duty Trucks (International Council on Clean Transportation, 2020), https://theicct.org/publication/californias-advanced-clean-trucks-regulation-sales-requirements-for-zero-emission-heavy-duty-trucks/.

11 California State Motor Vehicle and Engine Pollution Control Standards; Heavy-Duty Vehicle and Engine Emission Warranty and Maintenance Provisions; Advanced Clean Trucks; Zero Emission Airport Shuttle; Zero Emission Power Train Certification; Waiver of Preemption; Notice of Decision, 88 F.R. 20688 (April 6, 2023), https://www.govinfo.gov/content/pkg/FR-2023-04-06/pdf/2023-07184.pdf.

The California Air Resources Board adopted the Advanced Clean Fleets (ACF) regulation in April 2023.[12] As a complement to the ACT regulation, ACF requires federal, state, and local government fleets, in addition to large private fleets, to begin purchasing zero-emission HDVs starting in in 2024. ACF also requires that manufacturers sell only zero-emission medium- and heavy-duty vehicles starting in 2036. The regulation is intended to work in tandem with the ACT regulation to ensure there is both a supply and demand for zero-emission HDVs. Combined, the ACT and ACF regulations position California as the world leader in terms of legally-binding zero-emission HDV regulations.

12 California Air Resources Board, "California Approves Groundbreaking Regulation That Accelerates the Deployment of Heavy-Duty ZEVs to Protect Public Health," press release, April 28, 2023, https://ww2.arb.ca.gov/news/california-approves-groundbreaking-regulation-accelerates-deployment-heavy-duty-zevs-protect.

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MARKET SPOTLIGHT

ZERO-EMISSION MEDIUM- AND HEAVY-DUTY VEHICLE MARKET IN CHINA (JANUARY–JUNE 2024)

November 18, 2024 | By: Shiyue Mao, Lingxiao Xu, and Felipe Rodriguez

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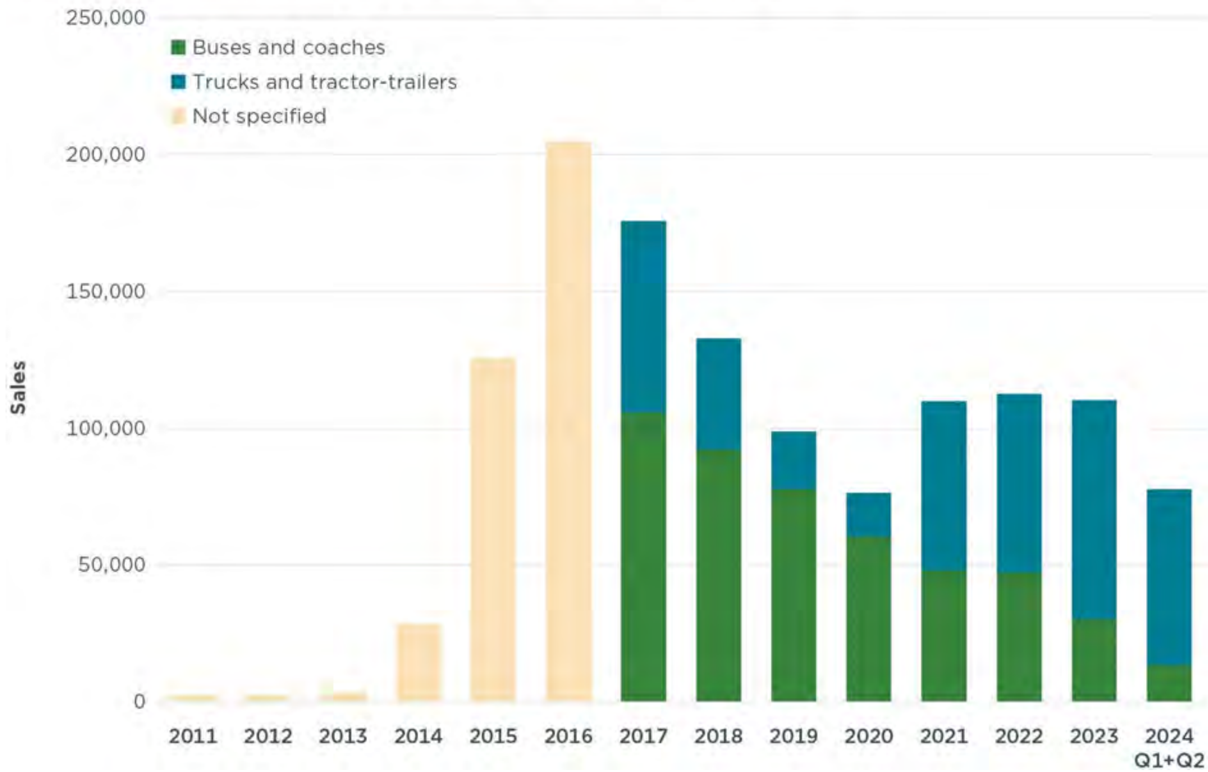
Overview

This overview of China's zero-emission heavy-duty vehicle (ZE-HDV) market covers city buses and coaches, medium and heavy straight trucks, and tractor-trailers above 3.5 tonnes. Sales of ZE-HDVs in China saw two spikes in the last 13 years: first in 2015–2016, underpinned by government subsidies, and more recently in 2021, amid a rebound in domestic and foreign demand after COVID-19.

Through the first half of 2024, total ZE-HDV sales in China reached approximately 77,700, including roughly 64,500 ZE trucks and tractor-trailers and 13,200 ZE buses and coaches. Sales of ZE trucks and tractor-trailers were particularly noteworthy, as they almost matched the total number of these vehicles sold in the whole year in 2022 (65,200). Meanwhile, ZE bus and coach sales continued to shrink.

Sales of zero-emission heavy-duty vehicles in China, 2011 to June 2024



Heavy trucks

The heavy truck market saw changes in the mix of fuel types from previous years. In the first half of 2024, diesel trucks accounted for 55% of sales, down from 80% in the first half of 2023, and natural gas-powered trucks made up 35% of sales, up 8% year-on-year. Battery electric trucks reached a 9% sales share and were the third most popular powertrain technology in the market.

Sales of both battery electric and fuel-cell heavy trucks have mostly grown steadily in 2024, except for a dip in February during the Spring Festival, when most business activity is paused. In June, the market share of battery electric heavy trucks hit a new high of 14%, a 35% increase from January 2024. The market for fuel-cell heavy trucks remains nascent, with 332 vehicles sold in June 2024, a 1% market share.

Lithium iron phosphate (LFP) batteries dominate the heavy truck market in China due to their economy, durability, and safety. In terms of capacity, the most popular battery sizes for these vehicles were 282 kWh, 350 kWh, and 423 kWh, indicating a balance between cost and efficiency.

The collective market share of the top 5 original equipment manufacturers (OEMs), known as the 5-firm concentration ratio or CR5, is an indicator of market maturity. In the first half of 2024, the CR5 among internal combustion engine (ICE) heavy truck manufacturers was 79%, while the ratio among ZE manufacturers was 69%. This implies that the ZE heavy truck industry is approaching a level of market maturity similar to that of ICE manufacturers, with top OEMs capturing a growing share of the market.

🔍 Click on the figures to take a closer look at the data

Medium trucks

Diesel remained the dominant powertrain in the medium truck market in the first half of 2024, accounting for 86% of total sales, a 4% year-on-year decrease. Battery electric reached a 10% market share, making it the second most popular powertrain in the segment.

By month, battery electric trucks showed steady growth in market share, reaching 14.4% in June 2024, more than double the level in January 2024. Just two fuel-cell trucks were sold in June, representing a 0.4% market share; this powertrain remains in early stages of development in this segment.

As in the heavy truck market, LFP is the dominant battery chemistry among medium trucks in China. Most electric medium truck models were equipped with 100 kWh batteries to balance cost and available range. Equipping trucks with heavier batteries may not necessarily improve the available range, as reduced energy efficiency due to the increased weight of the battery may offset the range benefits of added battery capacity.

Here there is a small difference in the market share of the top 5 OEMs between the ICE and ZE medium truck industries: In the first half of 2024, the CR5 of ICE OEMs was 79%, while the CR5 of zero-emission truck OEMs was 69%.

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City buses and coaches

City buses have the highest electrification rate of all vehicle categories in China, with a cumulative battery electric, hybrid electric, and fuel-cell electric market share of almost 100% as of mid-2024. Electrification among coaches, which are used for intercity transport, has been far more limited: The market share of battery electric coaches was 6% in the first half of 2024, and most coaches were still powered by diesel. This implies that the uptake of electric commercial vehicles is driven by demonstrated applicability in certain uses, with widespread adoption for (generally shorter-distance) intra-city bus travel but not yet for (typically longer-distance) trips between cities.

In terms of market share, there were no major changes in the adoption of zero-emission technologies during the first half of 2024. City bus sales saw a peak in January with 2,670 units sold, predominantly battery electric buses, followed by a sharp decline in February and March before a bounce in April. As of June 2024, the market share of battery electric coaches was 6.0%.

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Battery swapping

Battery swapping, whereby a depleted electric vehicle battery can be switched out for a fully charged replacement within minutes, is an innovative technology that can make battery electric vehicles operate more efficiently and affordably. Fleet operators save on the upfront investment by purchasing vehicles without batteries installed and renting batteries from third-party lessors; operators can also be free from range anxiety, assuming there is battery swapping infrastructure deployed close to their yard. Swap-capable technology has gained in popularity in China in recent years, particularly for trucks and tractors.

In the first half of 2024, sales of swap-capable vehicles increased and reached a total of 2,497 in June 2024. That is up 87% from the first half of 2023. The popularity of swap-capable vehicles has been jointly driven by policy and market developments: Several policies were introduced in 2024 to support this emerging technology (see Table 4.1), and pilot projects have been launched to assess use cases in several industries, including mining, steel, and port logistics.

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+ **Terminology, data sources, methodology, and assumptions**

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ASSESSING THE SCALE OF ZERO-EMISSION TRUCK DEPLOYMENT REQUIRED FOR MEETING INDIA'S NET-ZERO GOAL

April 17, 2024 | By: Namita Singh and Aviral Yadav

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India has committed to reduce the carbon emissions intensity of its GDP by 45% by 2030 and to achieve net-zero emissions by 2070. Reducing heavy-duty truck emissions, which are a large and growing source of overall transport emissions, will be essential to meeting these goals. This paper assesses the rate of zero-emission truck (ZET) adoption necessary for India to meet its 2030 and 2070 climate targets. Considering various policy and market scenarios, it examines the impact of ZET penetration on the total fleet's tank-to-wheel and well-to-wheel CO2 emissions. As India seeks to expand its production and use of green hydrogen, this paper also analyzes the impact of grey and green hydrogen uses on fleet-wide emissions.

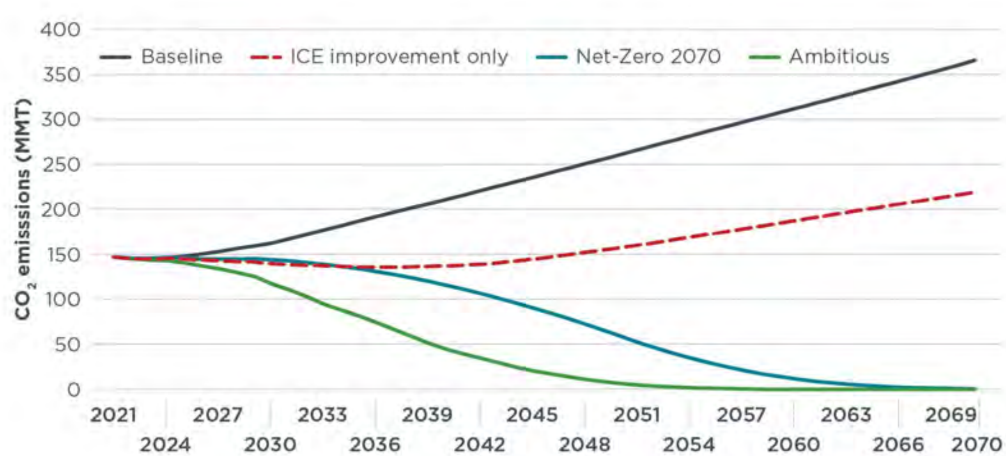

Figure 10. TTW CO_2 emissions from the HDT segment

This paper finds that for India to achieve its 2070 net-zero target would require 100% ZET penetration by 2050. A more ambitious scenario, which would keep India below the 2 °C warming limit set out in the Paris Agreement, would necessitate ZET uptake of 30% by 2030 and 100% by 2045. Grid decarbonization and green hydrogen use will also be critical to India's emissions-reduction outlook. Overall, accelerating ZET adoption would contribute significantly to India's economy wide emissions reduction aims.

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RACE TO ZERO: EUROPEAN HEAVY-DUTY VEHICLE MARKET DEVELOPMENT QUARTERLY (JANUARY–DECEMBER 2024)

February 11, 2025 | By: Eamonn Mulholland and Pierre-Louis Ragon

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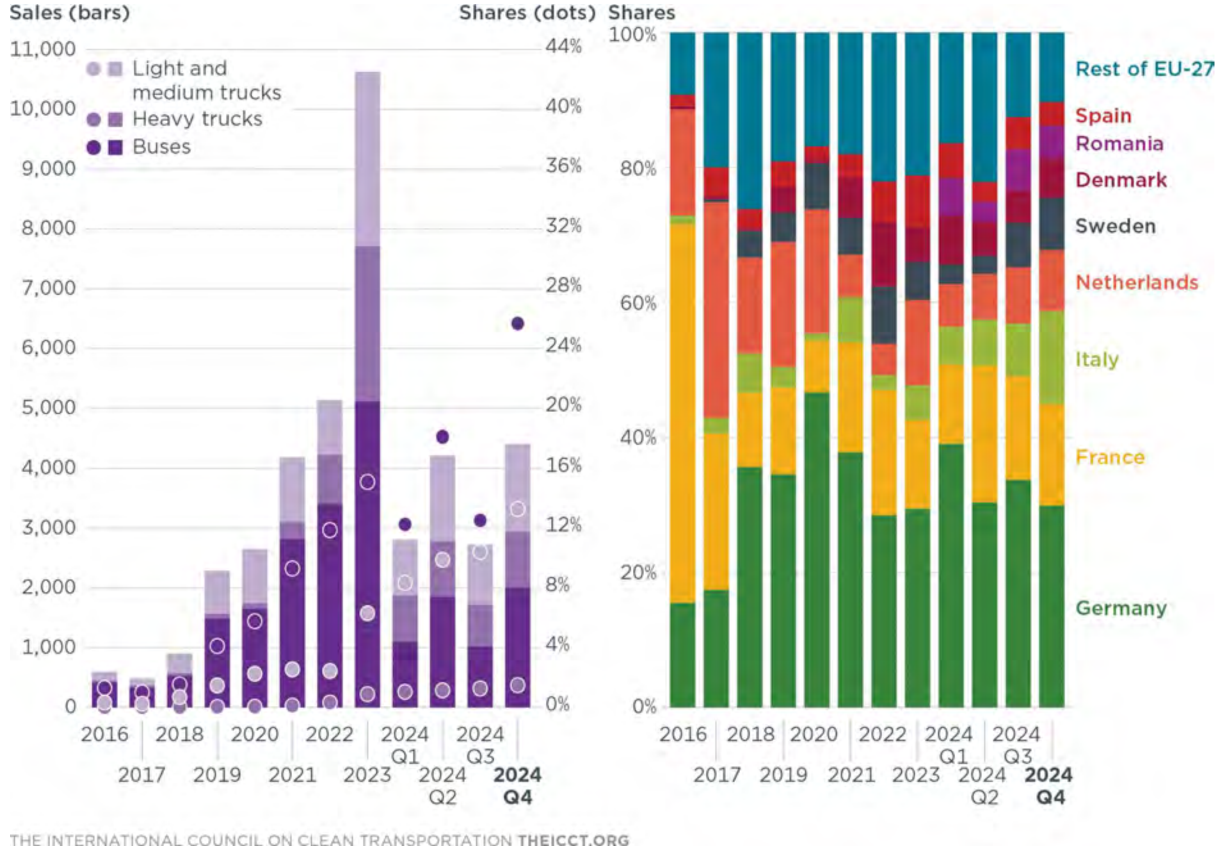
Summary

Just over 14,000 zero-emission heavy-duty vehicles (HDVs) were sold in 2024, up from 11,000 in 2023. Heavy trucks (above 12 tonnes) had a zero-emission sales share of 1.2% in 2024, up from 0.9% in 2023; light and medium trucks (below 12 tonnes) had a 10% zero-emission share, up from 6% in 2023; and buses and coaches saw a marginal increase to 17% in 2024 from 16% in 2023. Sale shares of zero-emission buses and coaches fluctuated from a low of 12% in the first quarter to a high of 26% in the fourth quarter, and electric city buses pushed this share significantly. When the sales share of zero-emission city buses breached 50% in the fourth quarter of 2024, it marked the first quarter in which sales surpassed internal combustion engine buses.

Germany led the increase in sales of zero-emission trucks: Its sales of zero-emission heavy trucks rose from 750 (1% share) in 2023 to 1,200 (1.7% share) in 2024, and its sales of zero-emission light and medium trucks rose from 1,600 (7% share) in 2023 to 2,700 (16% share) in 2024. In other major vehicle markets such as Spain and Italy, which were a combined 6% of EU-27 sales in 2024, sales of zero-emission trucks remained low despite these markets accounting for nearly 20% of the conventional truck market.


Sales (bars)
Shares (dots)
Light and medium trucks
Heavy trucks
Buses
11,000
10,000
9,000
8,000
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2016
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2024 Q1
2024 Q2
2024 Q3
2024 Q4
Shares
100%
80%
60%
40%
20%
0%
Rest of EU-27
Spain
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Germany
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Overall market developments

In 2024, sales of all HDVs were 360,000, down from 390,000 in 2023. This 8% drop was largely driven by a fall in sales in the third quarter, when the 74,000 vehicles sold was substantially lower than the 100,000 sold in the third quarter of 2023. Sales bounced back in the fourth quarter relative to the third by 12%, and 2024 ended with a similar sales volume as the same period in 2023. While Germany's share of the market remained the same in 2024 as it was in 2023, France and Spain increased their shares by 1.5 and 2.5 percentage points, respectively.

Manufacturer market shares shifted only slightly in 2024. Mercedes remained the top seller (19.6% of all HDVs) but captured less than the 21% of the market it had in 2023. Following behind were MAN with a 14% share, Iveco (13.1%), Volvo (12.8%), Scania (12.4%), DAF (10.1%), and Renault (7.8%).

Heavy trucks

Trucks with a gross vehicle weight above 12 tonnes

In 2024, heavy trucks were 77% of all HDV sales. Out of 275,000 heavy trucks sold, 3,400 (1.2%) were zero-emission vehicles. Sales in the segment contracted by 5% relative to 2023 when 290,000 vehicles were sold. The zero-emission market still grew against the backdrop of this contraction, as the 2,600 zero-emission vehicles sold in 2023 were a 0.9% sales share.

In the fourth quarter of 2024, 940 zero-emission heavy trucks were sold, representing a sales share of 1.5%, roughly the same volume and share as in the last quarter of 2023, when 950 zero-emission heavy trucks were sold (1.4% share).

Volvo Trucks maintained its leading position in the zero-emission heavy truck market in the fourth quarter of 2024, but its 33% share was a drop from its 43.5% share in the previous quarter. Renault trailed closely by selling 32% of all zero-emission heavy trucks and was followed by Mercedes with a 17% share.

Germany continued to lead in sales of zero-emission heavy trucks in the fourth quarter of 2024, with the 300 units sold representing 32% of the market. Just five countries (Germany, France, the Netherlands, Sweden, and Denmark) were responsible for 90% of all zero-emission heavy trucks sales.

🔍 Click on the figures to take a closer look at the data

Light and medium trucks

Trucks with a gross vehicle weight between 3.5 tonnes and 12 tonnes

In 2024, light and medium trucks were 13% of all HDV sales. Out of 46,000 light and medium trucks sold, 4,800 (10%) were zero-emission vehicles. The segment contracted by 16% relative to 2023, when 55,000 vehicles were sold. The zero-emission market grew against the backdrop of this contraction, though: In 2023, the 3,500 zero-emission sales were only 6% of the market. In the fourth quarter of 2024, 1,500 zero-emission light and medium trucks were sold, a sales share of 13%. In terms of volume and share, this is more than double the fourth quarter of 2023 when 780 zero-emission light and medium trucks were sold, a share of 6%.

Germany was home to 55% of the zero-emission sales. The same five countries (Germany, France, the Netherlands, Denmark, and Sweden) were home to 88% of all zero-emission light and medium trucks sales. Notably, in the fourth quarter of 2024, zero-emission vehicles were 48% of all light and medium trucks sales in Denmark and 42% in Sweden.

Ford regained its position as the leading seller of zero-emission light and medium trucks. The Ford E-Transit was the most popular zero-emission model in 2024 with 1,800 sold and it was followed by the Iveco eDaily (1,200 sold), the Mercedes eSprinter (560 sold), and the Fiat Ducato (430 sold). Combined, these four models were 83% of all zero-emission light and medium trucks sold in 2024.

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Figure 3.4. Sales of zero-emission light and medium commercial vehicles by Member State in Q4 2024

Buses and coaches

With a gross vehicle weight above 3.5 tonnes

In 2024, buses and coaches were 10% of all HDV sales. Out of 35,000 buses and coaches sold, 6,000 (17%) were zero-emission vehicles. The bus and coach market grew by 31% relative to 2023 when 27,000 vehicles were sold. The volume of zero-emission buses and coaches also increased in 2024 relative to 2023, when 4,500 zero-emission vehicles were sold; the sales share remained relatively constant at 17% in 2024 compared with 16% in 2023.

In the fourth quarter of 2024, 2,000 zero-emission buses and coaches were sold, 26% of total sales and an increase in both volume and share compared with the last quarter of 2023, when 1,600 (22% share) were sold. Over 50% of all city buses sold in the fourth quarter of 2024 were battery electric—zero-emission powertrains were more popular than combustion engines for the first time ever. Seven countries (Belgium, Ireland, Latvia, Lithuania, Luxembourg, the Netherlands, and Romania) only sold zero-emission city buses in the fourth quarter of 2024. That same quarter, sales share of zero-emission interurban buses and coaches increased to 6%, largely driven by a surge in electric minibuses sold by Iveco, Mercedes, and Ford.

🔍 Click on the figures to take a closer look at the data

Technology focus: Energy efficiency technology deployment

Manufacturers are pursuing various strategies to reduce the carbon dioxide (CO2) emissions of their new HDVs, and all major manufacturers recently launched new technology packages that benefit the energy efficiency of both conventional and zero-emission vehicles. These include improvements in the aerodynamic design of truck cabins, advanced driver assistance systems (ADAS), lightweighting of various vehicle components, and, for conventional vehicles, more efficient engines and transmissions. All combined, fuel savings of up to 15% have been reported in the new generation of long-haul tractor-trailers compared with 2020-2021 trucks.

New rules on truck cabin design implemented in 2021 allowed all major manufacturers to launch new, elongated truck cabins with significantly improved aerodynamics and other features such as air fenders, aero seals, under hood aerodynamic design improvement (closing gaps between components), side skirts, and improved windscreen design. Another innovation driven by the new safety requirements is the introduction of camera mirrors to replace traditional side mirrors; this reduces blind spots for increased safety and considerably reduces air drag on the side of the cabin. Improved aerodynamics have been reported to result in up to 5% fuel savings.

ADAS have also become more widespread in the past few years. ADAS deliver up to 5% fuel savings compared with vehicles that are not equipped with the technology. Most importantly, predictive cruise control (PCC) adjusts the speed of the vehicle to gain momentum as it approaches hills, which reduces the impacts of positive road gradients on fuel consumption. Recent improvements in PCC algorithms were reported to deliver further 2% fuel savings. For conventional vehicles, through more efficient combustion, engine lightweighting, and gearbox automation and increased rear axle ratio enabling engine downspeeding, fuel savings of up to 8% have been reported.

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Windrose rolls out electric longhaul sleeper truck in U.S.

by **Today's Trucking**
April 23, 2025

Electric vehicle manufacturer Windrose Technology said it has launched the first all-electric longhaul sleeper truck in the U.S. The EV truck has a 420-mile (676-km) range and is set for commercial deployment in the U.S., according to a news release.

Windrose partnered with JoyRide Logistics, a Phoenix, Ariz.-based carrier and the first U.S. regional trucking company to operate fully-electric sleeper trucks, all of which will be powered by EO Charging. The initial rollout begins in Arizona, California and Nevada, with nationwide expansion in sight, the company says.

"This isn't just a prototype or promise-this is a fully operational, long-range electric truck that's ready to haul freight today," Wen Han, founder, chairman, and CEO of Windrose said in the release. "We've validated our technology globally and are proud to bring it to the U.S.- one of the most important logistics markets in the world."

(Photo: Windrose Technology)

Windrose trucks have undergone real-world testing across Asia, Europe, Oceania and North America. In a recent U.S. field test, the Windrose sleeper completed a 2,800-mile (4,506-km) cross-country trip using only public charging stations. Further, Windrose also completed a 3,000-plus-mile (4,828-plus-km) loaded trip shipping clothing from the Hong Kong area to the China-Kazakhstan border.

Fast-charging capabilities

The sleeper includes a bunk area, fast-charging capabilities (megawatt charging system and combined charging system), and more than 700 kWh of battery offering with both lithium-ion phosphate and nickel manganese cobalt battery types, all while maintaining

Class 8 performance standards and weighing less than 26,000 lb. (11793 kg).

"Partnering with Windrose allows us to stay ahead – not just on sustainability, but on total operational performance," said Adis Danan, president at JoyRide Logistics. "We're talking fuel savings, reduced maintenance, and a future-ready fleet that our customers can get behind. We want to make electric logistics efficient, scalable and cool."

Powering the rollout is EO Charging, whose platform provides real estate acquisition, charging infrastructure deployment and vehicle financing, plus a promise of greater than 99% uptime.

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E-mobility is a crucial factor for the traffic of the future. As the technology leader of today, Daimler Truck is also aiming to shape the logistics and passenger transportation of tomorrow – with electrified solutions that provide maximum benefits for customers and the environment.

To this end Daimler Truck has initially focused on market segments in which electrified trucks and buses can function first – both technologically and economically. With the all-electric Mercedes-Benz eCitaro, Daimler Buses has been offering a locally CO_2-neutral city bus for environmentally friendly public transport in cities and metropolitan areas since 2018. Series production of the battery-powered eCitaro is well underway. Products such as the eCitaro make a substantial contribution to keeping the air cleaner in urban areas. The Mercedes-Benz eActros for heavy urban distribution is in series production since October 2021 and the eEconic, our special truck for municipal waste disposal, since July 2022. The light-duty FUSO eCanter is being put through its paces by customers under real-world, everyday conditions since 2017. In December 2018 the first Freightliner eM2 was also turned over to customers in the U.S.; the heavy Freightliner eCascadia followed in 2019. The Mercedes-Benz eActros 600 for long-distance haulage has been in series production since the end of 2024. With the Mercedes-Benz eActros GenH2 further locally CO_2-neutral vehicles are being planned or tested. Daimler Buses is also planning to launch the first all-electric intercity bus on the market from 2025. The first all-electric coach is due to follow at the end of this decade.

Customer trials are worth their weight in gold to Daimler Trucks: Every day new and important insights are gained. These include, for example, which routes the customers drive, when they want to or must load, or how long it actually takes for the trucks to be charged with enough power again and how the charging infrastructure has to be optimized to do so.

Mercedes-Benz

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GenH2 Truck

eActros 600

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Press release

Breakthrough: Volvo to launch electric truck with 600 km range

2024-09-03

AB Volvo

Up to 600 km on one single charge. That's how far Volvo's next-generation heavy-duty electric truck will be able to drive. The longer range represents a breakthrough for long-distance transport with zero tailpipe emissions.

The electrification of heavy trucks is continuing across the world and longer distances are now becoming a possibility.

Next year Volvo will launch a new long-range version of its FH Electric that will be able to reach up to 600 km on one charge. This will allow transport companies to operate electric trucks on ...egional and long-distance routes and to drive a full working day without having to recharge. ...ew Volvo FH Electric will be released for sale during the second half of 2025.

"Our new electric flagship will be a great complement to our wide range of electric trucks and enable zero-exhaust emission transport also for the longer distances. It will be a great solution for transport companies with a high annual mileage on their trucks and with a strong commitment to reduce CO2," says Roger Alm, President Volvo Trucks.

Five years of electric leadership

The enabler for the 600 km range is Volvo's new driveline technology, the so-called e-axle, which creates space for significantly more battery capacity onboard. More efficient batteries, a further improved battery management system and overall efficiency of the powertrain also contribute to the extended range.

Volvo Trucks is a global leader in medium- and heavy-duty electric trucks with eight battery-electric models in their portfolio. The wide product range makes it possible to electrify city and regional distribution, construction, waste management and, soon, long distance transport. Volvo has so far delivered more than 3,800 electric trucks to customers in 46 countries around the world.

"The transport sector represents seven percent of global carbon emissions. Battery-electric trucks are important tools to reduce the climate footprint. Besides the important environmental gains that electric trucks bring, they offer truck drivers a much better working environment, with much lower levels of noise and vibrations," says Roger Alm.

Volvo Trucks drives the transition towards fossil-free transport to reach its net-zero emissions target by 2040 using a three-path technology strategy. The three-path technology approach is built on battery electric, fuel cell electric and combustion engines that run on renewable fuels like green hydrogen, biogas or HVO (Hydrogenated Vegetable Oil).

September 3rd, 2024

LINK to high-resolution images

For further information, please contact:
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Volvo Trucks supplies complete transport solutions for discerning professional customers with its full range of medium- and heavy-duty trucks. Customer support is provided via a global network of dealers with 2,200 service points in about 130 countries. Volvo trucks are assembled in 12 countries across the globe. In 2023 approximately 145,000 Volvo trucks were delivered worldwide. Volvo

Trucks is part of the Volvo Group, one of the world's leading manufacturers of trucks, buses, construction equipment and marine and industrial engines. The group also provides complete solutions for financing and service. Volvo Trucks' work is based on the core values of quality, safety and environmental care.

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Clean Truck Partnership

The Clean Truck Partnership (CTP), is an agreement between CARB, the Truck and Engine Manufacturers Association (EMA), and other major truck manufacturers that represent over 90 percent of California's truck market. In exchange for commitments that the companies will meet California's vehicle standards and will require the sale and adoption of zero-emission (ZE) technology, regardless of whether any other entity challenges California's authority to set more stringent emissions standards under the federal Clean Air Act. CARB has agreed to work collaboratively with manufacturers to provide more lead time to meet CARB's existing regulatory requirements before imposing new regulations, and to support the development of necessary ZE infrastructure.

Commitment List - Status and Outcomes

This commitment list contains the status and outcome of CARB's tasks and actions outlined in the Clean Truck Partnership Agreement.

COMMITMENT LIST - STATUS AND OUTCOMES

PROGRAMS IDENTIFIED IN THE CLEAN TRUCK PARTNERSHIP

Advanced Clean Trucks

Heavy-Duty Low NOx

Advanced Clean Fleets

(800) 242-4450 | helpline@arb.ca.gov
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P.O. Box 2815, Sacramento, CA 95812

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The EQUATION

Trucking Industry Disinformation Will Cost Lives

October 30, 2024 | 10:00 am

JOE RAEDLE/NEWSMAKERS

Dave Cooke
Senior Vehicles Analyst

Recently, the states of Oregon and Massachusetts have proposed delaying enforcement of state truck engine emissions standards originally put in place to protect the health and welfare of their residents, standards stronger than what is enforced by EPA at the national level, and we're seeing truck manufacturers push for even more delays around the country. The rationale for this delay is largely based on industry disinformation, with manufacturers choosing to gin up anxiety among truck dealers to wage a war on the regulations by proxy. We heard this all in full effect at recent meetings of the California Air Resources Board (CARB) and Oregon Department of Environmental Quality, where some in industry advocated for delays all the way out to 2027.

This path taken by industry is a game of chicken with the regulators, a refusal to comply with the regulations as they stand and a dare to enforce them. Below, we walk through this cynical industry action and why it's critical that regulators hold firm in the face of this market manipulation. Lives are on the line.

Industry is compliant with state regulations and agreed not to oppose them

There are two separate state regulatory actions that

("Omnibus") rule, which requires new heavy-duty engines achieve a 75 percent reduction in health-harming NO_x emissions, on average, compared to the current federal standards that have been in effect since 2010.

California is the only state in which those standards are in effect in model year 2024, and manufacturers are overcomplying with both standards at this time, thanks in large part to electric truck sales that well exceed what is required by ACT and flexibilities in the Omnibus rule that were agreed to with the manufacturers.

Truck manufacturers, however, are now throwing a temper tantrum behind the scenes in order to try to renegotiate a rule they promised to follow. Because they've agreed not to oppose adoption of these standards, they are waging that war by proxy, pushing dealers to oppose the regulations through lies and market manipulation. The dealers themselves made clear they are feeling the pain of these actions and are struggling to fight back against the manufacturers, embodied best in a plea from one dealer to CARB at the recent hearing to get the manufacturers to "act in the spirit of the Clean Truck Partnership agreement and stop putting politics ahead of public services."

Truck makers are manipulating the market with draconian rules

compliance exclusively on the backs of dealers and ignoring the many flexibilities in the regulation aimed to reduce compliance burdens. Such tactics represent a new anti-regulatory approach to compliance that seem more like a political statement than sound business strategy.

This tactic only makes sense if the goal is not to comply with the regulation but to maximize the pain felt by dealers. And, because increasing a company's compliance costs is bad for business, this strategy is dependent upon one's competitors also pursuing this uneconomic strategy. Incredibly, that is exactly what appears to be happening, a fact highly suggestive of collusion among the truck manufacturers.

So what exactly are they doing? Rather than working *with* dealers as required by the Clean Truck Partnership and as one would expect from a good faith effort to comply with the law, manufacturers are instead enforcing quotas that have absolutely no grounding in either regulation. Manufacturers are requiring dealerships to purchase a specified number of electric trucks before receiving any allotment of diesel-powered vehicles, even in applications for which there is no electric vehicle availability. This behavior, known as ratio-ing, has resulted in massive decreases in in-state truck sales, including (according to the California New Car Dealer Association) an 80 percent year-over-year decrease in Class 8 vehicle sales, the heaviest and biggest on-road vehicles. This

Importantly, manufacturers are lying to their dealers about the origin of this artificial product shortage. According to interviews with dealers and manufacturers, sales representatives are telling dealerships that limited product availability is being driven by compliance with ACT regulation. However, representatives from the same manufacturers have explicitly told regulators (accurately) they are well-situated to comply with ACT.

ACT does not require a specific share of any given application be electric—rather, compliance is based on the average of a manufacturer's entire portfolio. This allows manufacturers to prioritize electric truck sales in the vehicle markets that are most advantageously deployed.

The voluntary decision by manufacturers to withhold sales from its dealers via ratio-ing is simply part of a strict, non-regulatory, and nonsensical business plan.

Truck makers are pursuing high-cost compliance to burden dealerships

Ultimately, it is the manufacturer that determines product availability, and it is critical to re-emphasize that the shortage felt by dealers is a crisis manufactured by truckmakers. This was reiterated by CARB at a recent meeting, and the dealers themselves confirmed this as well

Manufacturers comply with ACT and the Omnibus through credits. For ACT, there is a minimum number of zero-emission trucks a manufacturer is required to sell—if they sell more than is required, they can bank those credits to offset future obligations, and if they fall short they need to either draw upon any bank they may have built up or purchase vehicle credits from manufacturers that have exceeded their obligations. The Omnibus works in much the same way, but with credits tallied in tons of emissions. Under both rules, there is an excess of available credits, particularly from the growing number of all-electric truck manufacturers that naturally exceed the requirements of both rules.

As we heard repeatedly during the CARB hearing, manufacturers are refusing to engage in the credit market. As in the case of ratio-ing, this artificially increases their costs of compliance but also naturally increases the pain felt by dealerships. Manufacturers are price gouging on the electric trucks they do sell, with costs nearly $90,000 per truck higher in the US than a comparable EV goes for on the European market, and then in markets where such trucks aren't available, manufacturers are unwilling to compensate by using the flexibilities available. As Trevor Gasper of Thor Industries, an RV manufacturer that looks to truck manufacturers to supply chassis on which to build RVs, "These manufacturers are not interested in purchasing credits to assist the RV industry."

And it's one that flies in the face of industry sustainability commitments.

Truck makers have manufactured a crisis despite product availability

Of course, credits are meant as a temporary fallback—in the long run, it's more cost-effective to simply comply with the regulations yourself. And in fact, that's exactly what we see. Manufacturers have used their credit bank to buy time to supply product. While they certainly could have made some of these products available more quickly and, in some cases, have such compliant products available overseas, there is no doubt that manufacturers are preparing right now to comply without credits.

PACCAR was the first to certify its 13L heavy-duty diesel engine to the CARB 2024 standards, but Volvo introduced its own compliant engine shortly thereafter. The reason why they were able to do so is that 2024 compliance doesn't require massive investment or timelines, as Volvo themselves noted: "Really, the D13 is the same engine on the inside. (The CARB-complaint D13) is more about the turbo and then the enhanced aftertreatment system, and the 48-volt alternator." Cummins, the largest engine manufacturer, noted in recent comments to CARB that while they have not yet certified a diesel engine to these standards without credits, "This medium- and heavy-duty 20-50 mg engine families in 2025, 2026, and 2027."

The question of product availability isn't whether or not manufacturers *can* meet the rules on the books—it's *how* they approach meeting them. And right now they are choosing to ignore all the available flexibilities that lower costs in an effort to undermine the regs themselves, punishing dealers in the process.

Tallying up the harm

If state regulators grant delays in these regulations by capitulating to this manufactured crisis, they are granting truck manufacturers exactly what they have set out to do, and they are doing so on the backs of those who these regulations were meant to protect. Every delay, every carve-out, every weakening made by regulators at the behest of industry has a direct and permanent cost on the health of residents around the country.

The table below tallies up the harm from delaying these rules, as Oregon and Massachusetts have proposed, as we continue to see industry support for similar action in other locales. There are lives at stake, as evidenced by UCS modeling.

	Omnibus Delay to 2026		Omnibus Delay to 2027		ACT Delay to 2026		ACT Delay to 2027	
	Health Impacts ($M)	Deaths	Health Impacts ($M)	Deaths	Health Impacts ($M)	Deaths	Health Impacts ($M)	Deaths
Massachusetts	$304.5-391.4	19-25	$589.8-758.1	36-48	$36.9-48.7	2-3	$97.2-127.8	6-8
New Jersey	n/a		n/a		$119.5-160.4	7-10	$276.7-372.9	17-24
New York	n/a		$670.1-897.4	42-57	$103.6-136	6-9	$236.4-311.1	15-20
Oregon	$245.1-297.8	15-18	$475.1-577.2	29-36	$27.5-34.2	- 2	$74.9-93.2	5-6
Vermont	n/a		$26.1-31.9	- 2	n/a		$5.6-7	< - 1
Washington	n/a		$203-254.3	12-16	$28.8-35.6	- 2	$67.6-83.7	4-5
TOTAL:	$549.6-689.2	34-43	$1,964.1-2,518.8	121-159	$316.3-414.8	19-26	$758.4-995.7	47-63
TOTAL HARM GENERATED BY ACQUIESCING TO INDUSTRY DEMANDS:					$2.7-3.5 Billion		167-221 Premature Deaths	

Industry's push to delay state clean truck regulations until 2027 would result in up to $3.5 billion in monetized health impacts from ER visits, school days lost to asthma, etc. Part of these harms would be the premature deaths of up to 221 individuals, the result of additional pollution from delaying these critical regulations.

Regulators should ensure communities benefit as intended

Industry has engaged state regulators in a game of chicken, and for the health of communities around the country, it's critical that regulators not blink. Afterall, trucking industry disinformation is nothing new: this is just the latest example. But, if any agencies choose to weaken these rules through delay or carve-outs, they must ensure those emissions reductions still happen.

There is already a mechanism in place to do this in the Omnibus rule—as part of the Clean Truck Partnership, California negotiated an extension of a "legacy" provision that allows the sale of non-compliant engines in exchange for commensurate emissions reductions through designated

This is a poor replacement for compliance, but it at least makes an attempt to mitigate the harm caused directly by manufacturers, and on their dime.

Manufacturers have broken the rules with artificial caps that undermine the regulations. Regulators should hold firm on these rules to force industry's hand, but if they're going to fold, they better make sure industry pays for the harms caused by such market manipulations and ensure the communities suffering from diesel pollution aren't the ones paying with their health.

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Zero-Emission Class 8 Truck Pricing Comparisons – EU & US

As part of CARB's efforts to support clean trucks in California, this fact sheet explores the differences between zero-emission truck (ZET) pricing in the European Union (EU) and the United States (US) and the reasons for it. To better understand the current market situation, these findings are based on a preliminary assessment of pricing focused on battery electric Class 8 truck in the US/California and equivalent models (Class 5 LH) in the EU.

The assessment's primary finding is that, based on the incremental price difference between zero-emission and diesel trucks, ZETs in the EU have a roughly $57,000 less incremental price difference than similar ZETs in the US.

Process Used

Pricing data in California was pulled directly from purchase orders submitted as part of the HVIP voucher request process. Pricing in the EU came from EU industry sources.

There are many differences between European and American truck designs and regulations that make direct comparisons on pricing difficult. The standard approach to address this is to determine "incremental pricing"–the difference between the base diesel truck price and the battery electric truck price. This roughly reveals the added price of the electric powertrain (including batteries).

This assessment determined incremental pricing by finding the difference between the base diesel truck price in each region and the base ZET price, using equivalent models. Diesel truck pricing is quite different in each region, but the battery electric powertrains are essentially the same. This enables a more direct "apples-to-apples" comparison.

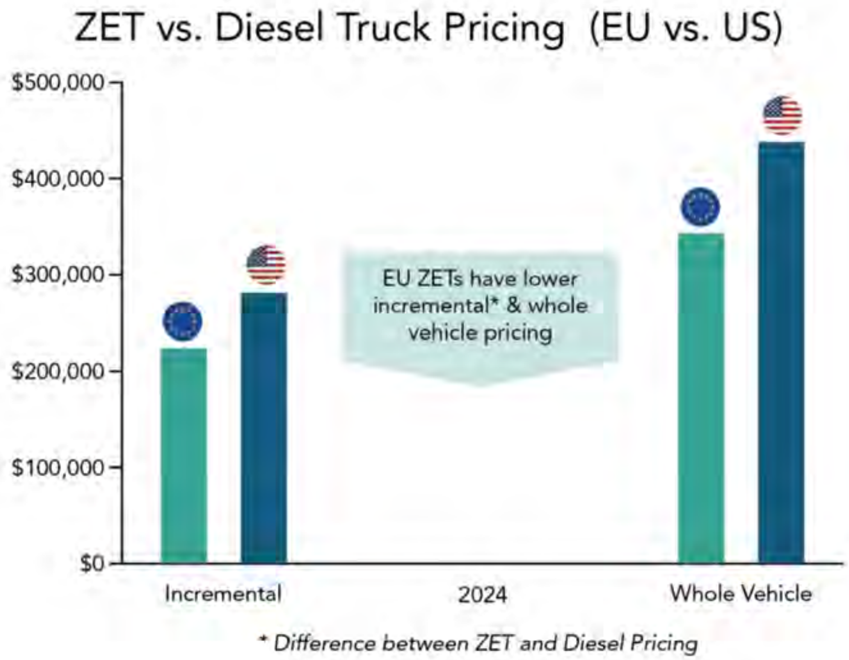
Findings

EU ZETs have lower incremental pricing than ZETs in the US/California.

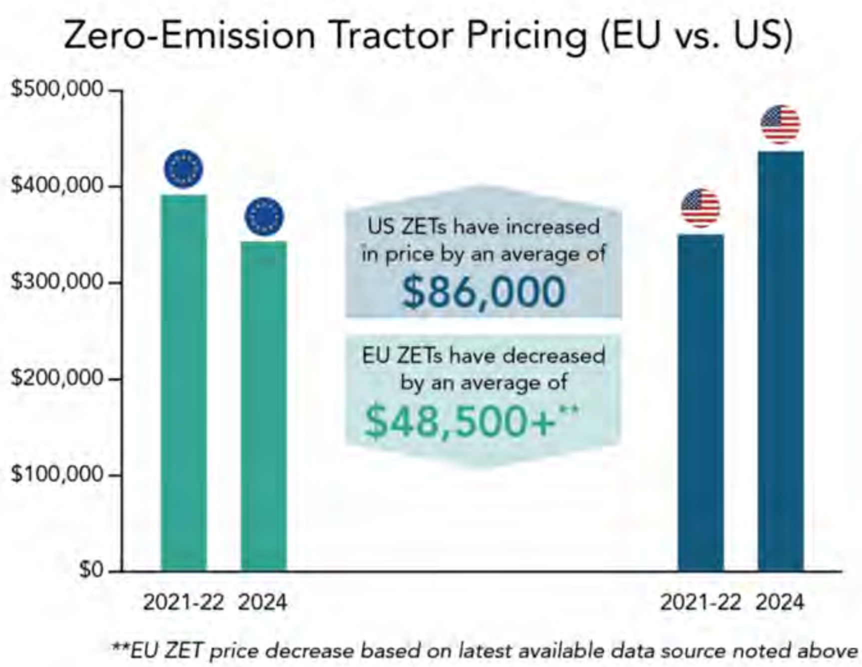
- The incremental ZE powertrain price for US/California Class 8 ZETs in 2024 averages $279,937.
- The incremental ZE powertrain price for European Class 5 LH ZETs averages roughly $223,000.
- **US incremental ZE powertrain price is around $57,000 more than EU incremental ZE powertrain price** even when accounting for lower base truck pricing in the EU.

EU ZETs have lower whole-vehicle prices compared to equivalent US/California ZETs.

- The average US/California zero-emission Class 8 truck in 2024 was priced at $435,839.
- The average EU zero-emission truck of similar capability to US trucks (Class 5 LH in Europe) in 2024 was priced at roughly $342,000.
- **US zero-emission trucks averaged nearly $94,000 more to purchase than in Europe.**



Total ZET sales volumes are roughly comparable between each region[iii]. Some European industry observers noted that as battery prices edge lower European vehicle makers have increased capability (increased battery size, range) while holding prices steady. Observers also note some OEM price competition in Europe in advance of the VECTO[iii] CO_2 model reporting deadline in 2025.



Aggregate HVIP Invoice Data by Year

HVIP Voucher Order Year	Average HVIP Purchase Order	Number of Orders	Average Diesel Equivalent Price	Average Incremental Cost
2021	$332,757	30	-	-
2022	$365,898	27	-	-
2023	$401,479	12	-	-
2024	$435,839	32	$155,902	$279,937

Truck Price Data Sources

- **US/California ZET Prices 2024 (Class 8 truck – day cab): $435,839**
  - Source: Purchase orders from HVIP voucher request documents; averaged across 32 orders
- **US/California ZET Prices 2021-22 (Class 8 truck – day cab): $349,328**
  - Source: Purchase orders from HVIP request documents 2021-2022; averaged across 57 orders
- **US Diesel Truck Prices (Class 8 truck - day cab): $155,902**
  - Source: Truckpaper.com retail sales site; based on retail prices for several hundred-day cab truck models that match models used for ZETs; prices averaged by OEM then roughly weighted by OEM market share
- **EU ZET Prices 2024 (Class 5 LH – day cab): $341,954**
  - Source: Nijenhuis Truck Solutions; average of the aggregated average price of multiple OEM models
- **EU ZET Prices 2021-22 (Class 5 LH – day cab): $390,550**
  - Source: Nijenhuis Truck Solutions; average of the aggregated average price of multiple OEM models
- **EU Diesel Truck Prices (Class 5 – LH – day cab): $118,858**
  - Sources: Truckpaper.com Global European retail sales site; average price of multiple OEM day cabs in models used for BETs; blended with Nijenhuis Truck Solutions aggregated price

*** Exchange rate between Euro and USD used for price conversions: 1 Euro = 1.07 USD

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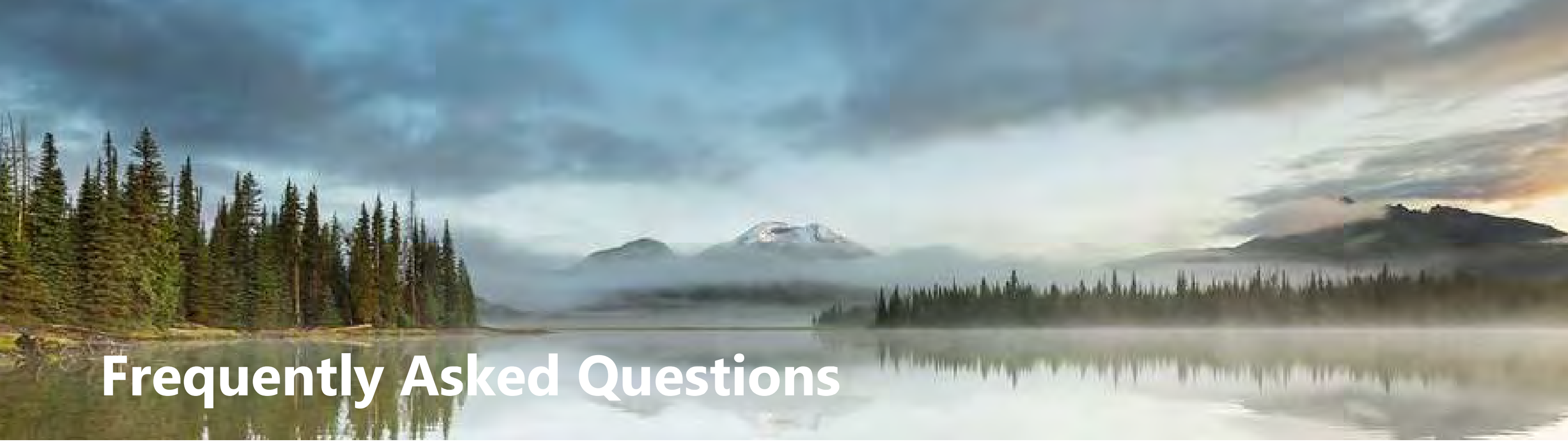
[i] Zeroing in on Zero Emission Trucks, May 2024 Market Update, CALSTART; *https://issuu.com/calstart/docs/zio_zet_may_2024_market_update_final*

[ii] Race to Zero European Heavy-Duty Vehicle Market Development Quarterly, March 19, 2024, ICCT; *https://theicct.org/publication/race-to-zero-eu-hdv-market-development-q4-2023-mar24/#:~:text=Summary,and%200.9%25%20of%20heavy%20trucks*.

[iii] Vehicle Energy Consumption Calculation Tool (VECTO) – common method to measure and compare HD vehicle performance in the EU market; *https://www.infineuminsight.com/en-gb/articles/vecto-drives-efficiency-gains/*



Oregon's Advanced Clean Trucks Rule

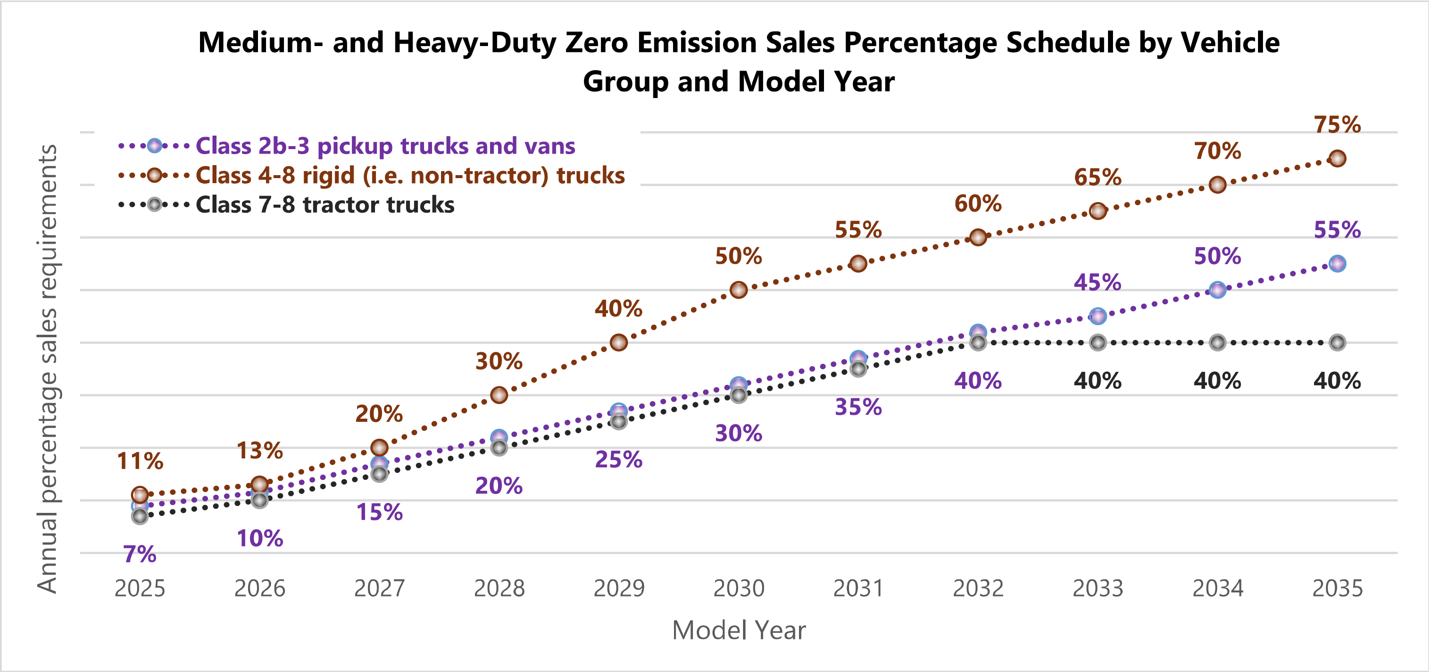
Updated 2/10/2025

In November 2021, Oregon's Environmental Quality Commission adopted the Clean Truck Rules, which includes Oregon's Advanced Clean Trucks Rule. This specific rule adopts by reference California's Advanced Clean Trucks Regulation designed to support the transition of medium- and heavy-duty vehicles to zero-emission engines over time.

At the same meeting, the commission also adopted California's Heavy-Duty Engine and Vehicle Omnibus Regulation, which in Oregon is known as the Heavy-Duty Low NOx Omnibus Rule, or the Low NOX Omnibus Rule. Details of this rule are described in a separate FAQ.

What does the rule require?

The ACT Rule requires medium- and heavy-duty vehicle manufacturers to sell an increasing number of zero-emission vehicles, beginning with the 2025 model year. The rule sets specific sales targets that grow each year, making a shift from producing gas- and diesel-powered trucks to cleaner electric- or hydrogen-powered options. **These target requirements apply to all new on-road vehicles with a gross vehicle weight rating greater than 8,500 lbs.**



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State of Oregon
Department of Environmental Quality

Are any vehicles exempt from the requirements?

Emergency vehicles, transit buses, motor coaches, articulated shuttles and double-decker buses are exempt from the ACT rule.

To whom does the rule apply?

The ACT rule applies to any manufacturers offering new medium- and heavy-duty vehicles for sale in Oregon. However, if a manufacturer sells an average of fewer than 500 medium- and heavy-duty vehicles in a model year, then it is exempt from the ACT Rule requirements.

Does the ACT rule ban the sale of certain new vehicles in Oregon?

No. The ACT rule includes a number of flexibilities for manufacturers to determine which vehicle models to move to zero emissions. There is no ban on producing combustion-powered vehicle types. Manufacturers can continue to produce and sell gasoline- or diesel-powered trucks, like motor homes or tow trucks, while focusing on electrifying other vehicles, such as zero-emission school buses.

Is it true that even without a ban, the ACT rule is so restrictive that there will be no diesel-powered vehicles available for sale in Oregon?

No. The ACT rule was designed to ensure a smooth adoption of ZEVs while still ensuring that diesel-powered vehicles are available for purchase. The rule is flexible and was recently changed to accommodate manufacturers' requests for more flexibility. For example, manufacturers can purchase credits from other manufacturers selling ZEVs or produce and sell near-ZEVs (e.g. plug-in hybrid electric trucks). In 2025, only 7-11% of vehicle sales must be zero-emission, as shown in the above chart.

Is there a market for zero-emission medium- and heavy-duty vehicles?

Yes. There are currently over 190 Class 2b-8 MHD ZEV models from 66 different manufacturers available for sale in the U.S., including medium-duty trucks, heavy-duty tractors, cargo vans, yard tractors, refuse trucks, coach buses, school buses, shuttle buses and transit buses.

How many ZEV sales have occurred in Oregon thus far?

Manufacturers have started to report their ZEV sales prior to the 2025 model year requirements. These manufacturers can earn early action credits on ZEV sales beginning with model year 2022. These early action credits can be used to help them meet their sales target requirements in 2025 and beyond.

Based on current reported sales through model year 2023, some manufacturers are already able to meet their 2025 ACT compliance obligation.

How do the purchase and operating costs of medium- and heavy-duty ZEVs compare with combustion-powered vehicles?

ZEVs have higher upfront costs but have lower operating costs than combustion-powered vehicles. The total cost of ZEV ownership in Oregon is similar to ownership of a combustion-powered vehicle for certain duty cycles. It is expected that upfront costs should come down as technology continues to improve, volumes increase and more ZEVs become available. Also, Oregon has a number of financial incentives and grants available to offset the higher purchase costs of ZEVs (See below).

Has DEQ made any changes to the ACT Rule?

On Nov. 21, 2024, the Environmental Quality Commission adopted temporary rules to incorporate recent California Air Resources Board changes to the Advanced Clean Truck regulation. Changes include:

- An increase to the deficit makeup period from one model year to three model years.
- Compliance to be based on reported sales of delivered vehicles instead of reporting when vehicles reach the ultimate purchaser.
- Several other minor updates to manufacturer reporting and certification requirements.

Temporary rules are in place until June 29, 2025. DEQ will propose permanent rules in early 2025. The process will include a rulemaking advisory committee, stakeholder engagement and a public comment period.

In addition, DEQ is closely tracking any future California amendments to its Advanced Clean Trucks regulation and will propose additional amendments as needed to ensure Oregon remains aligned with the California requirements.

What are the rules that apply to fleets that plan to purchase new medium- and heavy-duty vehicles in Oregon?

Vehicle owners and fleets do not have any specific purchasing requirements. The ACT rule only applies to businesses or manufacturers that sell new medium- and heavy-duty vehicles in Oregon.

NOTE: California adopted the Advanced Clean Fleets Regulation, which requires government and high priority fleets (organizations with $50 million or more in annual sales or at least 50 vehicles) to phase in ZEVs as a percentage of their total fleet. Additionally, it requires that by model year 2036, all new medium- and heavy-duty trucks sold must be ZEV. **Oregon has not adopted this rule and has no immediate plans to do so.**

Will there be adequate charging available to support the new ZEVs?

Yes. Many medium- and heavy-duty vehicles, such as urban delivery vans, drayage trucks, and transit and school buses drive less than 100 miles per day and can be electrified with only depot charging. These depots can largely be served by Level 2 chargers. Additionally, fleet managers can sequence charging to occur overnight when vehicles are not in use or during off-peak periods. There is ongoing state agency and utility coordination work to ensure there is sufficient infrastructure available.

What is DEQ doing to help support the transition to cleaner medium- and heavy-duty vehicles?

There are several grant programs and opportunities available to help fleets make the transition to cleaner vehicles. They include funding to support reducing diesel emissions through replacing older, more polluting diesel vehicles with similar cleaner burning or all-electric equipment. DEQ offers the Diesel Emission Mitigation Grants, Diesel Emission Reduction Act Grants and Congestion Mitigation Air Quality Grants. The one-time Zero-Emission Fueling Infrastructure Grants awarded $15 million to support entities with installing and siting medium and heavy-duty charging infrastructure. DEQ is also in the process of establishing a medium- and heavy-duty, zero-emission vehicle rebate program for the purchase of new zero-emission trucks. Recently, the agency was awarded $23 million through an EPA Climate Pollution Reduction Act Implementation Grant to help fund grants and rebates for medium- and heavy-duty vehicles and charging infrastructure. Finally, DEQ was also recently awarded $6.5 million through an EPA Clean Heavy-Duty Vehicles Grant to help replace 26 older diesel school buses with new zero-emission school buses.

In addition, DEQ's Clean Fuels Program offers incentives in the form of credits to providers of clean transportation fuels, including electricity. Owners of chargers that service on-road (light-, medium- and heavy-duty) and off-road vehicles can earn CFP credits when they report how much electricity is dispensed to EVs monthly. Those credits can be sold to other program participants, and the revenue can be used at the discretion of the charger owner.

What is the penalty for noncompliance?

DEQ will evaluate compliance based on the sales information submitted to DEQ. It is important to note the rules provide an additional three years for manufacturers to comply. Manufacturers can carry-over up to 30% of deficit balance each year. This is intended to provide flexibility to manufacturers as they begin to ramp up ZEV sales.

DEQ will not take any enforcement action on deficit compliance until manufacturers have had time to settle their deficits. That will occur in mid-2027, at the earliest. If DEQ does need to pursue an enforcement action, it will evaluate the facts of each case and apply the formula in Division 12 to calculate a penalty.

DEQ recognizes that the latest CARB amendments are awaiting review by California's Office of Administrative Law. To the degree the California ACT regulations are further modified, DEQ will move swiftly maintain identicality. When evaluating deficit compliance the agency will recognize manufacturers endeavors to comply with the rules, as they were in place in the state of Oregon.

Contacts

Rachel Sakata, rachel.sakata@deq.oregon.gov, 503-863-4271

Non-discrimination statement

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Enforcement Discretion for Advanced Clean Trucks Requirements
April 14, 2025

The Massachusetts Department of Environmental Protection (MassDEP) will exercise enforcement discretion to exempt on-road medium- and heavy-duty vehicles in Classes 2b-8 from Advanced Clean Trucks (ACT) requirements in 310 CMR 7.40 in Massachusetts for Model Years 2025 and 2026, provided that manufacturers supply internal combustion (ICE) engines to distributors seeking those vehicles, without restriction.

Background

MassDEP adopted California's ACT regulations in 310 CMR 7.40 in 2021. ACT requires manufacturers of on-road medium- and heavy-duty vehicles to produce and deliver for sale an increasing percentage of zero emission vehicles (ZEVs) starting in Model Year 2025 through Model Year 2035.

While manufacturers were involved in developing the ACT framework, they now indicate that ACT requirements are too difficult to meet. Some manufacturers are limiting ICE truck sales as a means to ensure their compliance with ACT sales requirements, reducing availability to a wide range of users. Further, the current federal administration has created significant uncertainty around ZEV incentives, charging investments, manufacturing and tariffs, each of which threaten a smooth transition to medium- and heavy-duty ZEVs.

Enforcement Discretion

MassDEP will exercise enforcement discretion by not taking enforcement action against manufacturers that do not meet their Model Year 2025 or Model Year 2026 ACT ZEV sales compliance obligations. To qualify for this exercise of enforcement discretion, manufacturers must supply ICE vehicles to distributors seeking them, without restriction — i.e., manufacturers may not engage in withholding or rationing practices.

This enforcement discretion replaces and supersedes the ACT enforcement discretion MassDEP issued on October 18, 2024 (i.e., state and local agencies no longer need to submit written requests regarding purchases of snow removal and street-sweeping vehicles since all medium- and heavy-duty vehicle purchases are covered by this updated enforcement discretion).

Disclaimer: This enforcement discretion directive does not constitute “final agency action” and is not a “regulation” as that term is used in M.G.L. c.30A. It may not be relied upon to create rights, duties, obligations or defenses, implied or otherwise, enforceable by any party in any administrative proceeding with the Commonwealth. In addition, this enforcement discretion directive does not exempt any person from complying with the other requirements in 310 CMR 7.40 or any other applicable local, state or federal law or regulation.

If you have any questions about this enforcement discretion, please contact Sharon Weber at Sharon.Weber@mass.gov.

October 18, 2024

Dear Attorney General Bonta, Secretary Garcia, Chair Randolph, and Legal Secretary Sapp:

We are writing to urge further attention to manufacturer behavior in the market for cleaner heavy-duty trucks that implicates both California's climate and clean air policies and its continued efforts to support a positive business environment, especially for small businesses. In our view, immediate oversight is warranted.

California truckers face real cost challenges, and the state, under Governor Newsom's California Climate Commitment, has invested billions in incentives to support these businesses as they transition to cleaner vehicles. However, there is now evidence (cited below and attached) that the few companies manufacturing trucks compliant with California rules may be employing pricing and production strategies that could erode the benefit of the state's investments, limit supply of some key models, and raise truck prices for ordinary businesses. These strategies, which appear to be being used by dominant market actors, have broad implications for consumers up and down the supply chain. These strategies appear to be operating in multiple states, and would have the additional effect of eroding clean air and climate progress.

Because these matters critically affect California's own market, and air quality – as well as that of other states – **we believe California officials should review these manufacturer behaviors for compliance with relevant state and federal antitrust law, unfair business practice law, and consumer protection statutes, partnering with federal regulators where appropriate**.

The truck market generally warrants protective attention because it is such a concentrated one; a few manufacturers, generally aligned through their trade group, the Engine Manufacturers Association, dominate sales, both in state and nationally. That means manufacturers have market power which can unreasonably affect small businesses, as well as communities exposed to truck pollution. Market power may operate with particular force in California and in states that follow its rules because only certain cleaner combustion trucks and zero emission trucks can be sold in these states – meaning that changes in production and pricing for just a subset of truck products in already concentrated market can have large, immediate, effects on trucking fleets and other supply chain businesses.

Specifically, CARB staff recently documented at least three such manufacturer behaviors with regard to both the Advanced Clean Trucks (ACT) rule, which requires growing sales of zero emission trucks, and with the Heavy-Duty Low NOx Omnibus Rule (HDO), which requires combustion trucks to cut tailpipe pollution. It appears these strategies, individually and collectively, could have large market impacts.

These strategies, per the memo, include (1) **supply restrictions** on HDO-compliant engines, (2) **tying requirements** that dealers of HDO compliant engines tie sales of such engines to a set sales ratio of zero emission trucks, whether or not buyers demand those additional vehicles (thereby restricting overall supply of HDO compliant engines and shifting truck maker compliance costs directly to buyers), and (3) what appear to be **substantial price increases** for some ACT-compliant zero emission truck models, even though prices are falling for similar models in Europe. Several corporate communications regarding these policies are attached to this letter substantiating CARB's memo.

While companies have a right to lobby governments, the question here is their behavior with regard to consumers. These specific restrictions in the market itself, appearing in multiple states from multiple manufacturers, raise questions about the legitimate use of market power, and, per reporting, the associated shifts in costs and compliance burdens to consumers in ways that raise questions about consumer protection. To our knowledge, these policies appear to be underway, by multiple manufacturers, in many states that have adopted HDO and ACT, and were a critical factor in Oregon's recent decision to propose rolling back HDO requirements for at least one year. We are not aware of any other roll-backs of this sort in recent history, shrinking the market for clean vehicles and slowing the pace of transition, to the detriment of consumers, market competition, and the environment.

As Oregon regulators wrote, consistent with the strategies CARB flagged in the memo above, "some manufacturers are:

- Expected to have limited availability of Low NOx Omnibus compliant engine families.
- Expected to limit their use of available compliance flexibilities like credit purchases and emission offset projects.
- Expected to place restrictions on dealers that order new vehicles such as requiring a zero-emission vehicle to be sold prior to releasing any diesel-powered vehicles for sale."

Per Oregon, "[a] pause in implementation for one year is being proposed to avoid severe restrictions in supply of new vehicles based on these manufacturer business decisions." We are informed that the Commonwealth of Massachusetts, which also plans to implement HDO next year, is facing similar challenges, and that states which intend to implement ACT and HDO in 2026 and 2027 are also facing issues.

Thus, these strategies may have both California and national implications for the truck market, as well as for clean air and climate policy. As the country continues to recover from inflationary spikes and supply chain constrictions, these corporate strategies appear to push in exactly the opposite direction by potentially raising prices and constraints for our supply chain.

This is not the first time that such questions have required government attention. For instance, the European Commission has previously fined heavy-duty truck makers for truck pricing collusion, suggesting that the practice can occur in the truck market, and that companies warrant careful oversight. Though we allege no specific violations here, we do believe that attention is warranted to review the facts on the ground.

Here, CARB and Oregon have both pointed to significant supply restrictions and pricing issues that implicate those laws. California has a further interest here because of its existing state investments in this market, which may now be in some jeopardy, and its climate and clean air policies, which CARB asserts face implementation challenges as a result of corporate behavior. Moreover, CARB previously reached an agreement with manufacturers to generally further the transition to cleaner vehicles to which the state, at least, had faithfully adhered; the spirit, at least, of that agreement now appears under pressure from manufacturers.

We hope you will ask manufacturers to provide information to the state, and to federal oversight bodies, to demonstrate that their actions comply with relevant law. Small truckers and fleets deserve cost-effective access to clean trucks. Moreover, the related clean truck rules rules are critical to environmental justice, public health, and climate protection, and cost-effective compliance with them is of considerable importance to small businesses state- and nation-wide.

Thank you for all you do for the people of California.

Sincerely,

Craig Holt Segall
SVP, Evergreen Action

CC:

Dr. Steve Cliff, EO, CARB, and CARB Executive Office

FTC West Coast Bureau Heads
EPA Region 9 Regional Administrator

Attachment 1: Additional Supporting Files

In addition to linked documents in the letter, we have compiled the following materials for review.

- Presentation from Daimler regarding sales limitations (attached)
  - Note Slides 10 and 11, limiting diesel engine availability, slide 5 specifying tying requirements, and slide 1, applying policy to all dealers
- Letter to Isuzu Dealerships in Oregon regarding sales limits
  - Note statement from Isuzu Commercial Trucks President stating that sales of specific diesel truck lines will be discontinued in relevant states
- Letter from Trask Chassis on sales limits
  - Indicating sales limitations in all 50 states, and stating tying ratio requirements for combustion truck sales
- Letter from Ballard Truck Center (MA) on sales limits
  - Describing "devastating" financial impacts of sales ratio requirements
- Letter from Oregon Department of Environmental Quality to Volvo Trucks making inquiries regarding OEM compliance strategies
  - Our understanding is that several manufacturers received a similar letter. Oregon DEQ notes in its letter that "[b]ased on our conversations with dealers, the manufacturers appear to have very similar market strategies"
- [November_2023_MSRC_Agenda_Final.pdf (cleantransportationfunding.org)]
  - MSRC had a presentation last fall that showed their projects were being quoted higher and higher prices for Class 8 ZEV tractors.
- Volvo Dealer letter to NY (see attached)
  - Volvo dealer letter talking to NY about the trouble 'if ratios are applied to me'.
- https://ww2.arb.ca.gov/sites/default/files/barcu/board/mt/2024/mt052324.pdf)May 23,2024 CARB Board Meeting_
  - James Wheeler, President of Municipal Maintenance Equipment, talks about trouble getting diesel chassis because the dealers aren't selling enough ZEVs (despite CARB's published data that there are enough ACT credits in the market)
  - "So we could buy the clean emissions. They're willing to buy the credits to offset. We just don't have that method, so all truck sales are running through California truck dealers. And there's a limited supply through California truck dealers, because they're not selling enough electrics yet. So ACT is limiting their ability to supply and there is no national supply currently."
- Tow-Truck Companies Warn CARB of Obstacles to Meeting ZEV Mandates | Regulation Status | newsdata.com

    - A trade press recap of May 23rd, 2024, Board Hearing testimony and discussion that included whether OEMs were actually using the credits and flexibilities available to them:
- How regulations impact truck buying and operation right now (fleetequipmentmag.com)
    - Cummins talking about OEM strategies
    - "This year's ICE-based truck sales in California have been affected," said Jim Nebergall, executive director of market strategy at Cummins. The range of impact on the market is between 30-50% according to figures shared by Cummins and other industry leaders.
    - "As Cummins, we're impacted because OEMs won't place an engine order on us unless they can actually sell it, and they can only sell it if they have sold enough zero-emissions vehicles. It's a dynamic real-time calculation to boot," Swenson added."
- CARB regulations are causing sales challenges for dealers | Trucks, Parts, Service (truckpartsandservice.com)
    - Eric Bassett, Owner of Riverview International Trucks, says because CARB's rules designate units into categories for Class 7-8 tractors (with a fifth wheel) and Class 4-8 trucks (without one), he's been able to place more orders for Class 8 chassis, straight trucks and medium-duty units. But those sales also have stipulations. Because of ACT's ZEV sales requirement, Bassett says this year he is required to sell and deliver one ZEV unit to earn ten ICE order slots.

40+ Orgs to Governors: Stay Committed to Clean Truck Standards

December 2, 2024

The Honorable Michelle Lujan Grisham

The Honorable Maura Healey

The Honorable Kathy Hochul

The Honorable Jay Inslee

The Honorable Tina Kotek

The Honorable Dan McKee

The Honorable Wes Moore

The Honorable Phil Murphy

The Honorable Jared Polis

The Honorable Gavin Newsom

The Honorable Phil Scott

Dear Governor:

We, the undersigned organizations representing millions of members and supporters across the country, urge **Governors to continue being leaders on reducing vehicle emissions and stay committed to the clean truck standards your states have adopted, which will deliver vital health, environmental, and economic benefits.** Your states have consistently led on clean air and climate policies that deliver health and economic benefits. That continued leadership is needed now more than ever as state action will be pivotal for common sense clean air and climate policies to advance during the next four years.

In addition to clean trucks standards, many of your states have passed ambitious policies to reduce carbon emissions to protect communities grappling with the profound impacts of climate change and cover the toll of increasingly common **billion-dollar disasters (https://www.ncei.noaa.gov/access/billions/time-series)**. Because pollution from heavy-duty vehicles has an outsized impact on public health and the climate crisis, transitioning to cleaner trucks is imperative for curbing carbon and diesel emissions at the pace required. These cost-effective and technologically-feasible clean trucks standards are essential for curbing local air pollution, addressing the worst effects of climate change, and ensuring the U.S. remains competitive in the growing global clean truck marketplace.

We are deeply concerned by the truck makers, whose reported vehicle pricing and availability strategies appear to be having significantly disruptive effects in the market for clean vehicles, accompanied by claims that the companies cannot meet the clean truck standards that have been adopted in your states. The trucking industry has launched a coordinated multi-state effort to recklessly pressure states to delay implementation of the Heavy-duty Omnibus (HDO) and Advanced Clean Trucks (ACT) standards. In a **recent letter to the Truck & Engine Manufacturers Association (https://www.politico.com/f/?id=00000193-1dbb-d194-adbf-1fbffc7d0000)** (EMA), many of you reminded truck makers that the ACT standards are achievable and contain ample compliance flexibilities, and we wholeheartedly agree.

According to the American Lung Association's **State of the Air Report (https://www.lung.org/research/sota/key-findings)**, 39 percent of Americans— over 131 million people—live in areas that have received failing grades for unhealthy levels of ozone or particulate matter in their air. Cleaner trucks are needed to address long standing air quality problems in communities located near trucking corridors and hubs, ports, and warehouses. These communities are often disproportionately affected by diesel exhaust emissions, experience increased health burdens due to poor air quality, and are more vulnerable to the impacts of climate change.

Adopting these clean trucks standards shows your commitment to ensuring more Americans are breathing clean air, thriving in healthy communities, and advancing the clean energy economy. We appreciate that each state led a comprehensive process carefully studying the benefits of the rules, leading public workshops, engaging industry and communities, and providing truck makers helpful considerations such as sufficient lead time and compliance flexibilities.

Prior to adopting these regulations, many of your states joined **the Multi-State Medium and Heavy Duty Zero-Emission Vehicle Initiative (https://www-f.nescaum.org/documents/multi-state-medium-and-heavy-duty-zero-emission-vehicle-action-plan/)**, which established goals to make at least 30 percent of new Medium and Heavy Duty (MHD) vehicle sales ZEVs by 2030, and 100 percent of sales ZEVs by no later than 2050. This concerted effort to get cleaner trucks on our roads requires that states continue with their original implementation plans and timeline.

Unfortunately, truck makers have a long track record of working **to undermine (https://influencemap.org/report/US-Heavy-Duty-Transport-Climate-Change-20434)** truck standards at the federal and state levels and now, they are **misleading dealers and stoking fear about the regulations (https://www.ccjdigital.com/regulations/emissions/article/15705512/oems-shift-burden-of-ghg-compliance-to-customers-and-dealers)**. The California Air Resources Board (CARB) published a recent **analysis (https://ww2.arb.ca.gov/sites/default/files/2024-09/240925_actmemo_ADA_0.pdf)** based on interviews with dealers, upfitters, fleets, and manufacturers outlining the complaints about alleged product shortages of cleaner HDO engines. CARB confirmed that the truck companies are well-situated to comply with the regulations.

CARB's recent analysis further shows that truck fleets in California are paying disproportionately high prices for zero emission trucks as compared to what they would pay for similar products in Europe. As battery prices (the most expensive part of a zero emission truck) are going down, basic economics suggest that the overall price of a truck should go down. In Europe that is true. In California it is not.

Federal antitrust, consumer protection, and unfair business practice laws defend consumers and the public when market power is used unfairly, and we urge you to use all relevant tools to hold industry accountable. Proposals to delay implementation of cleaner trucks that are being rushed through based upon unsubstantiated fears and the disruptive strategies of truck manufacturers are irresponsible and unacceptable. **It is critical that fleets are not unduly disadvantaged in the marketplace and we encourage you and your Attorney's General offices to investigate market behavior around cleaner trucks.**

The state truck standards took into consideration manufacturer needs by including credit flexibilities and extended compliance timelines. Manufacturers have received billions of dollars from the federal government to support truck electrification. State and federal governments are making major investments in the charging infrastructure to power these vehicles. These standards help fleets benefit from cost savings and avoid risks associated with the volatility of fossil fuel prices and supply, and help manufacturers spur innovation in the U.S.

Governors are responsible for protecting their residents from harm, and by adopting these crucial vehicle emissions standards you've demonstrated bold leadership. Do not let the trucking industry's disinformation and market tactics erode your efforts to safeguard the health of your residents and air quality of your communities. We call on you to remain firm and implement the clean truck standards that your state carefully adopted.

Sincerely,

350 Bay Area Action

Alliance of Nurses for Healthy Environments

C40 Cities

California Nurses for Environmental Health & Justice

California Interfaith Power & Light

CALSTART

Center for Biological Diversity

Center for Community Action and Environmental Justice (CCAEJ)

Central California Asthma Collaborative

Clean Energy Works

The Climate Center

Climate Solutions

Coalition for Clean Air

Coalition for Healthy Ports

Coltura

Conservation Law Foundation

Earthjustice

Elders Climate Action

Electric Vehicle Association

EV Charging for All Coalition

Evergreen Action

Generation180

Good Neighbor Steering Committee

GreenLatinos

Interfaith Power & Light

League of Conservation Voters (LCV)

Move LA

Neighbors for Clean Air

New Mexico & El Paso Region Interfaith Power and Light

New Mexico Coalition for Clean Affordable Energy

Pacific Environment

The People's Collective for Environmental Justice

Plug In America

Public Citizen

Regional Asthma Management & Prevention (RAMP)

RiSE for Environmental Justice

SanDiego350

Sierra Club

Southwest Energy Efficiency Project

The Sunrise Project

Union of Concerned Scientists

WE ACT for Environmental Justice

Western Resource Advocates

November 8, 2024

Dear Truck and Engine Manufacturers Association Members:

As you know, Advanced Clean Trucks (ACT) is an important part of our states' plans to achieve our greenhouse gas emissions-reduction goals and reduce the threat of climate change to public health, the environment, and the economy. Across our states, transportation is collectively the highest-emitting sector, making up almost 40 percent of our states' total emissions. Nearly 20 percent of those emissions come from medium- and heavy-duty vehicles. Therefore, it is crucial that we have a roadmap for continuing to decarbonize these vehicles. We are eager to work closely with the trucking industry to spur the manufacturing and deployment of zero-emission vehicles (ZEVs).

ACT requires manufacturers to sell increasing percentages of ZEVs through model year 2035 or purchase credits from those who exceed the sales requirements. Recognizing that some vehicle types are more difficult to convert, ACT does not require fleet-wide compliance, but rather allows manufacturers to focus on the vehicle types for which zero-emission technologies are most favorable. ACT *does not* place any purchasing requirements on dealers or fleets. We have heard that several major medium- and heavy-duty vehicle engine manufacturers are placing blanket purchase requirements onto dealers rather than utilizing the flexibilities built into ACT. These existing flexibilities include:

- **Using early action credits**: Manufacturers are able to generate and bank credits for sales, which can be used for compliance starting in the first applicable model year, incentivizing early movers.
- **Banking and trading credits**: Manufacturers may continue generating and banking credits to use for compliance in the future, or purchase excess credits earned from other manufacturers, adding flexibility across the industry.
- **Adopting near-zero-emission vehicles**: A manufacturer may meet 50% of their compliance each year with credits earned from sales of plug-in hybrids, allowing for more vehicle types and routes to lower emissions.
- **Using non-tractor credits to meet tractor deficits for manufacturers with 25 or fewer tractor (e.g., semi-truck) deficits**: A manufacturer that sells very few Class 7-8 semi-trucks, or tractors, in a model year may use non-tractor credits for tractor compliance.
- **Using interchangeable non-tractor credits**: A manufacturer may use Class 2b-3 and Class 4-8 non-tractor credits interchangeably to make up those non-tractor deficits, providing flexibility for different product portfolios.

- **Carrying forward deficits**: A manufacturer that does not comply in a given model year has additional time to make up for their shortfall.

Additional ACT flexibilities were recently approved in California on October 24, 2024, as part of Clean Truck Partnership implementation. These include lengthening the amount of time manufacturers have to make up shortfalls, simplifying credit accrual, and allowing secondary manufacturers to participate in the credit market. The other undersigned states are considering updates to our respective ACT rules, as appropriate, to integrate these compliance flexibilities.

We are confident that ACT's requirements are achievable through close collaboration between the public and private sectors, and we recognize the important role of the trucking industry in meeting these goals. To that end, we propose a meeting to discuss implementable solutions to increase ZEV adoption and next steps to meeting existing compliance obligations across Section 177 states. One potential option for advancing a collaborative approach may be the establishment of a Clean Truck Partnership across Section 177 states. We are directing our air and climate regulatory agencies to participate in this meeting and engage in these conversations on our behalf.

We thank you for your continued partnership and look forward to our ongoing collaboration to decarbonize the transportation sector and combat climate change.

Sincerely,

Governor Phil Murphy
State of New Jersey

Governor Jared Polis
State of Colorado

Governor Gavin Newsom
State of California

Governor Maura Healey
Commonwealth of Massachusetts

Governor Michelle Lujan Grisham
State of New Mexico

Governor Kathy Hochul
State of New York

Governor Tina Kotek
State of Oregon

Governor Daniel J. McKee
State of Rhode Island

Governor Jay Inslee
State of Washington

BLOG

BATTERY ELECTRIC TRUCKS IN THE U.S. NORTHEAST: ELECTRIC UTILITIES AND PLANNING FOR TOMORROW

May 17, 2024 | By: Jasreet Kaur Gill and Yihao Xie

ore than 20,000 trucks travel the network of roads in the U.S. ortheast corridor every day, many delivering goods from the arbors of New York, New Jersey, and Boston to factories and onsumers throughout the country. Several signs now point to hese trucks beginning the electric transition.

nflation Reduction Act incentives coupled with declining costs re expected to make electric medium- and heavy-duty vehicles MHDVs) economically attractive to own and operate. anufacturers will be obliged to produce and sell electric trucks New York and Massachusetts because the states adopted the dvanced Clean Trucks rule. The U.S. Environmental Protection gency's final 2027–2032 HDV CO_2 emission standards set tighter mission limits on future MHDVs nationwide, and federal funding beginning to flow to support the switch to zero-emission trucks s part of the Biden administration's national goal of a zero-missions freight sector announced late last month.

hirty-one out of over 220 "zero-emission freight hubs" in Phase 1 nd 2 of the recently published National Zero-Emission Freight orridor Strategy are facilities located in Massachusetts, New ork, and New Jersey. The Northeast corridor also stood out in our ational infrastructure assessment of MHDV charging nfrastructure needs in 2025 and 2030: Five counties surrounding orts in New York and Massachusetts ranked the highest in the nited States for MHDV charging needs per square kilometer. igure 1 is a map of estimated county-level power draw amount n the distribution grid; it illustrates the peak load, per square ilometer, from electric MHDV depot charging in 2030. Coastal ounties near ports have the darkest shades, which indicate a igh peak load.

igure 1. Estimated peak load per square kilometer from fleet lepot charging in 2030 in Connecticut, Massachusetts, New York, lew Jersey, and Rhode Island counties. *Source: [Ragon et al. 2023)](https://theicct.org/)*.

hree investor-owned utilities–Consolidated Edison (Con Edison), lational Grid, and Eversource—serve the counties with the ighest MHDV charging needs in the Northeast. Their service erritories are illustrated in Figure 2.

igure 2. Service areas for National Grid, Con Edison, and versource in Massachusetts and downstate New York

et us highlight a few ways that these three are preparing to erve electric truck customers.

1. **Subsidies**. The high upfront costs associated with vehicle purchase and infrastructure installation for electric MHDVs is

a major hurdle for truck fleet operators, and the Joint Utilities of New York, which includes Con Edison and National Grid, created a make-ready pilot program with a $67 million budget to assist fleets with installing chargers and estimating their vehicle and infrastructure costs. This program provides eligible fleets with subsidies for up to 90% of utility-side charging infrastructure installation costs and 50% of customer-side costs.

2. Tools to aid fleet decision-making and cost analysis. Utilities have created tools for their own use and for their customers to better understand grid-planning timelines, future upgrades that might be needed, and the costs involved in electrifying trucks. National Grid provides fleet advisory services that help customers estimate power demand and distribution impacts, understand their future electricity costs, and explore options to reduce electricity costs.

Con Edison created a fleet electrification calculator to help fleets estimate the cost of a charging station for different types of vehicles (light, medium, heavy) and it shows fleet owners their costs and savings if they switch to electric MHDVs. Once fleets put these tools to use, utilities can also get valuable customer behavior and preference data, which can help identify locations that need the most amount of power.

The Massachusetts Clean Energy Center and CALSTART created a program with Eversource and National Grid that assigns a project team to help fleet owners with the entire process of electrification. The team helps with things including searching for truck models, understanding funding opportunities and taking advantage of incentives, and planning for charging equipment.

3. Reduced electricity rates. The cost of operating battery electric trucks is highly dependent on electricity cost. Con Edison offers a $0.03/kWh rate reduction for charging between midnight and 8 am, and additional incentives for avoiding charging during peak times. For Con Edison, this has an added benefit because it could help smooth out the demand on the overall system, especially when loads from other activities are high.

here are other potential supports. One example from outside he Northeast is to offer multilingual fleet services. California's acific Gas and Electric shares its EV fleet program in several anguages, which makes accessing the information easier for a arger group of people.

Vhat about distribution grid capacity? Can existing electrical ssets handle electric truck charging? Based on the estimates rom our 2023 infrastructure assessment, by 2030, the peak load rom truck depot charging in areas served by National Grid, Con dison, and Eversource could be up to 68 MW. The same study stimated that the nameplate capacity of chargers on local listribution grids, in other words, the theoretical maximum apacity where all MHDV chargers draw power simultaneously rom the grid at their rated powers, can exceed 500 MW. This loesn't account for public charging, which will also need lectricity. Adding half a gigawatt of new nameplate capacity cross the areas of service in the Northeast will likely involve new eeder lines, transformer upgrades, and potentially construction f substations that can cost hundreds of thousands or millions of lollars. It's important to overcome the challenges, because long vait times may put projects behind schedule and put ompliance with the Advanced Clean Trucks regulation at risk.

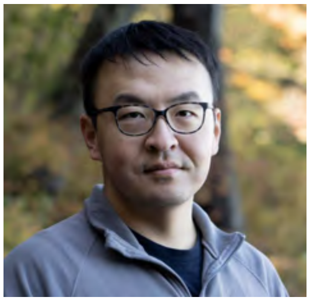
ı response to a New York State Department of Public Service roceeding to address MHDV charging infrastructure challenges, he Joint Utilities of New York acknowledged the imminent need o build MHDV charging infrastructure and agreed that grid ıvestments must be prioritized in areas where demand for ower is high and spare capacity is tight. With federal funding nd the help of CALSTART, National Grid has launched the Iortheast Freight Corridors Charging Plan through which it aims o map out an electric truck charging network for the entire Iortheast region.

ctions by the Joint Utilities of New York and National Grid reflect heir willingness to take action to expedite and expand truck harging. The next step is to translate these signals to proactive lanning, and for regulators to approve construction and onnection of MHDV customers to the grid.

AUTHORS

Jasreet Kaur Gill

Intern



Yihao Xie

Researcher

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MAY 2023

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Pierre-Louis Ragon, Sara Kelly, Nicole Egerstrom, Jerold Brito, Ben Sharpe, Charlie Allcock, Ray Minjares and Felipe Rodríguez

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DECARBONIZING TRANSPORT

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February 1, 2024

The California Air Resources Board

Public Hearing to Consider the Proposed Advanced Clean Fleets Regulation

Staff Report: Initial Statement of Reasons

Date of Release: August 30, 2022

Scheduled for Consideration: October 27, 2022

Table of Contents

A. List of Appendices

B. List of Acronyms and Abbreviations

AB	Assembly Bill
ACC	Advanced Clean Cars
ACF	Advanced Clean Fleets
ACT	Advanced Clean Trucks
APS	Air Pollution Specialist
AQIP	Air Quality Improvement Program
ARE	Air Resources Engineer
ARS	Air Resources Supervisor
ART	Air Resources Technician
ASB	Zero-Emission Airport Shuttle Bus
BACT	Best Available Control Technology
BAU	Business-as-Usual
BEV	Battery-Electric Vehicle
CAISO	California Independent System Operator
Caltrans	California Department of Transportation
CARB or Board	California Air Resources Board
CCR	California Code of Regulations
CEC	California Energy Commission
CEQA	California Environmental Quality Act
CI	Confidence Interval
CNG	Compressed Natural Gas
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalents
CPUC	California Public Utilities Commission
CTA	California Trucking Association
DAC	Disadvantaged Community
DEF	Diesel Exhaust Fluid
DMV	Department of Motor Vehicles
DOF	Department of Finance
EER	Energy Efficiency Ratio
EIA	Energy Information Administration
EMFAC	Emission Factor Inventory Model
EPA	Environmental Protection Agency
ER	Emergency Room
EV	Electric Vehicle
EVSE	Electric Vehicle Supply Equipment
FCEV	Fuel Cell Electric Vehicle
FY	Fiscal Year
GHG	Greenhouse Gas
GM	General Motors
GO-Biz	Governor’s Office of Business and Economic Development
GDP	Gross Domestic Product
GSP	Gross State Product
GVWR	Gross Vehicle Weight Rating
HD I/M	Heavy-Duty Inspection and Maintenance
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project

ICCT	International Council on Clean Transportation
ICE	Internal Combustion Engine
ICT	Innovative Clean Transit
IOU	Investor-Owned Utility
IPT	Incidence-per-Ton
ISOR	Initial Statement of Reasons
IWG	Interagency Working Group
kW	Kilowatt
kWh	Kilowatt-Hour
lbs.	Pounds
LCFS	Low Carbon Fuel Standard
LER	Large Entity Reporting
MMT	Million Metric Tons
MY	Model Year
NAAQS	National Ambient Air Quality Standards
NOx	Oxides of Nitrogen
NZEV	Near-Zero-Emission Vehicle
OAL	Office of Administrative Law
OBD	On-Board Diagnostics
OEM	Original Equipment Manufacturer
PG&E	Pacific Gas and Electric
PHEV	Plug-In Hybrid Electric Vehicle
PM	Particulate Matter
PM2.5	Fine Particulate Matter
POAK	Port of Oakland
POLA	Port of Los Angeles
POU	Publicly Owned Utility
PPB	Parts per Billion
PSPS	Public Safety Power Shutoff
PTO	Power Take-Off
PY	Personnel Year
RD	Renewable Diesel
REMI	Regional Economic Models, Inc.
RNG	Renewable Natural Gas
SB	Senate Bill
SC-CO_2	Social Cost of Carbon
SCE	Southern California Edison
SDG&E	San Diego Gas and Electric
SIP	State Implementation Plan
SLCP	Short-Lived Climate Pollutant
SoCalGas	Southern California Gas Company
SRIA	Standardized Regulatory Impact Assessment
SWCV	Solid Waste Collection Vehicle
TE	Transportation Electrification
TCO	Total Cost of Ownership
tpd	Tons per Day
TRU	Transport Refrigeration Unit
TTW	Tank-to-Wheel

VMT	Vehicle Miles Traveled
ZE	Zero-Emission
ZEB	Zero-Emission Bus
ZEV	Zero-Emission Vehicle

Executive Summary

Mobile sources and the fossil fuels that power them are the largest contributors in California to the formation of ozone, greenhouse gas (GHG) emissions, fine particulate matter (PM2.5), and toxic diesel particulate matter (PM). In the State, the transportation sector alone accounts for 41 percent of total GHG emissions (50 percent when upstream emissions from fuel is included) and is a major contributor to oxides of nitrogen (NOx) and PM emissions. Medium- and heavy-duty vehicles contribute a quarter of the transportation sector's GHG emissions and a third of the transportation sector's NOx emissions, a disproportionately high share considering these vehicles represent only about 1.8 million trucks among the 30 million registered vehicles in the state. The proposed Advanced Clean Fleets (ACF) regulation, or "proposed ACF regulation," would contribute to achieving the State's criteria pollutant and GHG reduction goals as well as cleaner technology targets needed to protect communities. Implementing this proposed ACF regulation is expected to save over 5,000 Californian lives between 2024 and 2050. These avoided premature mortalities and other avoided adverse health benefits have an estimated value of over $57 billion dollars.

The proposed ACF regulation is part of a comprehensive strategy that would, consistent with public health needs, accelerate the widespread adoption of zero-emission vehicles (ZEV) in the medium- and heavy-duty truck sector and in light-duty package delivery vehicles. The proposed ACF regulation would require certain fleets to deploy ZEVs starting in 2024 and would establish a clear end date of new medium- and heavy-duty internal combustion engine (ICE) vehicle sales in 2040.

The proposed ACF regulation builds on other policies to continue reducing emissions, including the Advanced Clean Trucks (ACT) regulation.[1] It would be the next significant step in accelerating towards a zero-emission (ZE) transportation system as well as a more equitable future in California. With the adoption of the ACT regulation in 2020, the California Air Resources Board (CARB or Board) took a major step in securing a ZE future. The ACT regulation covers everything from heavy-duty pickups or work trucks to the semi-trucks used in drayage and long-haul applications, and requires truck manufacturers, beginning with the 2024 model year (MY), to produce and sell ZEVs into California's market in growing numbers. The proposed ACF regulation and the ACT regulation together are expected to result in about 510,000, 1,230,000, and 1,590,000 ZEVs in California in 2035, 2045, and 2050, respectively. These quantities of ZEVS are in turn projected to significantly reduce criteria and GHG pollutants when compared to Legal Baseline as shown *in* Table 1.

Table 1: Estimated ACF Emission Reductions in 2040 and 2050

Year	NOx	PM2.5	GHG
2040	47%	24%	41%
2050	57%	37%	62%

The proposed ACF regulation establishes aggressive, but achievable, emissions targets, and would comprise the next installment of policies to help transform the medium- and heavy-

[1] The ACT regulation is comprised of California Code of Regulations (Cal. Code Regs.) title 13, sections 1963, 1963.1, 1963.2, 1963.3, 1963.4, 1963.5, 2012, 2012.1, and 2012.2.

duty sector and light-duty package delivery vehicles to ZE by focusing on specific fleets where accelerated ZE transitions are feasible and critical to these goals. It is one of a range of policies – including potential commitments in the State Implementation Plan (SIP), incentive spending, infrastructure installations, and land use policies – that jointly can achieve a full transition to a ZE transportation system. Other policies, which are not the subject of this rulemaking, are cleaning up the remaining combustion fleet, including CARB's Heavy-Duty Omnibus Regulation and Heavy-Duty Vehicle Inspection and Maintenance Regulation (HD I/M). [2,3] Thus, vehicles powered by internal combustion engines are not in the ambit of this proposal, but CARB has established a comprehensive set of rules and policies aimed at all portions of the vehicle fleet in order to protect public health. The primary objectives of this proposal include the following:

- Achieve criteria pollutant and GHG emissions reductions consistent with the goals identified in the SIP Strategy and Scoping Plan, including supporting compliance with state and federal ambient air quality standards.
- Provide criteria pollutant and toxic air contaminant emissions reductions in disadvantaged communities (DAC), which is consistent with CARB's statewide strategy to reduce these emissions in communities affected by a high cumulative exposure burdens under Assembly Bill (AB) 617.[4]
- Support the 100 percent ZE transition targets set by the Board in Resolution 20-19 which calls for:
    - Drayage trucks, last mile delivery, and government fleets to be ZE by 2035.
    - Refuse trucks, local buses, and utility fleets to be ZE by 2040.
    - All trucks and buses to be ZE, where feasible by 2045.
- Support the goals of Executive Order N-79-20, which calls for accelerated ZEV deployment with these targets:
    - 100 percent ZE drayage by 2035.
    - 100 percent ZE trucks and buses where feasible by 2045.
- Ensure requirements, such as ZEV deployment schedules and related infrastructure build-out, are technologically feasible, cost-effective, and support market conditions.
- Lead the transition away from petroleum fuels and towards electric drivetrains.
- Contribute towards achieving carbon neutrality in California pursuant to Senate Bill (SB) 100,[5] and in accordance with Executive Order B-55-18.
- Complement the ACT regulation to enhance widespread ZEV deployment.
- Mindfully set requirements to allow time for public ZE infrastructure buildout for smaller fleets or for regional haul applications who would be reliant on a regional network of public chargers.

[2] The Omnibus regulation is comprised of Cal. Code Regs., title 13, sections 1900, 1956.8, 1961.2, 1965, 1968.2, 1971.1, 1971.5, 2035, 2036, 2111 through 2119, 2121, 2123, 2125 through 2131, 2133, 2137, 2139, 2139.5, 2140 through 2149, 2166, 2166.1, 2167 through 2170, 2423, and 2485; and Cal. Code Regs., tit. 17 sections 95662 and 95663.
[3] The rulemaking action for the HD I/M regulation has not yet been completed; the proposed HD I/M regulation is comprised of Cal. Code Regs., tit. 13, sections 2193, 2195, 2195.6, 2196 through 2196.8, 2197 through 2197.3, and 2198 through 2199.1.
[4] Assembly Bill 617 (C. Garcia, Stats. 2017, ch. 136).
[5] Senate Bill 100 (De León, Stats. 2018, ch. 312).

- Ensure manufacturers and fleets work together to place ZEVs in service suitably and successfully as market expands.
- Complement current and existing programs to achieve emissions reductions that are real, permanent, quantifiable, verifiable, and enforceable.
- Establish a fair and level playing field among fleet owners.
- Craft requirements in a way that ensures institutional capacity for CARB to manage, implement, and enforce requirements.

The proposed ACF regulation provides a ZEV phase-in approach which provides initial focus where the best fleet electrification opportunities exist, sets clear targets for regulated fleets to make a full conversion to ZEVs, and creates a catalyst to accelerate development of a heavy-duty public infrastructure network. In addition, it aggressively pushes drayage trucks to be ZE, given the suitability of their duty cycles, outsized impact on disproportionately impacted communities, and ability to maximize emissions reductions in heavily impacted communities. This approach gives fleets the flexibility to phase in ZEVs in the most suitable applications first and focuses initial ZEV infrastructure development to support community health around ports and railyards.

The proposed ACF regulation attempts to strike a balance between moving the market quickly to ZE while recognizing fleets more suited for electrification should lead the way for smaller fleets. Staff recognizes the complexities of applying purchase mandates to fleets affected by the proposed ACF regulation and acknowledges that additional tools may be needed to meet the 100 percent ZE by 2045 goal set in the Governor's Executive Order N-79-20. For instance, it is important that manufacturers continue to have strong reasons to set competitive prices, especially for small fleet owners who may experience more economic constraints on vehicle purchases; simply requiring ZEV purchases for these fleet owners could result in elevated prices for a key sector of the small business economy. Thus, CARB continues to investigate a range of tools that can address this portion of the fleet as well, in an equitable and effective way.

In addition to accelerating the deployment of ZEVs, the proposed ACF regulation states that 100 percent of manufacturer sales of all Class 2b-8 vehicles must be ZE by 2040, which sends a clear signal regarding the end of ICE powered truck sales in California. This end point for sales of new ICE vehicles in California ensures accelerated improvements in the economics of ZEVs and the investments needed to expand the market quickly. This increases confidence for infrastructure providers and ZEV components suppliers to invest in and supports a rapidly growing market, ensuring that ZEV technology advancements continue. It also provides more air quality benefits to our communities as well as more choices to fleets and consumers.

A. Purpose of The Proposed ACF regulation

The purpose of the proposed ACF regulation is to accelerate the widespread adoption and usage of ZEVs in the medium- and heavy-duty truck sector and light-duty vehicles used in mail and package delivery, to reduce harmful emissions generated from on-road mobile sources.

A number of policy, planning, and regulatory actions have led to the development of the proposed ACF regulation and the need to accelerate ZEV deployments everywhere feasible. In 2018, the Governor issued Executive Order B-55-18, which set a target to achieve carbon neutrality in California no later than 2045, and to achieve and maintain net negative emissions thereafter. In 2020, Executive Order N-79-20 set specific targets to transition the truck fleet to ZE technology by 2045. In January 2021, the ACT regulation was adopted by CARB as a key part of the holistic approach to accelerate a large-scale ZEV transition of medium- and heavy-duty trucks. The ACT regulation's ZEV sales requirement establishes a supply of medium- and heavy-duty ZEVs, while the ACT regulation's one-time fleet reporting requirement provided detailed information about fleets and how they use their vehicles. In October 2021, CARB released the 2020 Mobile Source Strategy, a top-down analysis of policy options and emissions reductions needs, which identified the proposed ACF regulation as part of a comprehensive strategy to achieve a ZE truck and bus fleet by 2045 everywhere feasible, and significantly earlier for certain well-suited market segments.[6] In addition, CARB released the 2022 State SIP Strategy (draft) which builds on 2020 Mobile Source Strategy, and includes ACF as well as a proposed commitment to accelerate the number of medium- and heavy-duty ZEV beyond the ACT and proposed ACF regulation.[7] Additionally, the 2022 Scoping Plan Update (draft) lists the proposed ACF regulation as a necessary policy to achieve climate change goals and includes it in the modeling. [8] The proposed ACF regulation directly supports achieving these goals through the regulatory transition of medium- and heavy-duty ZEVs in California.

B. Summary of Proposed ACF regulation

The proposed ACF regulation would require State and local government fleets, drayage trucks, high priority fleets, and federal fleets to phase in medium- and heavy-duty ZEVs over time. The proposed ACF regulation additionally sets a clear end date for new internal combustion-powered medium- and heavy-duty vehicle sales in California. The proposed ACF regulation includes four components: three sets of fleet requirements on State and local government fleets, drayage trucks, and high priority and federal fleets, and a ZEV sales requirement on medium- and heavy-duty truck manufacturers. The following provides information on each of the proposed components.

1. State and Local Government Fleets

- Applies to California cities, counties, public utilities, special districts, local agencies or districts, and State government agencies that own a Class 2b-8 vehicle.
  - o Excludes federal agencies, which are regulated under the high priority and federal fleet requirements.
- When adding vehicles to their California fleet, affected fleet owners must only add ZEVs per the following schedule.

[6] California Air Resources Board, *2020 Mobile Source Strategy*, October 28, 2021 (web link: https://ww2.arb.ca.gov/sites/default/files/2021-12/2020_Mobile_Source_Strategy.pdf, last accessed August 2022).

[7] California Air Resources Board, *2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy)*, 2022 (web link: https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy, last accessed August 2022).

[8] California Air Resources Board, *The AB 32 Scoping Plan (draft)*, 2022 (web link: https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents, last accessed August 2022).

    - Fleets outside designated low-population counties: 50 percent of the total number of vehicle additions must be ZEVs beginning January 1, 2024, increasing to 100 percent beginning January 1, 2027.
    - Fleets in designated low-population counties: 100 percent of the total number of vehicle additions must be ZEVs beginning January 1, 2027.
- Compliance exemptions for backup vehicles, daily usage, infrastructure construction delays, ZEV unavailability, and mutual aid assistance.
- Annual reporting, starting April 1, 2024, with recordkeeping requirements.

2. Drayage Trucks

- Applies to Class 7-8 heavy-duty trucks transporting containerized, bulk, or break-bulk goods, empty containers or chassis' to and from California's intermodal seaports and railyards.
- All trucks added to CARB's Online System must be a ZEV beginning January 1, 2024.
    - All drayage trucks must visit a regulated seaport or intermodal railyard at least once each calendar year to remain in CARB's Online System.
    - Existing ICE drayage trucks may not exceed their minimum useful life to remain in the CARB's Online System.
    - All drayage trucks entering seaports and intermodal railyards would be required to be ZE by 2035.
- Compliance exemptions for dedicated use uni-body vehicles (e.g., auto transports), infrastructure construction delays, and ZEV vehicle delivery delays.
- Annual reporting starting January 1, 2024, with reporting or recordkeeping requirements for truck owners, seaports, railyards, and marine terminals.

3. High Priority and Federal Fleets

- Applies to fleets that meet the following criteria:
    - Any fleet owner who owns, operates, or directs 50 or more Class 2b-8 vehicles or off-road yard tractors including vehicles under common ownership and control, that operates at least 1 vehicle in California.
    - Any entity with $50 million or more in annual revenue and owns or operates at least 1 affected vehicle that is operated in California.
    - Federal government agencies that own, operate, or direct one or more affected vehicles in California.
- Affected vehicles include all Class 2b-8 on-road vehicles, off-road yard tractors, and light-duty package delivery vehicles in the fleet.
- High priority and federal fleets must meet the Model Year Schedule, or opt-in to the ZEV Milestones Option.
    - Model Year Schedule: Beginning January 1, 2024, all additions to the fleet must be ZEVs, and all ICE vehicles must be removed from the California fleet at the end of their useful life.
    - ZEV Milestones Option: ZEV phase-in requirement where a portion of the fleet must be ZE based on the schedule laid out in Table 2.

Table 2: High Priority and Federal Fleet ZEV Phase-In Schedule

Group	Percentage of Fleet that Must be ZEVs	10%	25%	50%	75%	100%
1	Box trucks, vans, two-axle buses, yard trucks, light-duty delivery vehicles	2025	2028	2031	2033	2035
2	Work trucks, day cab tractors, three-axle buses	2027	2030	2033	2036	2039
3	Sleeper cab tractors and specialty vehicles	2030	2033	2036	2039	2042

- Compliance exemptions for backup vehicles, daily usage, infrastructure construction delays, vehicle delivery delays, ZEV unavailability, declared emergency events, and mutual aid assistance.
- Annual reporting starting February 1, 2024, and recordkeeping requirements.

4. 100 Percent ZEV Sales Requirement

- Beginning 2040 MY, all new medium- and heavy-duty vehicles sold by manufacturers in California must be ZEV.
  - This requirement does not apply to authorized emergency vehicles.
- This requirement impacts all fleets and individuals who purchase medium- and heavy-duty vehicles in California.

C. Potential Impacts and Benefits of Proposed ACF regulation

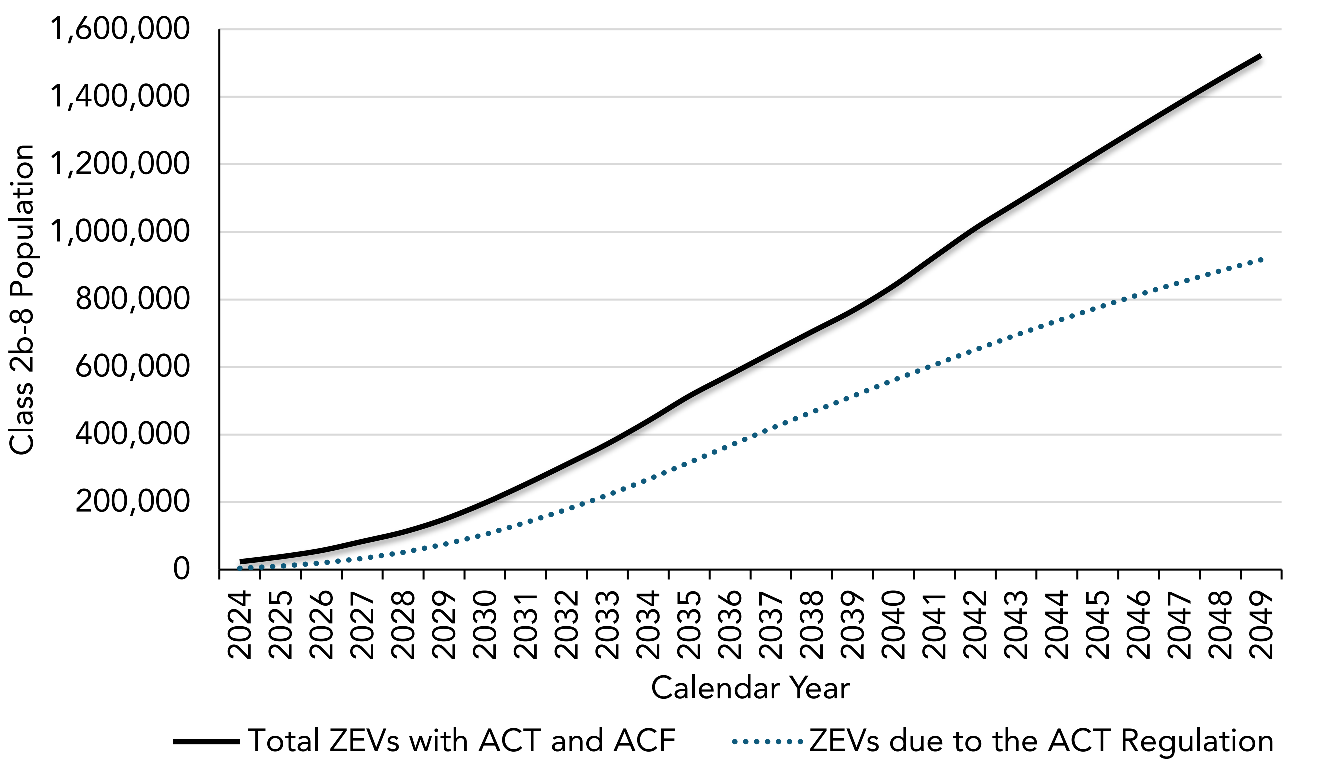
The proposed ACF regulation would help reduce emissions from fleets that pose acute health risks to local communities in which they operate and would contribute towards achieving CARB's emissions reductions goals for attaining federal health-based air quality standards and the State's GHG reduction goals. The proposed ACF regulation would result in cost-savings and reductions in criteria pollutants, toxic air contaminants, and GHG emissions at the statewide, regional, and local levels. This is a part of California's holistic plan to meet challenging federal air quality mandates and State climate goals, as well as protect the public health of all Californians. Table 3 enumerates the cumulative statewide benefits for emissions, cost-savings, and avoided premature deaths expected from full implementation of the proposed ACF regulation through calendar year 2050. The overall direct cost of the proposed ACF regulation to fleets is expected to be a savings of $22.2 billion, with additional health benefits savings of $57.8 billion, and social cost of carbon savings ranging from $9.4 billion to $36.4 billion. All costs are in 2021 constant dollars.

Table 3: Statewide Cumulative Benefits of Proposed ACF Regulation to 2050

Benefit Criteria	Cumulative Benefit by 2050
NOx Reduction	418,943 tons
PM2.5 Reduction	8,638 tons
GHG Reduction	307 MMT CO_2
Avoided Cardiopulmonary Mortalities	5,519
Health Benefits Savings	$57.8 billion
Social Cost of Carbon Savings	$9.4 to $36.4 billion
Net Fleet Cost-Savings	$22.2 billion

The proposed ACF regulation is projected to significantly increase the number of medium- and heavy-duty ZEVs in California beyond the ZEV sales expected from the ACT regulation as shown in Figure 1. The estimated number of ZEV would increase from about 320,000 to about 510,000 in 2035, from about 780,000 to about 1,230,000 ZEVs by 2045, and from about 950,000 to about 1,590,000 ZEVs by 2050.

Figure 1: Statewide Population Forecast with the Proposed ACF Regulation



The proposed ACF regulation is projected to result in significant NOx, PM2.5, and GHG emissions reductions above and beyond the ACT regulation. ZEVs produce no tailpipe emissions, reduce brake wear, PM emissions, and have lower upstream emissions. Table 4 summarizes the expected criteria pollutant emission benefits from 2031 through 2050. These emissions reductions, in tons per day (tpd), would contribute to the SIP Strategy and Climate Change Scoping Plan.

Table 4: Projected Emissions Reductions of the Proposed ACF Regulation

Calendar Year	NOx (tpd)	PM2.5 (tpd)	CO_2 (MMT/yr.)
2031	19.99	0.33	4.55
2037	51.99	0.95	10.91
2040	68.59	1.31	14.26
2045	83.89	1.86	19.89
2050	97.24	2.29	24.27

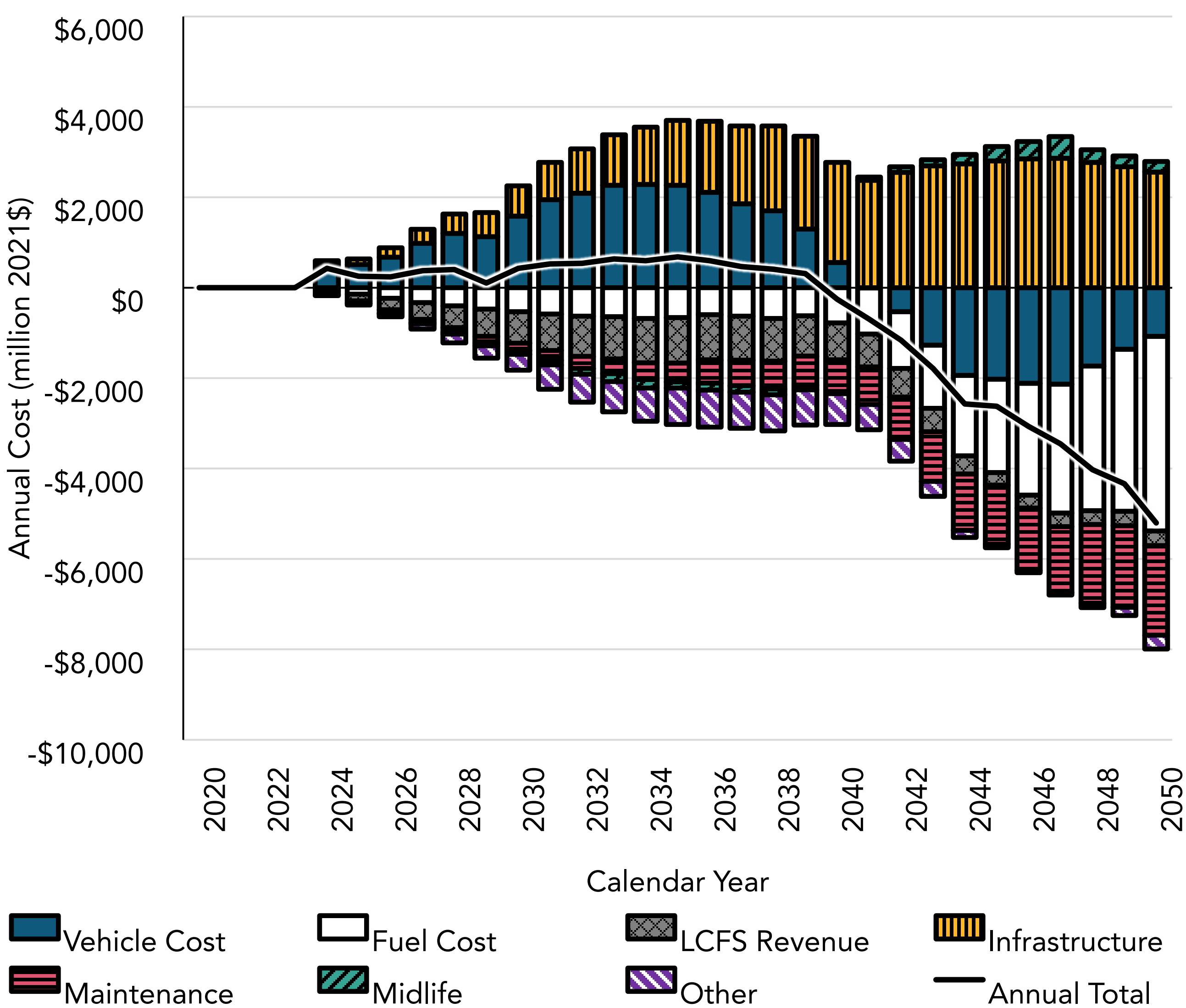
The proposed ACF regulation would also result in health benefits for individuals in California. The value of health benefits calculated for this regulation is due to fewer instances of premature mortality and hospital or emergency room (ER) visits. Table 5 displays the total cumulative number of avoided mortality and morbidity events and the total valuation to 2050.

Table 5: Estimated Cumulative Avoided Mortality and Morbidity Events and Total Valuation of Health Benefits to 2050

Cardiopulmonary Mortality	Hospitalizations for Cardiovascular Illness	Hospitalizations for Respiratory illness	ER Visits	Total Valuation
5,500	870	1,040	2,500	$57.7 Billion

Currently, ZEVs cost more than their combustion-powered counterparts due to higher vehicle costs and additional infrastructure expenses. However, due to a combination of lower fuel costs, maintenance cost-savings, and Low Carbon Fuel Standard (LCFS) revenue, ZEVs are expected to provide a positive total cost of ownership (TCO) for several use cases now and for most applications by 2030. Overall, the proposed ACF regulation is expected to result in a net savings to the California fleet. The proposed ACF regulation is expected to result in a net cost savings of $22.2 billion as illustrated in Figure 2. These costs do not include grants or rebates, so additional vehicle incentives, utility investments, and other investments will provide additional savings to fleet owners. This $22.2 billion in cost-savings are in addition to the $57.7 billion in health savings to the State.

Figure 2: Total Estimated Direct Costs of the Proposed ACF Regulation Relative to the Legal Baseline Scenario (Million 2021$)



D. Challenges and Long-Term Outlook

For over 50 years CARB has been ratcheting down on criteria and toxic pollution and more recently has been taking steps to reduce climate pollution. Pollution from black carbon and smog forming pollutants still impact Californians daily. For 5 decades, CARB has established a multitude of policies and plans and implemented numerous control measures and regulations to control and limit on- and off-road sources of emissions. However, trucks emit a disproportionate amount of air pollution. Additionally, trucks often operate in clusters centered around distribution warehouses, railyards, and ports which further exacerbates the air quality problem in these overburdened communities. A number of policies to reduce pollution from engines and their fuels have made significant progress, but more needs to be done, especially considering the long-life of trucks and the urgency of climate action. CARB found that expected efficiency gains from electrification of trucks and buses are better than previously estimated, especially for low-speed duty cycles.[9] Today, ZE trucks cost more upfront to purchase than their ICE counterparts and are in the early stages of a market transformation, but the ZEV service and support networks need to be expanded, along with charging and hydrogen fueling infrastructure. However, the efficiency of ZE trucks coupled with no tailpipe emissions means a win-win for all Californians who are disproportionately impacted by truck exhaust–including truck drivers. ZEVs have no tailpipe emissions and also have reduced PM associated with reduced brake wear, compared to conventionally fueled trucks. ICE truck exhaust emissions also increase with age which does not happen with ZEVs. In addition, ZEVs and associated lifecycle emissions from fuel and energy use are expected to continue to decline over time as the electrical grid gets even cleaner and as technology improves. Making this transition to ZE is critical to meet the State's air quality and climate change goals.

Some near-term challenges include the incremental cost to purchase the ZEV along with building-out chargers to recharge vehicles overnight at the fleet's yard, also known as depot chargers, and hydrogen fueling infrastructure, as well as the learning curve associated with adopting new technology. Most fleet vehicles travel relatively short distances each day and have operations that are suitable for electrification, but issues due to unknowns from using a new technology from the fleet perspective may exist. A mid-term challenge facing a long-haul and intrastate trucking operation is the need for publicly available charging and hydrogen fuel network. Faster chargers with capacities up to 350 kilowatts (kW) are being deployed in the field today and work is underway to develop and demonstrate chargers that exceed 1 megawatt that would allow even the largest vehicles to recharge in well under an hour. In addition, longer range trucks need supplemental storage capacity for batteries or hydrogen tanks, which can add more weight to the truck. State law allows ZEVs and near-zero-emission vehicles (NZEV) to exceed California maximum weight limits by 2,000 pounds (lbs.) which addresses some of the vehicle weight and payload capacity concerns of zero-emission technology for weight limited loads. [10] However, weight may only be an issue for a about 10 percent of the largest trucks on the road and may only affect about 2 percent of the most common dry van tractor trailer combination at maximum weight.[11] Additionally, payload capacity concerns are expected to diminish over time as battery energy densities improve and emphasis is placed on vehicle light-weighting. Weight is less of a concern for fuel cell electric vehicles (FCEV) as they have comparable range to combustion vehicles and weigh less than long-range BEVs with bigger batteries.[12] Staff anticipates these challenges to diminish with technology improvements and scale as BEVs and FCEVs become more commonplace.

Concerns have been raised around the availability and rollout of public and private ZEV infrastructure, including both charging and hydrogen stations, and the grid's ability to meet

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[9] California Air Resources Board, *Battery Electric Truck and Bus Energy Efficiency Compared to Conventional Diesel Vehicles,* 2018 (Web Link: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2019/act2019/appg.pdf, last accessed August 2022).
[10] Assembly Bill 2061 (Frazier, Stats. 2018, ch. 580).
[11] North American Council for Freight Efficiency, *Lightweighting*, 2021 (Web link: https://nacfe.org/technology/lightweighting-2/, last accessed August 2022).
[12] North American Council for Freight Efficiency, *Making Sense of Heavy-Duty Hydrogen Fuel Cell Tractors*, 2021 (Web link: https://nacfe.org/wp-content/uploads/2020/12/NACFE-Guidance-on-Hydrogen-Fuel-Cell-Tractors-FINAL-121620.pdf, last accessed August 2022).

the steadily growing electrical demand generated by the proposed ACF regulation and other rules promoting electrification. CARB staff have closely collaborated with multiple State agencies on this issue including the California Energy Commission (CEC), California Public Utilities Commission (CPUC), Governor's Office of Business and Economic Development (GO-Biz), and others. Robust modeling efforts by CEC have estimated that 157,000 chargers will be necessary by 2030 to support heavy-duty vehicle electrification.[13] This charging need will initially be focused "behind the fence" through depot charging, but publicly accessible options will be needed to enable a widespread charging network for long-range and interstate travels.

To meet the projected charging and refueling infrastructure needs, expanded incentive programs were launched by CEC. CPUC has directed the investor-owned utilities (IOU) to offer infrastructure support programs and incentives for fleet owners to install infrastructure in their territories. This includes funding programs such as the CEC's Energy Infrastructure Incentives for Zero-Emission Commercial Vehicles (EnergIIZE) program which is providing funding to support ZEV infrastructure as well as programs the CPUC has approved which authorize investor-owned utilities (IOUs) to invest in medium- and heavy-duty infrastructure. [14,15] Federal investments in charging and hydrogen stations are starting to takeoff through the Infrastructure Investment and Jobs Act. In addition, private companies are also making significant investments in ZE vehicles and infrastructure with billions of dollars in announcements.[16] Private efforts often target ZE vehicle fleet integration, charging needs, as well as to gather data to improve future products offerings. Private investments in hydrogen stations have also increased significantly in recent years as discussed on page 5 of the Assembly Bill 8 report.[17] In addition, Nikola Corporation has announced plans to build three hydrogen fueling stations for the fuel cell truck market in Colton, Ontario, and one serving the Port of Long Beach in collaboration with the Travel Centers of America.[18]

California's electric grid is designed to meet the highest demand, which in California occurs between 4 p.m. and 9 p.m. during the hottest days in summer. Fleet owners may opt to charge vehicles outside of these "peak hours." In addition, electric vehicles (EV) have the potential to serve as secondary storage to absorb excess renewable power from the grid and avoid curtailment. Work is ongoing to support the development of vehicle to load or back feeding into the grid. Other concerns have been raised about the impact public safety power

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[13] California Energy Commission, *Assembly Bill 2127 Electric Vehicle Charging Infrastructure Assessment*, 2021 (web link: https://efiling.energy.ca.gov/getdocument.aspx?tn=238853, last accessed August 2022).
[14] California Public Utility Commission, *Clean Energy and Pollution Reduction Act of 2015 (SB 350)*, 2022 (web link: *https://www.cpuc.ca.gov/sb350/*, last accessed August 2022).
[15] California Energy Commission, EnergIIZE Commercial Vehicles, 2022 (web link: *https://energiize.org/*, last accessed August 2022).
[16] Environmental Defense Fund, *Charged-Up Analysis of the Jobs, Investments and Companies in the Zero Emissions Medium and Heavy Duty Vehicle Supply Chain Economy*, 2021 (web link: https://www.edf.org/sites/default/files/documents/National%20MHD-ZEV-Supply-Chain-Analysis%2010.27.21_0.pdf, last accessed August 2022).
[17] California Air Resources Board, *2021 Annual Evaluation of Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development*, 2021 (web link: https://ww2.arb.ca.gov/sites/default/files/2021-09/2021_AB-8_FINAL.pdf, last accessed August 2022).
[18] Nikola, *Nikola Announces Locations of Three California Hydrogen Dispensing Stations, Continued Scaling of Infrastructure*, 2022 (web link: https://nikolamotor.com/press_releases/nikola-announces-locations-of-three-california-hydrogen-dispensing-stations-continued-scaling-of-infrastructure-192, last accessed August 2022.

shutoff (PSPS) events may have on ZEV operations. The recent CPUC Decision 20-06-017 has potential to build support for distributed generation using localized microgrids that provide resiliency during power loss events, such as PSPS events and other declared emergencies.[19]

CARB staff is confident that the proposed ACF regulation targets fleets best suited for electrification while allowing flexibility over a longer time horizon for the more challenging use cases. The proposed ACF regulation is structured to phase in ZEV deployments where they are best suited to begin accelerating the transition to ZEVs in all truck market segments. This approach also considers infrastructure planning and network development strategies that will complement market expansion.

Implementation of both the existing ACT regulation and the proposed ACF regulation is expected to transition a vast majority of heavy-duty trucks to ZEVs. Shifting the remaining fleet to ZE technology requires additional policy tools to cost-effectively complete the transition for remaining fleets that are more dependent on purchasing trucks on the secondary market. The 2022 SIP Strategy identifies a Zero-Emission Truck Measure which would use targeted market signal tools, or a similar proposal that would start in 2030. Placing regulatory requirements on fleets is only one way to help accelerate the transition to ZE; for example, given the rapidly accelerating state of the truck market and working with State partners, it may also make sense to examine the current truck manufacturer requirements as they exist under ACT, as these requirements may be too low relative to public health needs and in light of accelerating technology deployments. Ensuring that manufacturers are motivated to partner with fleets and utilities to ensure that their product, ZE trucks, are being priced competitively and being used successfully is a critical underpinning of ensuing a successful accelerated transition to zero.

Federal action is also very important to support California's clean air policies. Federal adoption of cleaner NOx truck standards as well as an ACT regulation (or its CO_2 regulatory equivalent) will help California communities, but, critically, will also ensure that communities throughout the nation benefit from a robust clean truck market. National policies will help increase scale and further accelerate deployment of ZE technologies. The proposed ACF regulation is necessary to ensure California leads the nation in a shift to ZE and in meeting the State's air quality and climate targets.

I. Introduction and Background

This document summarizes staff's proposed ACF regulation to reduce emissions from light-duty delivery vehicles and Class 2b and larger medium- and heavy-duty vehicles with a manufacturer's gross vehicle weight rating (GVWR) greater than 8,500 lbs. that operate in California. The proposed ACF regulation is part of a holistic effort of achieving a ZE truck and bus California fleet by 2045 everywhere feasible and significantly earlier for certain market segments such as last mile delivery, State and local government fleets, and drayage applications. The initial focus is on drayage trucks, which have the largest impact in DACs, and on high priority fleets, with vehicles that are most suitable for early electrification. The

[19] California Public Utilities Commission, *Decision 20-06-017: Actions to Accelerate Microgrid Deployment and Other Resiliency Solutions*, June 11, 2020 (web link: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M340/K748/340748922.PDF, last accessed August 2022).

goal of this effort is to accelerate the number of medium- and heavy-duty ZEV purchases to help achieve a full transition to ZEVs in California as soon as possible.

Mobile sources and the fossil fuels that power them are the largest contributors to the formation of ozone, GHG emissions, PM2.5, and toxic diesel PM. In California, the transportation sector alone accounts for 41 percent of total GHG emissions (50 percent when upstream emissions from fuel are included) and is a major contributor to ground level ozone and PM2.5. Statewide, about 12 million Californians live in 19 areas where levels of ozone and PM2.5 exceed the National Ambient Air Quality Standards (NAAQS) for ozone and PM2.5, (non-attainment areas). Exposure to PM2.5 and ozone is associated with increased risk of premature mortality, which has been estimated to contribute to 7,500 premature deaths each year in California.[20] The South Coast and San Joaquin Valley Air Basins have the most critical air quality challenges. These regions experience some of the nation's highest PM levels and are the only two areas in the nation with an "extreme" classification for non-attainment with the federal ozone standard. In addition, seven other areas in California are in serious or severe nonattainment with the federal ozone standard. Achieving federal air quality standards in these regions, as well as across California, provides essential public health protection by reducing hospitalizations for heart and lung related causes, decreasing ER visits, and reducing incidences of asthma.

In California, climate change is contributing to an escalation of serious problems along with worsening air quality challenges, including raging wildfires, coastal erosion, extreme weather, disruption of water supply, threats to agriculture, spread of insect-borne diseases, and continuing health threats from air pollution. Reducing GHG emissions helps put California on a trajectory to avoid the worst impacts of climate change and supports a growing clean energy economy.

In addition to regional air pollutant levels, many communities in the state experience measurable harm in the form of negative health impacts from high levels of localized pollution. There is an immediate need to reduce emissions and exposure in these highly impacted, low-income[21], and DACs throughout the state. Heavy-duty vehicle activity is often concentrated in and near these communities. This is not a coincidence. Decades of racist and classist practices, including red-lining and siting decisions, have concentrated heavy-duty vehicle and freight activities in these communities, with concomitant disproportionate pollution burdens. For instance, communities in and around ports move much of the nation's freight, and so experience pollution on a national scale in their neighborhoods. CARB has legal and moral obligations to lessen these burdens.

In light of all these needs, the proposed ACF regulation, in concert with existing State regulatory and incentive programs, seeks to accelerate the market transition to ZEVs. ZEV technologies eliminate all tailpipe emissions of criteria pollutants and greenhouse gases from the operation of vehicles, which positively affects our air quality and climate challenge. The proposed ACF regulation would help reduce emissions from fleets that pose acute health risks to local communities in which they operate and contribute towards achieving CARB's emissions reductions goals for attaining federal health-based air quality standards. The

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[20] California Air Resources Board, *Revised Proposed 2016 State Strategy for the State Implementation Plan*, 2017 (web link: https://ww3.arb.ca.gov/planning/sip/2016sip/rev2016statesip.pdf, last accessed August 2022).
[21] "Low-income communities" is defined in Health and Safety Code section 39713(d)(2) (added by Assembly Bill 1550 (Gomez, Stats. 2016, ch.369)).

proposed ACF regulation would result in reductions in criteria pollutants, toxic air contaminants, and GHG emissions at the statewide, regional, and local levels. This proposed ACF regulation is part of California's holistic plan to address challenging federal air quality mandates, protect the public health of all Californians, and meet climate change goals.

Medium- and heavy-duty ZEVs available today are already capable of meeting the average needs of local and regional trucking operations and a variety of vocational uses. Several data sources show the majority of trucks operating in California average less than 100 miles per day, except for semi-trucks where most average less than 200 miles per day.[22,23] Collected by CARB in 2021, recent Large Entity Reporting (LER) survey responses on daily mileage showed similar results for trucks that are owned by the responding entities. [24] Today's medium- and heavy-duty ZEVs have energy storage systems that can meet most of these daily operational requirements.

ZEVs also have unique advantages that eventually lead to shifts in fleet operational behaviors. Some of the advantages include quiet vehicle operation that improves safety on work sites, and enables later work shifts during times with less traffic and more efficient delivery schedules. Other benefits include less time spent on scheduled maintenance or out-of-service time due to the mechanical simplicity of ZEV systems. Over time, continued technology improvements, cost-reductions, and infrastructure growth would allow the ZEV market to continue expanding into all transportation service applications, including long-haul trucking.

Although medium- and heavy-duty ZEVs currently have higher upfront capital costs than vehicles powered by ICEs, they have lower fuel and maintenance costs that are expected to result in a positive TCO in most applications where they are suitable. Economic analyses by CARB and numerous third parties have found that medium- and heavy-duty ZEVs result in a

[22] United States Census Bureau, *2002 Vehicle Inventory and Use Survey*, 2002 (web link: https://www2.census.gov/library/publications/economic-census/2002/vehicle-inventory-and-use-survey/ec02tv-us.pdf, last accessed August 2022).

[23] California Department of Transportation, *CalTrans Truck Survey*, 2018 (web link: http://www.scag.ca.gov/committees/CommitteeDocLibrary/mtf012319_CAVIUS.pdf, last accessed August 2022).

[24] California Air Resources Board, *Large Entity Reporting Data*, 2021 (web link: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks/large-entity-reporting, last accessed August 2022).

lower TCO when compared to purchasing new gasoline or diesel counterparts in some applications today, and in nearly all applications by 2030.[25,26,27,28,29,30,31,32]

Increasing public pressure to address our climate crisis is pushing governments and businesses to reduce California's carbon footprint through the development of sustainability plans and the adoption of carbon reducing incentive programs and regulations. As a result of such climate focused policies and other long economic drivers, the medium- and heavy-duty ZEV market has developed rapidly over the past several years in the United States.

Staff analysis shows there are more than 148 models in North America where manufacturers are accepting orders or pre-orders and more than 130 models are actively being produced and are being delivered to the customer. Currently, all major manufacturers have announced upcoming medium- and heavy-duty ZEV plans and all but one has ZEV models in development with plans to launch them commercially prior to 2024. In addition, companies like Amazon, DHL, and the U.S. Postal Service have commissioned or self-manufactured purpose-built ZEVs in quantity for their own delivery business use.[33,34,35,36] Finally, several companies including major truck parts suppliers have a variety of EV components and drivetrain solutions for vehicle manufacturers to use in their vehicles. Appendix J provides a

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[25] California Air Resources Board, *Draft Advanced Clean Trucks Total Cost of Ownership Discussion Document*, 2019 (web link: https://ww3.arb.ca.gov/regact/2019/act2019/apph.pdf, last accessed August 2022).
[26] Atlas Public Policy, *Assessing Financial Barriers to Adoption of Electric Trucks*, 2020 (web link: https://atlaspolicy.com/wp-content/uploads/2020/02/Assessing-Financial-Barriers-to-Adoption-of-Electric-Trucks.pdf, last accessed August 2022).
[27] Hydrogen Council, *Path to Hydrogen Competitiveness – A Cost Perspective*, 2020 (web link: https://hydrogencouncil.com/wp-content/uploads/2020/01/Path-to-Hydrogen-Competitiveness_Full-Study-1.pdf, last accessed August 2022).
[28] ICF International, *Comparison of Medium-Duty and Heavy-Duty Technologies in California*, 2019 (web link: https://caletc.aodesignsolutions.com/assets/files/ICF-Truck-Report_Final_December-2019.pdf, last accessed August 2022).
[29] North American Council for Fuel Efficiency, *Regional Haul*, 2019 (web link: https://nacfe.org/regional-haul/, last accessed August 2022).
[30] North American Council for Fuel Efficiency, *Viable Class 7/8 Electric, Hybrid, and Alternative Fuel Tractors*, 2019 (web link: https://nacfe.org/future-technology/viable-class-7-8/, last accessed August 2022).
[31] University of California Los Angeles, *Zero-Emission Drayage Trucks – Challenges and Opportunities for the San Pedro Bay Ports*, 2019 (web link: https://innovation.luskin.ucla.edu/wp-content/uploads/2019/10/Zero_Emission_Drayage_Trucks.pdf, last accessed August 2022).
[32] Union of Concerned Scientists, *Ready to Work – Now is the Time for Heavy-Duty Electric Vehicles*, 2019 (web link: https://www.ucsusa.org/sites/default/files/2019-12/ReadyforWorkFullReport.pdf, last accessed August 2022).
[33] New York Times, *Can Anyone Satisfy Amazon's Craving for Electric Vans?*, 2022 (web link: https://www.nytimes.com/2022/01/18/technology/amazon-electric-vans.html, last accessed August 2022).
[34] Lightning eMotors, *DHL Express Deploys Nearly 100 New Lightning Electric Delivery Vans in U.S.*, 2021 (web link: https://lightningemotors.com/dhl-express-deploys-lightning-electric-vans-in-us/, last accessed August 2022).
[35] Reuters, *U.S. Postal chief commits to 10% of new delivery fleet as electric vehicles*, 2021 (web link: https://www.reuters.com/technology/us-postal-chief-commits-10-new-delivery-fleet-electric-vehicles-2021-02-24/, last accessed August 2022).
[36] CNN, *U.S. Postal Service says at least 40% of new delivery trucks will be electric*, 2022 (web link: https://www.cnn.com/2022/07/20/business/usps-electric-vehicle/index.html, last accessed August 2022).

partial list of medium-and heavy-duty ZEVs that are currently available or that can be ordered.

California is not alone in adopting regulations that will accelerate the ZE market. Five other states have already completed adoption of the ACT regulation (Massachusetts, New Jersey, New York, Oregon, and Washington) and two more states (Colorado and Maine) are currently in the public process required to adopt. New York has signed legislation, including the same ZE deadlines as California Executive Order N-79-20 for heavy-duty, light-duty, and off-road vehicles. The multi-state Medium- and Heavy-Duty ZEV Memorandum of Understanding continues to grow with Quebec and Virginia joining in 2021 to now include 17 states, one province and the District of Columbia.[37] Additionally, five other states (Illinois, Indiana, Michigan, Minnesota, and Wisconsin) have created a Regional Electric Vehicle Midwest Coalition Memorandum of Understanding (MOU) to accelerate medium- and heavy-duty ZE technology deployment via collaboration on infrastructure, manufacturing, and equity actions.[38] In addition, a Memorandum of Cooperation signed in June 2022 lays the foundation for potential collaboration on medium- and heavy-duty ZE policy and regulation between California and Canada.[39] This builds on Canada's commitment to decarbonize the transportation sector that has already seen actions including the path to 100 percent sales of light duty trucks by 2035 and over a half a billion dollars in MHD ZEV incentive funding.[40] Figure 3 shows regions with commitments to MHD ZEV deployment. California is also collaborating with the 16 countries and numerous regional, city and private entities of the Global Commercial Vehicle Drive To Zero's 100 percent in 2040 goals, currently chairing the Transportation Decarbonisation Alliance of countries, regions, cities and companies, and promoting the goals of the Zero Emission Vehicle Transition Council with membership spanning from Mexico to Canada and Europe to Asia. [41,42,43] As more jurisdictions pass ACT regulations and supporting policies, the ZE supply chains will grow, prices will continue to drop (benefitting consumers and fleets), new economic opportunities for electric vehicle supply equipment (EVSE) providers will continue to expand, and growing numbers of communities will benefit from air quality improvements.

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[37] *Multi-State Medium- and Heavy-Duty Zero Emission Vehicle Memorandum of Understanding.* (web link: https://www.energy.ca.gov/sites/default/files/2020-08/Multistate-Truck-ZEV-Governors-MOU-20200714_ADA.pdf, last accessed August 2022).

[38] Regional Electric Vehicle Midwest Coalition, *Memorandum of Understanding Between Illinois, Indiana, Michigan, Minnesota, and Wisconsin*. (web link: https://www.michigan.gov/-/media/Project/Websites/leo/REV_Midwest_MOU_master.pdf?rev=6dd781b5a4eb4551b3b3a5b875d67fb9#:~:text=THIS%20MEMORANDUM%20OF%20UNDERSTANDING%20(%E2%80%9CMOU,the%20%E2%80%9CParticipating%20States%E2%80%9D), last accessed August 2022).

[39] *Memorandum of Cooperation between the Government of Canada and the Government of the State of California of the United States of America concerning Climate Action and Nature Protection*. (web link: https://www.canada.ca/en/services/environment/weather/climatechange/climate-plan/reduce-emissions/memorandum-cooperation-canada-california-climate-action-nature-protection.html, last accessed August 2022).

[40] Transport Canada, *Zero-emission vehicles*, 2022, (web link: https://tc.canada.ca/en/road-transportation/innovative-technologies/zero-emission-vehicles, last accessed August 2022).

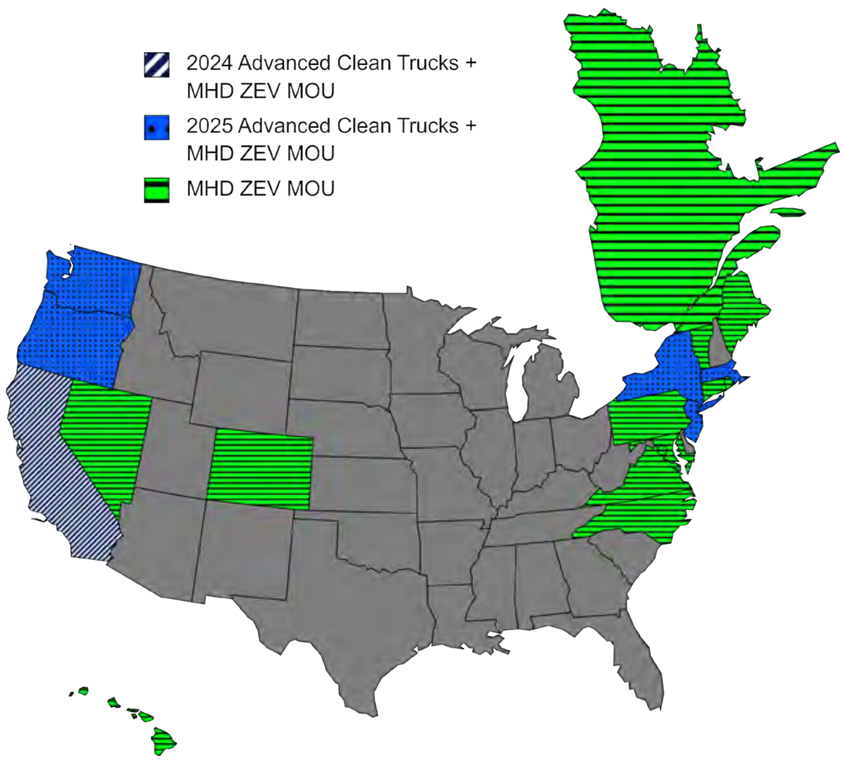
[41] Drive to Zero, *Pledge Partners*, 2022, (web link: *https://globaldrivetozero.org/about/pledge-partners/*, last accessed August 2022).

[42] Transportation Decarbonisation Alliance, *TDA Members*, 2022 (web link: https://tda-mobility.org/tda-members/, last accessed August 2022).

[43] ZEV Transition Council, 2022 (web link: *https://zevtc.org/the-council/members/*, last accessed August 2022).

According to CALSTART's Zero-Emission Technology Inventory analytics, it is estimated that there will be more than 590 ZE truck and bus models available internationally by the end of 2022.[44] This shows that the ZEV market is expanding rapidly internationally, and these same drivetrains or configurations could be brought to California and United States market. For a market growth example beyond just models available, the monthly 2021 sales in China for "New Energy" heavy trucks (battery, battery swap and fuel cell) rose smoothly from a couple hundred per month initially to over three thousand a month by year's end totaling over 10,000 and poised to follow the rapid bus electrification trajectory already seen there.[45] ACEA and the major truck manufacturers supplying the European market (many of which are also suppliers to North America) have committed to all truck sales being fossil-free by 2040, underscoring the widespread and long term commitment to bringing ZEVs to market.[46]

Figure 3: Map of North American Regions with Commitments to Medium- and Heavy-Duty ZEV Deployment



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[44] CALSTART, *Zero-emission Technology Inventory (ZETI) Analytics*, 2020 (web link: https://globaldrivetozero.org/tools/zeti-analytics/, last accessed August 2022).

[45] Bloomberg, *China's New Energy Heavy Trucks Will See More Growth in 2022*, 2022 (web link: https://www.bloomberg.com/news/articles/2022-02-01/china-s-new-energy-heavy-trucks-will-see-more-growth-in-2022 last accessed August 2022).

[46] ACEA, *All new trucks sold must be fossil free by 2040, agree truck makers and climate researchers*, 2020 (web link: https://www.acea.auto/press-release/all-new-trucks-sold-must-be-fossil-free-by-2040-agree-truck-makers-and-climate-researchers/, last accessed August 2022).

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A. Overview of Proposed ACF regulation

The proposed ACF regulation is part of CARB's portfolio of regulations already working to decarbonize the transportation sector. For the medium- and heavy-duty market, ZE focused regulations began with the Innovative Clean Transit (ICT) regulation adopted by CARB in 2018, which will transition the State's transit fleet to ZE by about 2040.[47] The Zero-Emission Airport Shuttle Bus (ASB) regulation and the Zero-Emission Powertrain Certification regulations were approved in 2019. [48,49] In January 2021, the ACT regulation was adopted by CARB and became effective under state law on March 15, 2021. It is a key part of the holistic approach to accelerate a large-scale ZEV transition of medium- and heavy-duty trucks. The ACT regulation requires manufacturers who certify Class 2b–8 chassis or complete vehicles with combustion engines to sell medium- and heavy-duty ZEVs as an increasing percentage of their annual California sales from 2024 to 2035. By 2035, ZEV sales would need to be 55 percent of Class 2b–3 truck sales, 75 percent of Class 4–8 straight truck sales, and 40 percent of truck tractor sales.

The proposed ACF regulation would continue CARB's efforts to decarbonize the transportation sector by requiring State and local government fleets, drayage trucks, high priority fleets, and federal fleets to phase in medium- and heavy-duty ZEVs over time. As a backstop, the proposed ACF regulation sets a clear end date for new combustion-powered Class 2b-8 vehicle sales in California. The following is a summary of the proposed ACF regulation:

- State and local government fleets: Phased-in requirement for newly added medium- and heavy-duty vehicles to be ZEVs starting with 50 percent in 2024 and 100 percent in 2027. Municipalities in designated low-population counties would be excluded until 2027.
- Drayage trucks: ZEV registration requirements for newly added drayage trucks starting in 2024, while allowing useful life for legacy trucks. All trucks conducting drayage operations must be ZEVs by 2035.
- High priority and federal fleets: Fleets may only add ZEVs to their California fleets and must remove vehicles at the end of a minimum useful life. Optionally, fleets may choose a phased-in schedule with increasing ZEV targets as a percentage of the total vehicle fleet. High priority fleets include entities with more than $50 million in annual revenues, or those fleets that own, operate, or direct at least 50 medium- and heavy-duty trucks and buses under common ownership and control.
    - Affected vehicles include on-road medium- and heavy-duty vehicles, light-duty package delivery vehicles with GVWR equal to or less than 8,500 lbs., and off-road yard tractors that operate in California.
- Vehicle sales: 100 percent of all new Class 2b-8 vehicles vehicle sales into California must be ZE starting in 2040.

[47] The ICT regulation is comprised of Cal. Code Regs., tit. 13, sections 2023 to 2023.11.
[48] The ASB regulation is comprised of Cal. Code Regs., tit. 17, sections 95690.1 to 95690.8.
[49] The Zero-Emission Powertrain regulation is comprised of Cal. Code Regs., tit. 13, section 1956.8. and tit. 17 section 95663.

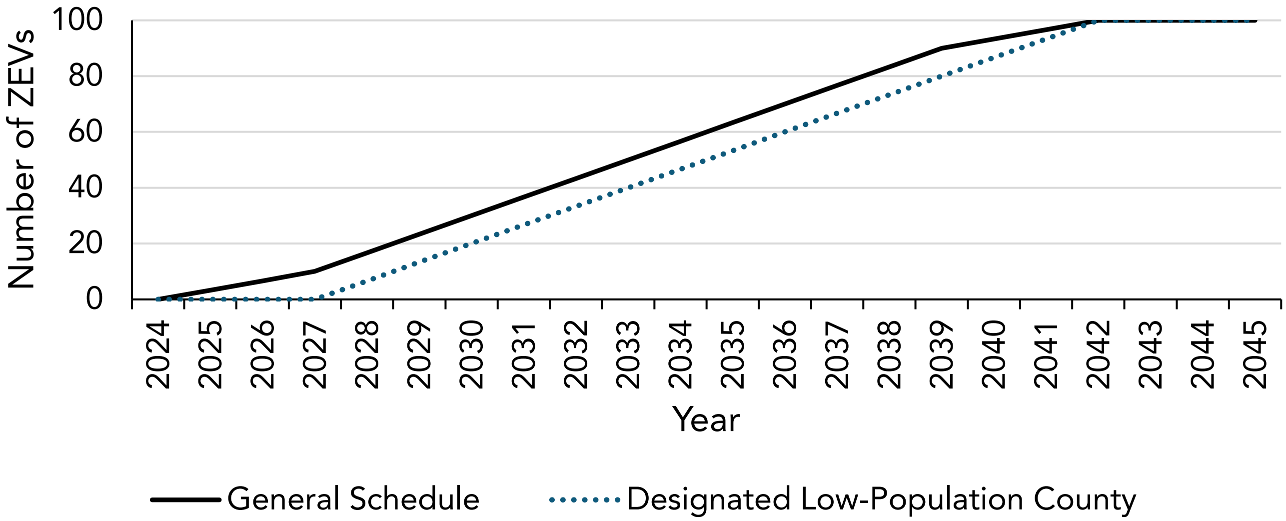
The proposed ACF regulation excludes certain vehicles with two-engines, military tactical vehicles, historical vehicles, heavy cranes, emergency vehicles, and dedicated snow removal vehicles. The proposed ACF regulation also does not apply to transit buses subject to the ICT regulation nor school buses. Staff has listened to stakeholder concerns and has designed several provisions for fleet owners who are complying with the regulation. The provisions have been designed for edge use cases that can serve as guardrails for fleets and are described in more detail in the following sections.

1. State and Local Government Fleet Requirements

State and local government agency fleet requirements were designed with the special needs and circumstances of these agencies in mind. The proposed requirements would apply to cities, counties, public utilities, special districts, local agencies and districts, and the State fleet, but excludes federal agencies. A ZEV purchase requirement at normal time of vehicle replacement was chosen as the appropriate framework to allow enough flexibility for budget fluctuations and cycles. State and local government agencies would not be required to retire trucks nor required to purchase additional vehicles to comply. However, when purchases are made, they would need to be ZEVs or NZEVs capable of ZE operation if a ZE version of a needed vehicle is not commercially available.

The proposed ACF regulation would require 50 percent of new vehicle additions to the fleet to be ZEV starting January 1, 2024, and 100 percent starting on January 1, 2027. Additional time would be provided to fleets based in designated low-population counties by exempting them from ZEV purchase requirements until 2027. Designated low-population counties include the counties of Alpine, Amador, Butte, Calaveras, Colusa, Del Norte, Glenn, Humboldt, Inyo, Lake, Lassen, Mariposa, Mendocino, Modoc, Mono, Nevada, Plumas, Shasta, Sierra, Siskiyou, Sutter, Tehama, Trinity, Tuolumne, and Yuba. Many of these areas have fewer air quality challenges than other parts of the state and the fleets based in these areas tend to have fewer vehicles, operate in remote areas that are expected to take longer for ZEV infrastructure and support networks to be developed, and tend to have more limited budgets. Figure 4 illustrates a compliance example showing the number of ZEVs in the fleet for two government fleets with 100 trucks each. One fleet meets the general requirements and would start adding ZEVs as 50 percent of their planned purchases starting in 2024. The other fleet represents one that is in a designated low population county and begins adding ZEVs in 2027. Both examples assume a business-as-usual 15-year replacement cycle. In this example, these fleets exceed 50 percent ZEVs in 2033 and 2035, respectively and complete the transition to all ZEVs in 2042.

Figure 4: 100 Truck Fleet Examples for State and Local Government Requirements



Annual reporting and recordkeeping would be required starting April 1, 2024. The proposed ACF regulation also includes exemptions and extensions to address certain situations as summarized below.

- Backup Vehicle Exemption. Allow fleet owners to purchase a new ICE vehicle and exclude it from the ZEV addition requirement if it operates less than 1,000 miles per year. Mileage accrued while operating in support of a declared emergency event would be excluded.
- Daily Usage Exemption. Fleet owners may receive a one-year exemption to purchase a new ICE vehicle if a comparable ZEV is available but cannot be placed anywhere in the California fleet while meeting the daily usage needs of any existing ICE vehicle.
- Infrastructure Construction Delay Extension. Excuses the fleet owner from taking immediate delivery of ordered ZEVs for one year due to a construction delay beyond the fleet owner's control.
- ZEV Unavailability Exemption. Allows fleet owners to purchase a new ICE vehicle if no ZEV nor NZEV of the needed configuration is commercially available. A list of vehicles that are not available as ZEVs or NZEVs will be kept on the CARB website.
- Mutual Aid Assistance. Allows a fleet owner to apply for an exemption to purchase ICE vehicles for up to 25 percent of the fleet if the vehicles are needed to provide emergency response services to fulfill the terms of a signed mutual aid agreement.

The exact regulatory language, and purpose and rationale for these provisions as they apply to State and local government fleets are provided in Appendix A-1 and Appendix H-1 of the Staff Report, respectively.

2. Drayage Truck Requirements

The proposed drayage truck requirements would apply to Class 7-8 drayage trucks operating at intermodal seaports and railyards. These drayage trucks would be required to transition to ZEVs by 2035. The proposed requirements include a phased-in approach for drayage trucks. All drayage trucks would be required to register in CARB's Online System, starting in late

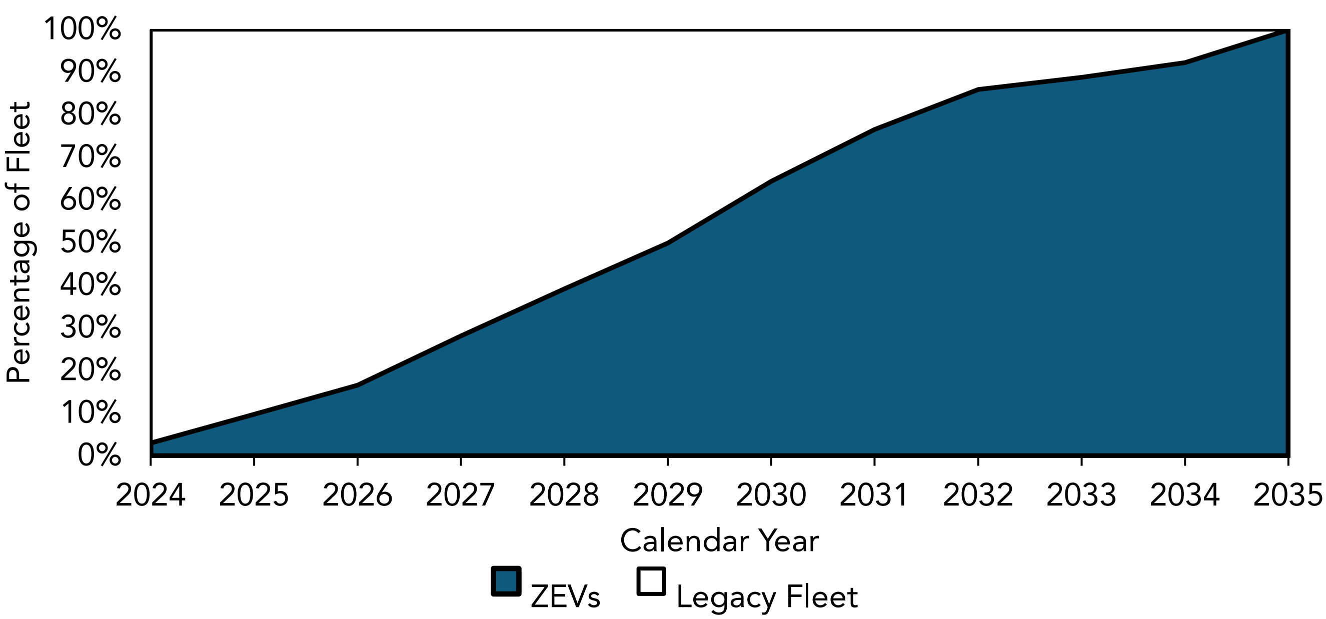
2023. Existing drayage trucks with ICEs, could remain in drayage service for a minimum period, defined as the later of the following two conditions:

- Thirteen (13) years from the MY that the engine and emissions control systems are first certified by CARB or the U.S. Environmental Protection Agency (U.S. EPA); or
- When the vehicle reaches 800,000 vehicle miles traveled (VMT) or 18 years from the MY that the engine and emissions control systems are first certified by CARB or the U.S. EPA, whichever is earlier.

Drayage trucks 12 years and older would be required to report their mileage annually. Beginning in 2024, any truck added to CARB's Online System must be a ZEV. All drayage trucks entering seaports and intermodal railyards must be ZEVs by 2035. To address infrastructure construction delays and vehicle delivery delays that are beyond the control of regulated entities, limited one-year compliance extensions provisions would be included. All drayage trucks must also visit a regulated seaport or intermodal railyard at least once each calendar year to remain in CARB's Online System. All regulated intermodal seaports and railyards would be required to report drayage truck visits annually. This approach builds on the structure of the existing drayage truck regulation and meets the goal of a complete transition of California's drayage fleet to ZE by 2035.

Figure 5 shows the projected portion of vehicles in the drayage fleet which will be zero-emission over time. ZEVs enter the drayage fleet beginning in 2024, reach 50 percent of the fleet in 2029, and reach 100 percent in 2035.

Figure 5: Drayage Fleet Over Time



Annual reporting and recordkeeping would be required before December 31, 2023. The proposed ACF regulation also includes exemptions and extensions to address certain situations as summarized below.

- Dedicated Use Vehicle Exemption. These include dedicated use or uni-body vehicles that do not have separate tractor and trailers or are vehicles using a power take off (PTO) with a hydraulic motor or blower, attached to the trailer that needs the PTO to load or unload. These vehicle types include but are not limited to (e.g., auto transport, fuel delivery vehicles, concrete mixers, on-road mobile cranes).
- Infrastructure Construction Delay Extension. Drayage truck owners may receive a one-year extension from the requirements and delay delivery of the ordered zero-emission vehicle(s) that would be reliant on the fueling infrastructure for one year.
- ZEV Vehicle Delivery Delay Extension. Drayage truck owners may exclude an existing legacy drayage truck from the requirements if the zero-emission vehicle is ordered one year in advance of the compliance date for the legacy drayage truck being replaced and the newly purchased zero-emission vehicle will not be delivered by the compliance deadline for reasons beyond the drayage truck owner's control.

The exact regulatory language, and purpose and rationale for these provisions as they apply to drayage fleets are provided in Appendix A-3 and Appendix H-3 of the Staff Report, respectively.

3. High Priority and Federal Fleet Requirements

High priority and federal fleets would be required to either add only ZEVs to their California fleets while retiring ICE vehicles at the end of minimum use life, or may opt to phase-in ZEVs as a percentage of the total fleet that operates in California. Affected California fleets would include all truck owners or controlling parties with an annual revenue greater than $50 million that operate at least 1 medium- or heavy-duty truck in California, or those who own, operate, or direct 50 or more medium- or heavy-duty trucks under common ownership and control and at least 1 of those trucks operates in California. The affected vehicles include all medium- and heavy-duty vehicles as well as any light-duty package delivery vehicles, as defined in the regulation. Controlling parties include the motor carrier, broker, or entity that directs or otherwise manages the day-to-day operation of multiple fleets under common ownership or control to serve the customers or clients of the controlling party. Controlling parties must include all vehicles in their fleet that are operated under common ownership or control in addition to their own vehicles that operate in California when determining compliance. In addition, all entities that hire and direct or hire and operate vehicles subject to portions of the proposed ACF regulation must verify that the fleets they hire comply with the regulations by looking them up on the CARB website to maintain consistency with other existing fleet rules which have similar requirements.

a) Model Year Schedule

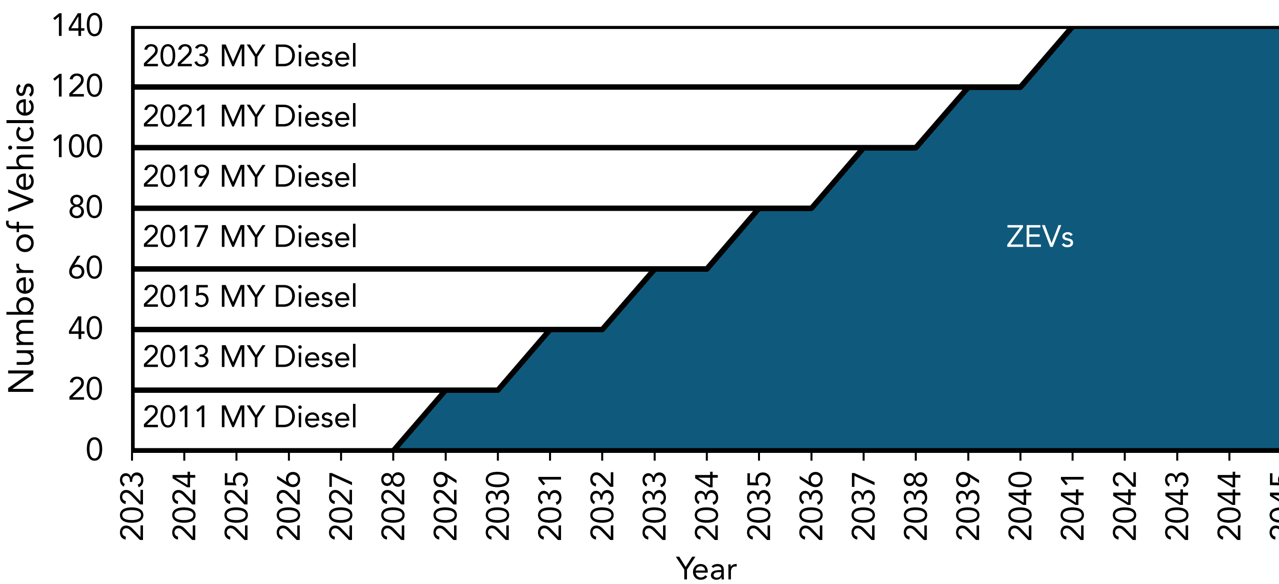
The proposed Model Year Schedule requires affected entities to add only ZEVs to their California fleets beginning in the 2024 calendar year and requires existing ICE vehicles to be removed from the California fleet at the end of their minimum useful life. Minimum useful life is defined as the latter date of two conditions:

- Thirteen (13) years commencing from the year the original engine and emissions control system in a vehicle was first certified for use by CARB or U.S. EPA; or

- The date that the vehicle exceeded 800,000 VMT or 18 years from the year the original engine and emissions control system of that vehicle was first certified for use by CARB or U.S. EPA, whichever is earlier.

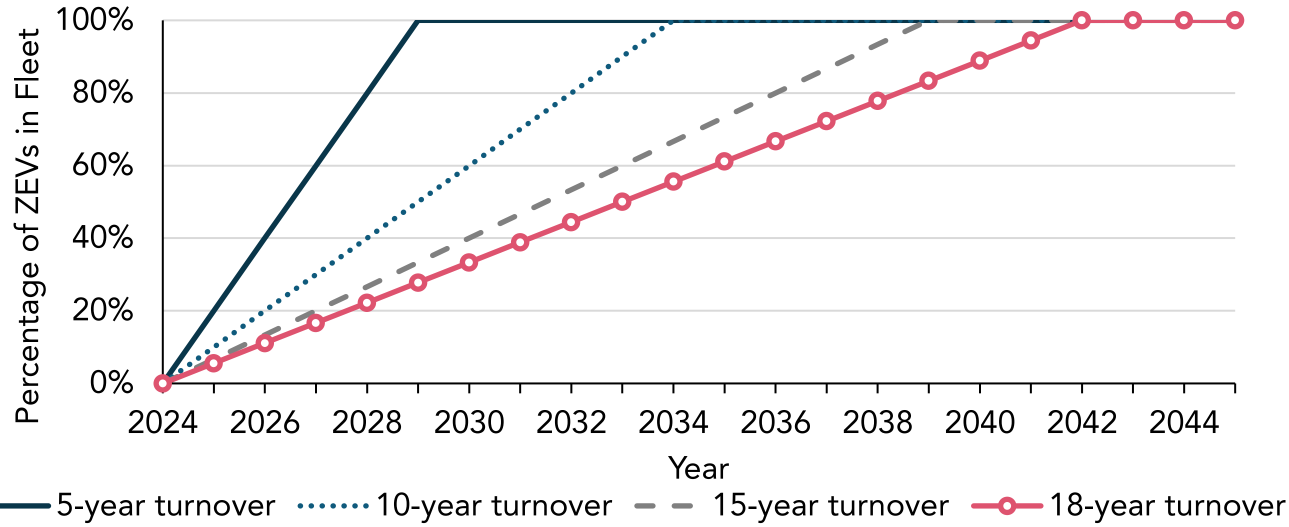
Vehicles that are 12 years and older would be required to report their mileage annually to determine when the vehicle is beyond its useful life. With this schedule, compliance is simply determined by the age and mileage of the existing ICE vehicles in the fleet. Figure 6 illustrates an example of a 140 vehicle fleet following the Model Year Schedule who purchases 20 new diesel vehicles every 2 years and keeps them for a full useful life of 18 years. The fleet would need to begin replacing their diesel-powered vehicles in 2029 when the first two vehicles become 18 years old and would make a full transition to ZEVs in 2041.

Figure 6: Model Year Schedule Fleet Example



However, fleet owners that replace their vehicles in shorter period would be required to add more ZEVs to their fleet at a faster rate with this schedule. Figure 7 illustrates how a fleet's replacement rate will affect how quickly they transition to ZEVs under the Model Year Schedule with their normal vehicle replacement cycle. The solid line shows that a fleet with a 5-year turnover cycle would need to be all ZEVs by 2029, a fleet with a 10-year turnover cycle would be all ZEVs by 2034, a fleet with a 15-year turnover cycle would be all ZEV by 2039, and a fleet with an 18-year turnover cycle would be all ZEVs by 2042.

Figure 7: Model Year Schedule Fleet Example Illustrating Impact of Turnover Rate



The proposed ACF regulation also includes exemptions and extensions for the Model Year Schedule to address certain situations as summarized below.

- Backup Vehicle Exemption. Allows a fleet owner to keep an existing ICE vehicle beyond its useful life if the vehicle is operated less than 1,000 miles per year. Mileage accrued while operating in support of a declared emergency event may be excluded.
- Daily Usage Exemption. A fleet owner may receive a one-year exemption to purchase a new ICE vehicle of a given configuration if a comparable ZEV is available but cannot be placed anywhere in the California fleet while meeting the daily usage needs of any existing ICE vehicle in the fleet.
- Infrastructure Construction Delay Extension. Allows a fleet owner to continue operating an existing vehicle up to one year beyond the end of its useful life and to delay delivery of the ordered ZEVs that would be reliant on the charging or hydrogen fueling infrastructure for one year due to construction delays beyond the control of the fleet owner.
- Vehicle Delivery Delay Extension. A fleet owner may continue operating an ICE vehicle beyond its useful life if a new ZEV is ordered to replace it one year in advance of its compliance date and the newly purchased ZEV is not be delivered by the compliance deadline for reasons beyond the fleet owner's control.
- ZEV Unavailability Exemption. Allows fleet owners to purchase a new ICE vehicle if no ZEV nor NZEV of the needed configuration is commercially available. A list of vehicles that are not available as ZEVs or NZEVs will be kept on the CARB website.
- Mutual Aid Assistance. Allows a fleet owner to apply for an exemption to purchase ICE vehicles for up to 25 percent of the fleet if the vehicles are needed to provide emergency response services to fulfill the terms of a signed mutual aid agreement.
- Declared Emergency Event Exemption. Allows any vehicle to be used to support an emergency event declared by the governor or other public official.

Beginning in 2024, affected fleets would need to report and keep records for eight years on certain information about the vehicles they operate or control in California. Reported vehicle information includes details necessary to enforce and track compliance with the proposed ACF regulation. The exact regulatory language, and purpose and rationale for these provisions as they apply to high priority and federal fleets are provided in Appendix A-2 and Appendix H-2 of the Staff Report, respectively.

b) ZEV Milestones Option

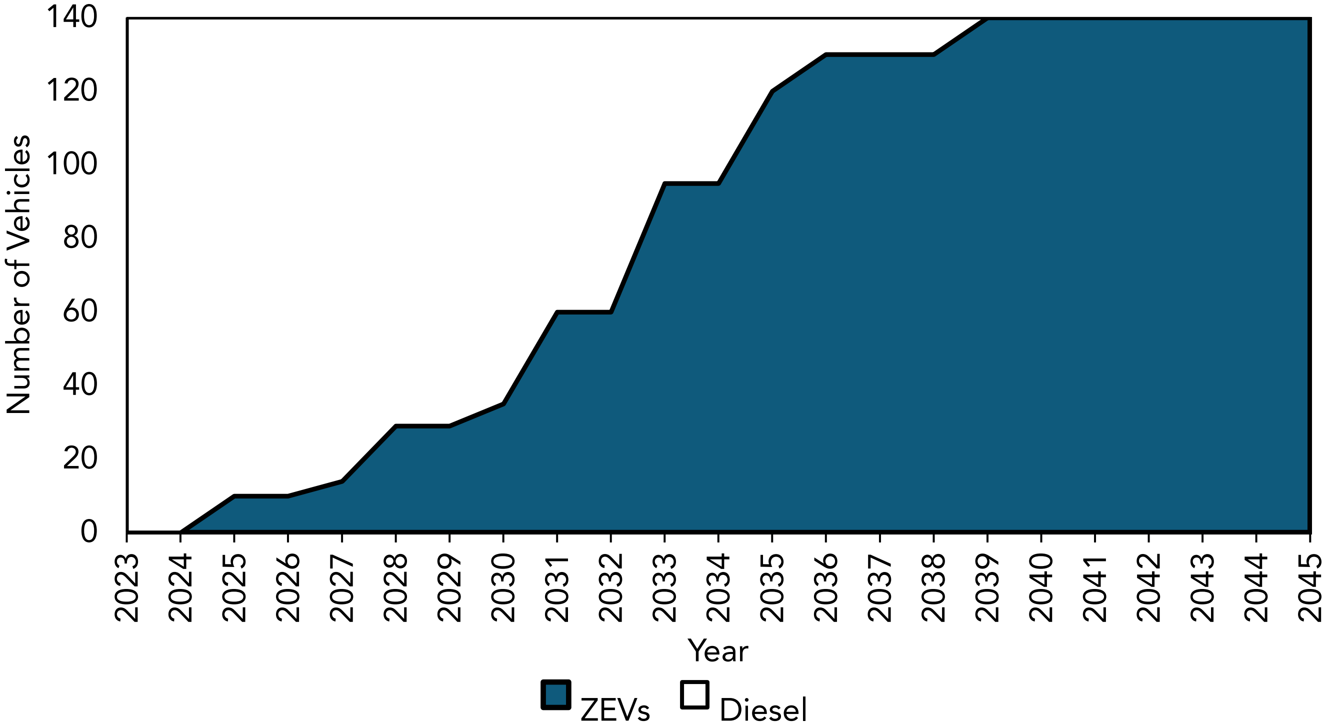
Under the optional ZEV Milestones Schedule, high priority and federal fleets must phase-in ZEVs as a percentage of their total California fleet starting at 10 percent and increasing to 100 percent based on vehicle body type as shown in Table 6. Vehicles in Group 1 are commonly used for local and regional delivery or passenger transportation and are already suitable for electrification. With this proposed schedule, all covered delivery vans and box trucks that operate in urban areas and frequent warehouses and distribution centers would be ZEVs by 2035, except for the expected small percentage of vehicles using exemptions. Vehicles in Group 2 and Group 3 are given more time because they are expected to have higher daily mileage needs, have more varied use cases and fewer of these ZEV models are available today.

Table 6: High Priority and Federal Fleet Zero-Emission Vehicle Phase-In Schedule

Group	Percentage of Fleet that Must be ZEV	10%	25%	50%	75%	100%
1	Box trucks, vans, two-axle buses, yard trucks, light-duty delivery vehicles	2025	2028	2031	2033	2035
2	Work trucks, day cab tractors, three-axle buses	2027	2030	2033	2036	2039
3	Sleeper cab tractors and specialty vehicles	2030	2033	2036	2039	2042

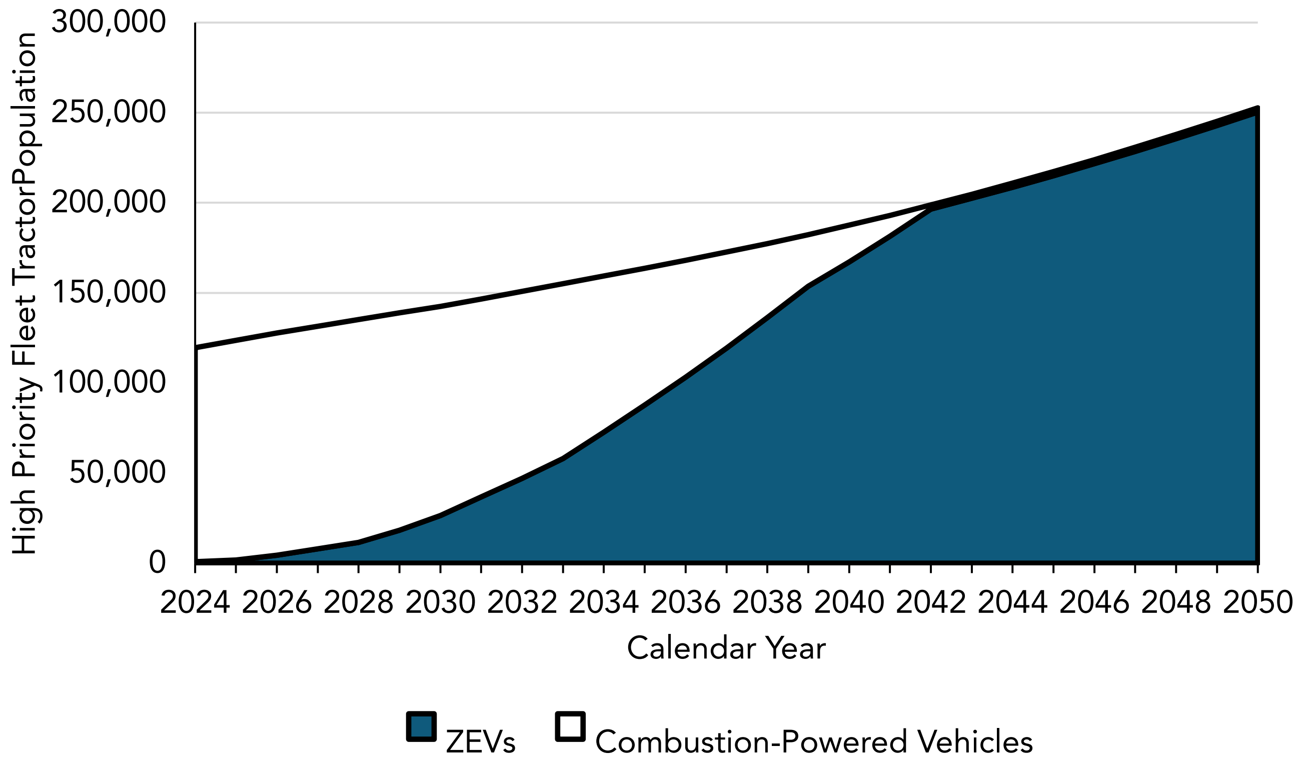
Fleet owners would have the flexibility to meet the ZEV milestones with any medium- or heavy-duty ZEVs in their fleet regardless of body type. For example, a mixed fleet with 100 box trucks and 40-day cab tractors would need 10 ZEVs to comply in 2025. The number of ZEVs required to meet the 2025 target is calculated as 10 percent of the 100 box trucks in this example. The tractors are not counted in 2025 because there is no ZEV target for day cab tractors in that year. However, fleet owners would have the flexibility to meet the 10 ZEV requirement with any combination of medium- and heavy-duty vehicles in the fleet. This means the fleet owner could meet the 2025 requirement with 10 ZEV tractors, 10 box trucks, or any combination that totals 10 ZEVs. Figure 8 illustrates the number of ZEVs this example fleet must have within their fleet to meet the ZEV Milestones Option.

Figure 8: ZEV Milestones Option Fleet Example with 100 Group 1 Vehicles and 40 Group 2 Vehicles



On these timelines, the majority of tractors that go to warehouses and transport products throughout the state would be ZEVs by 2035 and completely transition by 2042 as shown in Figure 9. This would result in direct health benefits to communities most impacted by warehouses, distribution centers, and high traffic corridors.

Figure 9: Tractor Population Over Time for High Priority and Federal Fleets



The proposed ACF regulation also includes exemptions and extensions for the ZEV Milestones Option to address certain situations as summarized below.

- Backup Vehicle Exemption. Allows fleet owners to exclude a vehicle from the ZEV milestone calculation if it operates less than 1,000 miles per year excluding any mileage accrued while operating in support of a declared emergency event.
- Daily Usage Exemption. Fleet owners may receive a one-year exemption to purchase a new ICE vehicle and exclude it from the ZEV milestone calculation if a new ZEV is available but cannot be placed anywhere in the California fleet while meeting the daily usage needs of any existing vehicle in the fleet.
- Infrastructure Construction Delay Extension. This extension applies to construction delays for ZE infrastructure that are beyond the fleet owners' control that were started at least one year ahead of the next ZEV compliance deadline. It allows the fleet owner to delay delivery of ordered ZEVs and count the existing ICE vehicle to be replaced as a ZEV when determining compliance with the ZEV milestone calculation until the ZEV is delivered.
- Vehicle Delivery Delay Extension. Fleet owners may count a vehicle to be replaced as a ZEV when determining compliance with the ZEV milestone calculation if a new ZEV is ordered one year in advance of the compliance date for the ICE vehicle being replaced and the newly purchased ZEV is not delivered by the compliance deadline for reasons beyond the fleet owner's control.
- ZEV Unavailability Exemption. Allows a fleet owner to purchase a new ICE vehicle and exclude it from the ZEV milestone calculation if all the remaining ICE vehicles in the fleet (that are not already using an exemption or extension) cannot be replaced with a ZEV or NZEV of the needed configuration because they are not available to purchase.

Additionally, if the remaining ICE vehicles in the fleet cannot be replaced with a ZEV or NZEV of the needed configuration because they are not available to purchase, those ICE vehicles may be excluded from the ZEV milestone calculation.

- Exemptions Pursuant to Declared Emergency Events. Fleet owners may purchase a new ICE vehicle and exclude it from the ZEV milestone calculation for up to 25 percent of the fleet if the vehicles are needed to provide emergency response services.
- Rental Vehicle Provision. Provides interstate rental fleet owners the options to report the average number of rental vehicles that are operated in California in lieu of counting all rental vehicles that operate in California when using the ZEV Milestones Option.

Beginning in 2024, affected fleets would need to report and keep records on certain information about the vehicles they operate or control in California. Reported vehicle information includes details necessary to enforce and track compliance with the proposed ACF regulation. The exact regulatory language, and purpose and rationale for these provisions as they apply to high priority and federal fleets are provided in Appendix A-2 and Appendix H-2 of the Staff Report, respectively. Annual reporting and recordkeeping would be required starting January 1, 2024.

c) Selecting the Appropriate Compliance Method

Both compliance options offer potential benefits for a given fleet situation. The Model Year Schedule ensures fleets can use their vehicles for their full useful life, is simple to understand, but it treats all existing vehicles the same based on age and mileage. This compliance method may present challenges for fleets, with high turnover rates (such as long-haul fleets), fleets with most vehicles already beyond their useful life, and would limit the ability of controlling parties to manage their fleet. With the Model Year Schedule, a control party cannot add or switch to another subhauler as part of their California fleet starting 2024 unless all of the vehicles in the newly added subhauler's fleet are ZEVs. The Model Year Schedule allows for a gradual transition to ZEV based on a percentage of the total California fleet regardless of vehicle age and mileage. The schedule more closely aligns projected ZEV feasibility and infrastructure buildout with the compliance requirements. The ZEV Milestones Option provides more flexibility for controlling parties to add and remove vehicles from the California fleet provided the fleet average continues to be met.

Figure 10 and Figure 11 illustrate two examples comparing the Model Year Schedule and optional ZEV Milestones Option. For a fleet with only Group 1 vehicles, they are able to keep their existing vehicles longer by using Model Year Schedule if they intend to keep all of their vehicles for the full useful life. For a mixed fleet with Group 1, Group 2, and Group 3 vehicles, the ZEV Milestones Option generally allows the fleet more time to transition to ZEVs while maintaining their normal vehicle purchase cycles because Group 2 and Group 3 vehicles have a delayed transition period.

Figure 10: Comparison Between Model Year Schedule and ZEV Milestones Option for a Fleet with 100 Group 1 Vehicles

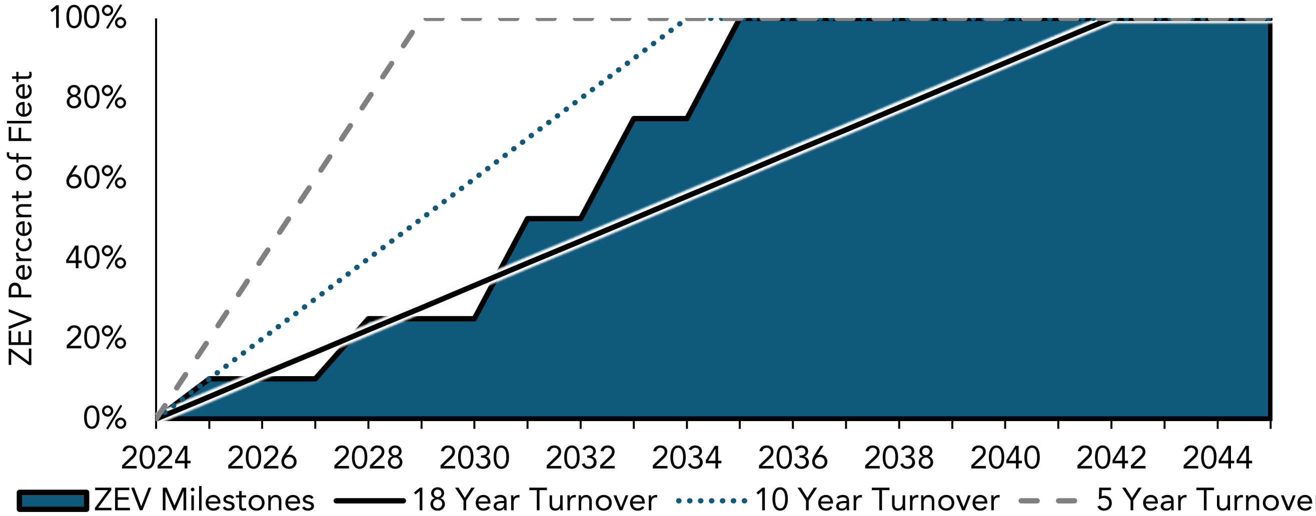
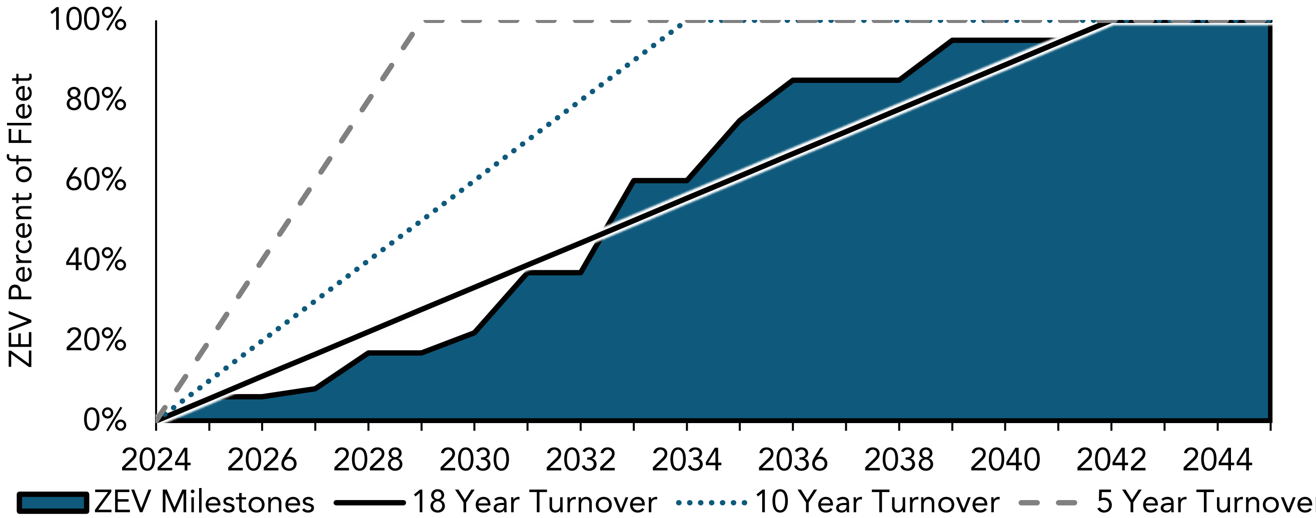


Figure 11: Comparison Between Model Year Schedule and ZEV Milestones Option for a Fleet with 60 Group 1, 20 Group 2, and 20 Group 3 Vehicles



d) Light-Duty Package Delivery Vehicles

The population of package delivery vehicles is expected to grow rapidly with expanding e-commerce deliveries. The inclusion of light-duty delivery vehicles in the high priority and federal fleets requirements is necessary to ensure emissions reductions in this last mile delivery operations. In general, package and mail delivery fleets are well-suited for electrification because they primarily return to base daily, they operate on fixed or predictable routes in cities and neighborhoods, and have frequent stops. Several major delivery companies have begun the process of incorporating ZE light-duty package delivery vehicles into their fleets with 100,000 ordered by Amazon, 10,000 ordered by UPS, 4,500 ordered by Walmart, 500 ordered by FedEx, and over 10,000 ordered by the U.S Postal

Service for placement throughout the United States.[50,51,52,53,54] These strides towards electrification demonstrate clear operational and technological feasibility for integration into fleet applications. The proposed ACF regulation includes flexibility for fleets to make an orderly transition to ZEVs by selecting the compliance method and includes provisions to ensure feasibility of deploying ZEVs where they are suited.

4. 100 Percent Manufacturer Sales Requirement

Finally, the proposed ACF regulation would include a new requirement on all vehicle manufacturers that 100 percent of all new Class 2b-8 vehicle sales in California must be ZEV starting in 2040. The requirement would not apply to emergency vehicles. The exact regulatory language, and purpose and rationale for these requirements are provided in Appendix A-4 and Appendix H-4 of the Staff Report, respectively.

B. Crossover with Other Requirements

CARB is responsible for protecting the public from the harmful effects of air pollution and developing programs and actions to fight climate change. Meeting these public health goals has resulted in a suite of regulations to control the harmful emissions of various air pollutants emitted from the operation of medium- and heavy-duty ICE vehicles. The following is a summary of existing regulations and key requirements that apply to fleets that would be affected by the proposed ACF regulation including existing laws.

1. Public Agencies and Utilities Regulation

In 2005, the rule for On-Road Heavy-Duty Diesel-Fueled Public and Utility Fleets was approved by CARB to reduce diesel PM emissions from fleet vehicles operated by public agencies and utilities.[55] The rule required affected owners to equip their heavy-duty vehicles with Best Available Control Technology (BACT) by December 31, 2012, with later

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[50] Amazon, *Amazon's custom electric delivery vehicles are starting to hit the road*, February 3, 2021 (web link: https://www.aboutamazon.com/news/transportation/amazons-custom-electric-delivery-vehicles-are-starting-to-hit-the-road, last accessed August 2022).

[51] United Parcel Service, *UPS invests in Arrival, accelerates fleet electrification with a commitment to purchase up to 10,000 electric vehicles*, January 29, 2020 (web link: https://about.ups.com/ca/en/newsroom/press-releases/sustainable-services/ups-invests-in-arrival-accelerates-fleet-electrification-with-order-of-10-000-electric-delivery-vehicles.html, last accessed August 2022).

[52] Walmart, *Walmart To Purchase 4,500 Canoo Electric Delivery Vehicles To Be Used for Last Mile Deliveries in Support of Its Growing eCommerce Business*, July 12, 2022 (web link: https://corporate.walmart.com/newsroom/2022/07/12/walmart-to-purchase-4-500-canoo-electric-delivery-vehicles-to-be-used-for-last-mile-deliveries-in-support-of-its-growing-ecommerce-business, last accessed August 2022).

[53] FedEx, *Charging Ahead: FedEx Receives First All-Electric, Zero-Tailpipe Emissions Delivery Vehicles from BrightDrop*, December 17, 2021, (web link: https://newsroom.fedex.com/newsroom/brightdropev600/, last accessed August 2022).

[54] United States Postal Service, *USPS Places Order for 50,000 Next Generation Delivery Vehicles; 10,019 To Be Electric, March 24, 2022* (web link: https://about.usps.com/newsroom/national-releases/2022/0324-usps-places-order-for-next-gen-delivery-vehicles-to-be-electric.htm, last accessed August 2022).

[55] The On-Road Heavy-Duty Diesel-Fueled Public and Utility Fleet regulation is comprised of Cal. Code Regs., tit. 13, sections 2022 and 2022.1.

requirements for designated low-population counties. Many of the same parties would be included in the proposed ACF regulation.

2. Drayage Truck Regulation

In 2007, the Drayage Truck regulation was adopted as part of CARB's efforts to reduce PM and NOx emissions from diesel-fueled engines, improve air quality associated with freight movement, and reduce near-source health risk from facilities where drayage trucks congregate.[56] Drayage trucks are on-road, heavy-duty trucks that transport containerized bulk or break-bulk goods, empty containers, and chassis to and from seaports and intermodal railyards. The Drayage Truck regulation will sunset at the end of 2022. At that time, the drayage fleet will be incorporated into the Truck and Bus regulation and must meet or exceed 2010 or newer engine emissions standards like all other diesel trucks. Drayage trucks would be included in the proposed ACF regulation.

3. Truck and Bus Regulation

In 2008, the Truck and Bus regulation was adopted by CARB as the final prong of the Diesel Risk Reduction Plan to reduce emissions of PM and NOx from heavy-duty trucks and buses over 14,000 lbs. GVWR.[57] The Truck and Bus regulation affects all vehicles travelling in California that are owned or operated by businesses, individuals, or federal entities. It requires retrofit, replacement, or repowering of older diesel vehicles, eventually ensuring that all affected vehicles meet or exceed 2010 or newer MY engine emissions by January 1, 2023. Federal fleets and a subset of fleets affected by the Truck and Bus regulation would be included in the proposed ACF regulation. Staff estimate that 36,900 California registered trucks and up to 192,000 trucks registered in other states will need to be upgraded to 2010 or newer MY engines by the end of 2023.[58]

4. Innovative Clean Transit Regulation

In December 2018, the ICT regulation was adopted by CARB which was the first medium- and heavy-duty ZEV fleet rule of its kind and it replaced the existing fleet rule for transit agencies. The ICT regulation requires all public transit agencies to gradually transition to a 100 percent zero-emission bus (ZEB) fleet where most will be ZE by 2040. The ICT regulation includes various exemptions and compliance options to provide safeguards and flexibility for transit agencies through the transition. The proposed ACF regulation would include some of the same public agencies that are subject to the ICT regulation if they also operate vehicles that are not transit buses such as a city that provides road maintenance or waste hauling services. The proposed ACF regulation builds upon the structure of the ICT purchase requirements for State and local government fleets.

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[56] The Drayage Truck regulation is comprised of Cal. Code Regs., tit. 13, section 2027.
[57] The Truck and Bus regulation is comprised of Cal. Code Regs., tit. 13, section 2025.
[58] California Air Resources Board, *Truck and Bus Regulation Final Compliance Deadline*, 2022 (web link: https://ww2.arb.ca.gov/sites/default/files/2022-06/tbcompliancedeadline_ADA.pdf, last accessed August 2022).

5. Zero-Emission Airport Shuttle Bus Regulation

In June 2019, the ASB regulation was adopted by CARB. It promotes the development and use of ZE technologies in medium- and heavy-duty airport shuttles that operate on fixed routes at 13 California airports.[59] The ASB regulation requires airport shuttle operators to transition their vehicles to ZEVs beginning in 2027, with a complete transition by the end of 2035. The ASB regulation provides compliance extensions and other flexibilities to ensure service continuity as operators transition to ZE shuttles. The proposed ACF regulation could include some fleet operators that are also subject to the ASB regulation.

6. California and Federal Phase 2 Greenhouse Gas Regulation

CARB staff worked jointly with U.S. EPA and National Highway Traffic Safety Administration staff on the next phase of federal GHG emissions standards and fuel efficiency standards, respectively, for medium- and heavy-duty engines and vehicles. The federal Phase 2 GHG emissions standards build on the Phase 1 GHG emissions standards and represent significant further GHG reductions for 2018 (2021 in California) and later MY heavy-duty vehicles.[60] The Phase 2 GHG emissions standards are structured to provide a range of options to manufacturers to reduce emissions for medium- and heavy-duty vehicles using a wide range of technologies, including aerodynamics, more efficient engines, and others. Additionally, the Phase 2 GHG emissions standards provide an opportunity to average, bank, and trade credits, as well as recognize advanced technologies that would apply to plug-in hybrid electric vehicles (PHEV), all-electric vehicles, and FCEVs. In 2018, CARB adopted the California Phase 2 program, which generally aligns with the federal Phase 2 GHG standards with minor changes.[61] The existing California Phase 2 GHG regulation provides an incentive to build lower emitting GHG vehicles, but these regulations have no specific requirement for medium- and heavy-duty manufacturers to build ZEVs. There are some synergies in costs and emissions benefits between California Phase 2 GHG and the proposed ACF regulation, because ZEVs could be used to comply with both regulations. The California Phase 2 GHG regulation also includes a temporary credit multiplier for ZEVs through 2027.

7. Advanced Clean Trucks Regulation

In January 2021, the ACT regulation was adopted as part of a holistic approach to accelerate a large-scale ZEV transition of medium- and heavy-duty vehicles.[62] Like the proposed ACF regulation, the goal of the ACT regulation is to achieve NOx and GHG emissions reductions through advanced clean technology, and to increase the penetration of the first wave of ZE heavy-duty technology into applications that are well suited to its use. The ACT regulation has two components consisting of a manufacturer sales requirement and a one-time large entity reporting (LER) requirement for fleet owners.

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[59] The ASB regulation is comprised of Cal. Code Regs., tit. 17, sections 95690.1 to 95690.8.

[60] The federal Phase 2 GHG regulations are comprised of Title 40, Code of Federal Regulations, Parts 85, 86, 600, 1033, 1036, 1037, 1039, 1065, 1066, and 1068) (81 Federal Register 73478 (October 25, 2016).

[61] The California Phase 2 GHG regulation is comprised of Cal. Code Regs., tit. 13, sections 1956.8, 1961.2, 1965, 2036, 2037, 2065, 2112, and 2141, and tit. 17, sections 95300 to 95311, 95662 and 95663.

[62]The ACT regulation is comprised of California Code of Regulations (Cal. Code Regs.) title 13, sections 1963, 1963.1, 1963.2, 1963.3, 1963.4, 1963.5, 2012, 2012.1, and 2012.2.

The manufacturer sales requirement applies to manufacturers that certify incomplete chassis or complete vehicles greater than 8,500 lbs. GVWR (i.e., Class 2b-8). Manufacturers are required to sell ZEVs as a percentage of their annual total sales. By 2035, required ZEV sales percentages will be as follows: 55 percent of Class 2b–3 truck sales, 75 percent of Class 4–8 truck sales, and 40 percent of tractor sales. Compliance is based on a credit and deficit system and provides some flexibility for manufacturers to sell more ZEVs in one weight category and fewer in another; credits may also be banked and traded. Small manufacturers with fewer than 500 annual sales in California are exempt but may opt-in to the regulation and report to claim ZEV credits.

Beginning in 2021, manufacturer sales reporting commenced to demonstrate compliance, earn credits, and to report details about credit trade transactions. ACT reporting applied to any vehicle manufacturer that produced and delivered for sale more than 500 on-road vehicles with a GVWR over 8,500 lbs. into California or into any state that adopted the ACT regulation. Manufacturers that produce vehicles below the 500-vehicle threshold have the option to voluntarily report to generate ZEV credits and NZEV credits.

The other component of the ACT regulation is the one-time LER requirement. Large entities (fleet owners, businesses, government agencies, municipalities, brokers, etc.) had to report information about their vehicles if, in 2019, they operated a facility in California and met any of the following criteria:

- Had more than $50 million in revenues in the 2019 tax year from all related subsidiaries, subdivisions, or branches, and have at least 1 vehicle that operated in California;
- Owned 50 or more vehicles that operated in California in 2019;
- Dispatched 50 or more vehicles into or throughout California in 2019; or
- Government agencies (federal, State, local, and municipalities) with at least 1 vehicle in California in 2019.

LER reporting was completed in 2021 and results of the data collected are posted on the *LER webpage*. Information collected through the survey was used to assist CARB in developing policies and recommendations, such as the proposed ACF regulation, to accelerate the transition to ZE medium- and heavy-duty vehicle fleets. The proposed ACF regulation seeks to align its requirements as closely as possible with the ACT regulation.

8. Heavy-Duty Omnibus Regulation

In September 2021, the Heavy-Duty Omnibus regulation was adopted by CARB which requires manufacturers to comply with more stringent exhaust emissions standards, test procedures, and other emissions control requirements for 2024 MY and newer California certified heavy-duty engines.[63] The combined requirements will reduce real world in-use emissions, and key elements of the regulation include:

[63]The Omnibus regulation is comprised of Cal. Code Regs., title 13, sections 1900, 1956.8, 1961.2, 1965, 1968.2, 1971.1, 1971.5, 2035, 2036, 2111 through 2119, 2121, 2123, 2125 through 2131, 2133, 2137, 2139, 2139.5, 2140 through 2149, 2166, 2166.1, 2167 through 2170, 2423, and 2485; and Cal. Code Regs., tit. 17 sections 95662 and 95663.

- Lowering NOx and PM emissions standards on existing regulatory cycles as well as a new NOx standard on a new low-load certification cycle, such that NOx standards are about 75 percent below current standards beginning in 2024 and 90 percent below current standards in 2027;
- Revamping the heavy-duty in-use testing program;
- Improving warranty, useful life, and emissions warranty information and reporting requirements;
- Strengthening the heavy-duty durability demonstration program;
- Improving the emissions averaging, banking, and trading program; and
- Creating powertrain certification test procedures for heavy-duty hybrid vehicles.

The Heavy-Duty Omnibus regulation provides emissions credits to manufacturers that certify the cleaner engines to a specific set of emissions standards. In addition, the Heavy-Duty Omnibus regulation provides an allowance for heavy-duty ZEVs to generate temporary NOx credits (2022 MY to 2026 MY) in order to incentivize the development, production, and sales of heavy-duty ZEVs in the California market. New diesel, compressed natural gas (CNG), and other engines sold in California will need to meet the compliance requirements of the Heavy-Duty Omnibus regulation and manufacturers may average, bank, and trade emissions credits for the pool of engines sold each MY. Fleets to be included in the proposed ACF regulation would be the same that purchase combustion vehicles impacted by the Heavy-Duty Omnibus regulation.

9. Transport Refrigeration Unit Regulation

In February 2022, CARB approved amendments to achieve additional health risk and emissions reductions in the regulation titled Airborne Toxic Control Measure for In-Use Diesel-Fueled Transport Refrigeration Units (TRU), TRU Generator Sets, and Facilities Where TRUs Operate.[64] The amendments include the transition of diesel-powered truck TRUs to ZE, a PM emission standard for newly manufactured non-truck TRU engines, the use of lower global warming potential refrigerants, facility registration and reporting, expanded TRU reporting and labeling, and fees. Some fleets affected by the TRU regulation would also be affected by the proposed ACF regulation.

10. Advanced Clean Cars Regulation

The Advanced Clean Cars (ACC) I regulation combines the control of smog-causing criteria pollutants and GHG emissions into a single coordinated package of light-duty vehicle regulations: the Low-Emission Vehicle regulation for criteria and GHG emissions and a technology forcing regulation for ZEVs that contributes to both types of emissions reductions.[65] The ACC I regulations were adopted in 2012 to address MY 2015-2025. The draft proposed ACC II regulations would increase ZEV sales requirements for MYs 2026-

[64] The TRU regulation is comprised of Cal. Code Regs., tit.13, sections 2477 through 2477.24.
[65] The ACC1 regulation is comprised of Cal. Code Regs. tit. 13, sections 1900, 1956.8, 1960.1, 1961, 1961.4, 1962.1 through 1962.8, 1965, 1968.2, 1968.5, 1969, 1976, 1978, 2037, 2038, 2062, 2112, 2139, 2140, 2145, 2147, 2235, and 2317.

2035.[66] ZE light-duty delivery vehicles that are required to be purchased by high priority fleets earn credit under the ACC I regulation as well as the upcoming ACC II regulation. The ACT regulation is similar to the ACC manufacturer sales requirements but for medium- and heavy- duty ZEV. The scope of the high priority and federal fleet requirements of the proposed ACF regulation would include light-duty delivery vehicles, that are subject to the ZEV sales requirements of the ACC II regulations (rather than ACT) because of their weight class. These requirements ensure manufacturers sell ZE light-duty delivery vehicles and fleets purchase them.

11. Zero-Emission Vehicle Purchases Required by Assembly Bill 739

In October 2017, California's Governor signed AB 739, which requires heavy-duty ZEV purchases by State agencies.[67] Beginning in 2025, at least 15 percent of new vehicle purchases with a GVWR of more than 19,000 lbs. must be ZEVs and at least 30 percent of such purchases must be ZEVs beginning in 2030. These same agencies would be affected by the proposed ACF regulation, and ZEVs purchased could be used to comply with both the proposed requirements and AB 739 requirements. The sales to comply with the legislation are already reflected in the BAU Baseline.

12. Heavy-Duty Inspection and Maintenance Regulation

The Heavy-Duty Inspection and Maintenance (HD I/M) regulation was approved by the Board in December 2021 to control emissions more effectively from non-gasoline on-road heavy-duty vehicles with a GVWR greater than 14,000 lbs. operating in California.[68] The regulation requires affected heavy-duty vehicles to perform periodic emissions testing twice a year to show compliance at specified intervals to ensure that the emissions control systems maintain the same efficiency as the vehicle ages. Not yet finalized, the regulation's requirements would be implemented in 3 phases with initial compliance certificate requirements beginning in 2023 and periodic testing requirements beginning in January 2024. Fleets to be included in the proposed ACF regulation would be the same that deploy vehicles subject to the HD I/M regulation.

C. Crossover with Funding Programs

CARB's incentive and regulatory programs work together to accelerate the market for ZEVs. California's Climate Change Scoping Plan and SIP Strategy, the State's blueprints for meeting climate change goals and the health-based NAAQS, call for emissions reductions from both regulations and incentives and recognize the importance of each. Financial incentives primarily support early commercialization and market development prior to regulatory requirements. Incentives help to drive early adopter purchase decisions by reducing

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[66] The rulemaking action for the proposed ACC II regulation is not yet complete. The proposed ACC II regulation would be comprised of Cal. Code Regs., tit. 13, sections 1900, 1961.2 through 1961.8, 1962.2, 1962.3, 1965, 1968.2, 1969, 1976, 1978, 2037, 2038, 2112, 2139, 2140, 2147, 2317, and 2903.

[67] AB 739 (Chau, Stats. 2017, ch. 639); Public Resources Code section 25722.11.

[68] The rulemaking action for the HD I/M regulation has not yet been completed; the proposed HD I/M regulation is comprised of Cal. Code Regs., tit. 13, sections 2193, 2195, 2195.6, 2196 through 2196.8, 2197 through 2197.3, and 2198 through 2199.1.

incremental costs and supporting vehicle cost reductions over time by building manufacturer economies of scale. Incentives for vehicles and infrastructure are critical, particularly in the early market development years and to help smaller fleets and owner-operators. As regulatory requirements approach, the incentive strategy shifts toward a focus on financial assistance for smaller fleets, often in DACs, that are challenged to qualify for traditional financing programs. For some incentive programs where the primary objective is achieving surplus emissions benefits, limited incentives are available while regulations are in effect unless the upgrade or purchase is beyond the minimum requirements of the regulations. California continues to dedicate increasing levels of financial resources to reduce criteria and climate pollutant emissions from the transportation sector. The State allocates billions of dollars annually to a multitude of programs with different, but complementary goals. CARB's incentives portfolio places an emphasis on technology advancement, deployment of ZE heavy-duty vehicles, and turning over the legacy fleet. These efforts to incentivize new technologies complement CARB's regulatory efforts that ensure these technologies are deployed in strategic and impactful ways that support the State's climate and low carbon transportation goals.

Incentives play a critical role supporting the State's climate change, air quality, ZE deployment, and petroleum reduction goals. They accelerate the transition of fleets to ZE as well as support equitable, community-driven clean transportation and multi-sector approaches. Incentives promote economic growth, job training, and apprenticeship opportunities and continue to build on the successes of previous investments.

CARB's incentive and investment programs work together. There is a natural progression of support for technologies starting in the precommercial demonstration phase all the way through to financing assistance for small businesses who are unable to qualify for conventional financing for cleaner trucks. As technologies become more established and demand continues to grow, CARB is beginning to shift from broad purchase incentives to more targeted strategies that support lower-income consumers and small fleets. CARB anticipates this shift will continue to accelerate in the coming years, helping to create an equitable transition to a clean transportation future. To date, 56 percent of CARB's Low Carbon Transportation funding has supported projects benefiting priority populations. For some heavy-duty solicitations, all of the projects benefit priority populations. Projects include pilots of large-scale deployments of ZE drayage trucks, deployments of ZE transit and school buses in urban and rural settings, and projects to support ZE technologies at freight facilities.

1. CARB's Zero-Emission Truck Incentives

CARB administers a portfolio of funding that improves air quality, enhances community protection, and reduces GHG emissions. Each of these programs have their own distinct goals that support the State's broader strategy and vison of a ZE economy. Details are provided below for each funding programs/projects. Additionally, CARB has conducted focused programs or initiatives aimed to promote certain vehicle types or sectors. While some of these funding programs/projects do or can fund buses (including transit and school buses), there are additional programs/projects which provide incentive funding only for buses. Another example includes refuse vehicles. Refuse vehicles operate within communities, and their impacts are felt particularly strongly by communities located near waste transfer stations, therefore emissions reductions from these vehicles would be directly beneficial. There are ZE refuse vehicles available from several manufacturers.[69] The route length and duty cycle of refuse vehicles make this sector well primed for electrification. ZE refuse vehicles are relatively new to the market, but well-suited for it, and are poised to benefit from additional incentives in this early stage. In recognition of this, CARB is beginning an initiative to encourage agencies to purchase ZE refuse vehicles by providing higher incentives in advance of this regulatory program.

2. Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project

SB 1403 guides CARB's heavy-duty vehicle investments funded with Cap-and-Trade auction proceeds, and extended the California Clean Truck, Bus, and Off-Road Vehicle and Equipment Technology Program created under SB 1204.[70,71] Funding allocations are subject to appropriations by the Legislature, and Board approval of the annual Funding Plan for Clean Transportation Incentives. Historically, most funding for ZE trucks has been provided through the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP), which began in 2009. Since its inception in 2010, HVIP has allocated more than $700 million to support the purchase of 3,4000 ZE trucks, and nearly 2,400 ZEBs which have similar components and technology as trucks. An additional $10 million through HVIP has been allocated to charging infrastructure for these trucks and buses. These numbers are as of June 2022. Response for HVIP voucher funding, especially in the last few years, has been so large that funding is often completely reserved within a few days and sometimes within a few hours. When this occurs, the program must close to applicants until new funding becomes available and the program can reopen, which at times has been more than 1 year. HVIP reopened March 30, 2022, for funding from 2021-22 fiscal year (FY), with $430 million available for voucher funding. More than 60 percent of the funding was requested the first day. As ZE technologies gain market acceptance, HVIP is shifting to focus on small and medium fleets that operate in DACs.

Within HVIP, the upcoming Innovative Small e-Fleets Project is a new pilot project that will provide incentives for ZE trucks geared towards small and disadvantaged fleets using innovative mechanisms such as flexible leases, peer to peer truck sharing, truck as a service, individual owner planning assistance and more. Lessons learned from this pilot are expected to influence future funding policies geared toward supporting smaller disadvantaged fleets.

3. Carl Moyer Program

The Carl Moyer Memorial Air Quality Standards Attainment Program is a grant program that funds the incremental cost of cleaner-than-required engines, equipment, and other sources of air pollution. The Carl Moyer Program complements California's regulatory program by providing incentives to obtain early or extra emissions reductions, including from emission sources in minority and low-income communities and areas disproportionately impacted by

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[69] California HVIP, ZE Refuse vehicles available in HVIP, 2022 (web link: https://californiahvip.org/vehicle-category/refuse/, last accessed August 2022).
[70] SB 1403 (Lara, Stats. 2018, ch. 370). Health and Safety Code Section 39719.2.
[71] SB 1204 (Lara, Stats. 2014 Ch. 524). Health and Safety Code Section 39719.2.

air pollution. The program is currently authorized at $130 million for FY 2022-2023 from smog abatement and tire fees.

The Carl Moyer Program has been successfully implemented through the cooperative efforts of CARB and California's air pollution control and air quality management districts (air districts). Emissions reductions resulting from the Carl Moyer Program are critical for enabling CARB and the air districts to fulfill their obligations under the SIP, to attain State and federal health-based air quality standards and to reduce exposure to toxic air pollutants. The Health and Safety Code section 44275 et seq. directs CARB to oversee the program by managing and distributing funds; developing and revising guidelines, protocols, and criteria for covered vehicle projects; and determining methodologies to evaluate project cost-effectiveness. Air districts follow the Board-approved Guidelines to select, fund, and monitor specific clean air projects in their areas, providing grants to public and private entities for the incremental cost of cleaner-than-required engines and/or equipment. The Board approved changes to the Carl Moyer Program in November 2021 to better support the electrification of the on-road heavy-duty sector in general, including an increase in the cost-effectiveness limit and funding caps for these cleaner vehicles.[72] The Board also streamlined the Carl Moyer Program to better ensure program participation and provide more funding opportunities for on-road heavy-duty electrification. In April 2022, the Carl Moyer Program increased eligible zero-emission on-road heavy-duty options, including expanding engine model year eligibility and providing additional flexibilities. In addition, in April 2022, the Incentive Program Advisory Group (IPAG) was convened to provide a public process to further accelerate equity work and zero-emission heavy-duty vehicle adoption, specifically for small fleets within the Carl Moyer Program and its On-Road Heavy-Duty Voucher Incentive Program (VIP).

4. Community Air Protection Program

The Legislature has appropriated Greenhouse Gas Reduction Fund moneys annually since 2017 for incentives supporting the Community Air Protection Program, established through AB 617.[73] The initial appropriation of Community Air Protection Program incentives included legislative direction to fund on-road heavy-duty projects pursuant to the Carl Moyer Program (see above) and the Proposition 1B Goods Movement Emission Reduction program, with a broad focus on zero-emission technologies and priority populations.[74] Legislative direction in subsequent appropriations expanded funding options to include zero-emission medium- and heavy-duty vehicle charging infrastructure (also handled through the Carl Moyer Program), new incentives to address stationary sources of pollution, and new incentives to address strategies identified in air district Community Emissions Reductions Programs created

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[72] California Air Resources Board, *Carl Moyer Program*, 2022 (web link: https://ww2.arb.ca.gov/resources/fact-sheets/carl-moyer-program, last access August 2022).

[73] AB 617 (C. Garcia, Stats. 2017 ch. 136). Health and Safety Code Sections new sections 39607.1, 40920.6, 40920.8, 42411, 42705.5,44391.2, amendments to sections 42400, 42402.

[74] California Air Resources Board, *Proposition 1B: Goods Movement Emission Reduction Program*, 2022 (web link: https://ww2.arb.ca.gov/our-work/programs/proposition-1b-goods-movement-emission-reduction-program, last accessed August 2022).

pursuant to AB 617.[75] The program is currently authorized at $250 million for FY 2021-2022 from the Greenhouse Gas Reduction Fund.

5. Volkswagen Environmental Mitigation Trust

The Volkswagen Environmental Mitigation Trust and the resulting Beneficiary Mitigation Plan for California includes $90 million for ZE Class 8 freight and port drayage trucks, with a maximum incentive of up to $200,000 per truck. The first statewide installment of $27 million has been allocated, and the remaining $63 million will be available beginning in late 2022 or early 2023. The Beneficiary Mitigation Plan contains the eligible mitigation actions, or project funding categories, that CARB will fund from the State's $423 million allocation of the Volkswagen Environmental Mitigation Trust.

6. Truck Loan Assistance Program

Launched in 2009, the Truck Loan Assistance Program utilizes Air Quality Improvement Program (AQIP) funds to help small-business fleet owners, affected by CARB's In-Use Truck and Bus Regulation, to secure financing for upgrading their fleets with newer trucks.[76] The program is implemented in partnership with the California Pollution Control Financing Authority through its California Capital Access Program and leverages public funding with private funding from participating lending institutions. The program is available for small fleets with 10 or fewer trucks at the time of application. It creates financing opportunities for truck owners, who fall below conventional lending criteria and are unable to qualify for traditional financing at reasonable rates, giving them an opportunity to improve their credit rating and build their business. Lenders use their traditional underwriting standards to establish loan terms; however, the program currently includes an interest rate cap of 20 percent. About $187 million in Truck Loan Assistance Program funding had been expended to small-business truckers to help purchase more than 36,000 cleaner trucks.

7. CARB and California Energy Commission Joint Solicitation

In late 2020 CARB and CEC issued the joint solicitation "Zero-Emission Drayage Truck and Infrastructure Pilot Project". The funding available for the original solicitation was $44.1 million. As part of the FY 2021 22 allocation, the Legislature also provided $40 million to CARB and $25 million to CEC to fund all remaining eligible zero-emission drayage truck and infrastructure projects that were received during the joint solicitation release.

8. Complementary California Incentives for Zero-Emission Infrastructure

CARB regularly coordinates with CEC, GO-Biz, CPUC, and the California State Transportation Agency. Additionally, the programs are complemented by local air district programs, as well as actions taken by other local government entities to support a sector-wide low carbon

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[75] California Air Resources Board, *Community Air Protection Program Communities*, 2022 (web link: https://ww2.arb.ca.gov/capp-communities, last accessed August 2022).
[76] California Air Resources Board, *Truck Loan Assistance Program*, 2022 (web link: https://ww2.arb.ca.gov/our-work/programs/truck-loan-assistance-program, last accessed August 2022).

heavy-duty vehicle and off-road technology transition. CARB coordinates closely with CEC to ensure that vehicle investments are complemented by investments in infrastructure. Each program has its own statutory and policy direction, but collectively they fit together to support California's multiple public health, air quality, and climate change goals.

In October 2015, California adopted SB 350, the Clean Energy and Pollution Reduction Act, which established GHG reduction targets and requires CPUC to direct the 6 IOUs in the state to "accelerate widespread transportation electrification (TE)."[77] The resulting programs developed by the electric utilities due to SB 350 from CPUC Decisions of 2018 and 2019, for which $740 million has been authorized, promote the deployment of medium- and heavy-duty ZEVs through incentivizing infrastructure upgrade projects that offset most or all the costs for electrical service upgrades. Additionally, CPUC IOU programs from that time forward have the intent to meet SB 350 goals, even when not called out directly. As shown in Table 7, this amounts to $1.8 billion supporting light-, medium-, and heavy-duty (on-road and off-road) charging infrastructure development, including direct current fast charging. CARB coordinates with CPUC for electric utility infrastructure upgrades to accommodate TE.

Table 7: Authorized Funding for Utility Electric Vehicle Programs

Year	Program Description	Funding
2016	SCE's Charge Ready Pilot	$22M
	SDG&E's Power Your Drive	$45M
	PG&E's EV Charge Network	$130M
2018	SCE's Charge Ready Bridge	$22M
	SB 350 Small IOU Programs	$7.6M
	SB 350 Priority Review Pilots	$42.8M
2019	SB 350 Standard Review Projects	$615M
	PG&E's EV Empower	$4M
	SDG&E's Power Your Drive Fleets Program and Vehicle-to-Grid School Bus Pilot	$109.13M
2020	AB 1082/1083 Schools, Parks & Beaches	$54.5M
	SCE's Charge Ready 2	$436M
	SB 676 Vehicle Grid Integration Pilots	$38.7M
2021	SDG&E's Power Your Drive Extension	$43.5M
	Transportation Electrification Framework Near-Term Priorities	$240M

Finally, CEC recently launched the EnergIIZE program, which provides incentives for fueling infrastructure to support battery-electric and fuel cell commercial vehicles.[78] EnergIIZE is part

[77] SB 350 (De León, Stats. 2015, ch. 547). Health and Safety Code new section 44258.5. Labor Code new sections 25302.2 and 25327. Public Utilities Code section new sections 237.5, 400, 454.51, 454.52, 454.55, 454.56, 9621, and 9622. Amendments to Labor Code sections 1720, 25310, and 25943; amendments to Public Utilities Code 337, 352, 359, 359.5, 365.2, 366.3, 399.4, 399.11,399.12,399.13, 399.15, 399.16, 399.18, 399.21, 399.30, 701.1,740.8,740.12, 9505, and 9620.

[78] California Energy Commission, *Energy Commission Announces Nation's First Incentive Project for Zero-Emission Truck and Bus Infrastructure*, 2021 (web link: https://www.energy.ca.gov/news/2021-04/energy-commission-announces-nations-first-incentive-project-zero-emission-truck, last accessed August 2022).

of CEC's FY2020-2023 Clean Transportation Investment Plan to invest $129.8 million in medium- and heavy-duty ZEV infrastructure by 2023.[79]

9. State Budget and Future Funding Availability

The ZEV budget package for FY 2021-22 included $3.9 billion dollars to multiple State agencies over 3 FYs to build on the investments in ZEVs and ZEV infrastructure the State has made over the past decade. The investments are designed to accelerate an equitable ZEV transition in both the light- and heavy-duty sectors. The budget also included initial funding commitments for 1,150 ZE drayage trucks, 1,000 ZE transit buses, and 1,000 ZE school buses, along with corresponding infrastructure, over 3 FYs, which provides strong incentives for early adopters, complementing CARB's regulations. The ZEV budget package for FY 2021-22 includes the nearly $570 allocated to HVIP as described above.

California's Budget Act for this fiscal year (FY 2022-23) appropriates funding for the ZE transformation. This fiscal year's budget includes $6.1 billion over 5 years to accelerate the State's transition to ZEVs.[80] The ZEV package builds on last year's $3.9 billion over 3 years ($1.8 billion in 2021-22), for a total of $10 billion. This is applied across a wide variety of sectors including light-, medium-, and heavy-duty vehicles, maritime, aviation, rail, and other off-road applications, as well as the necessary infrastructure and charging stations. The $3.9 billion includes approximately $1.2 billion to CEC to support infrastructure and ZEV manufacturing grants, in addition to other State agencies for categories such as the ZEV Market Development Strategy and to demonstrate and deploy ZEBs and rail equipment and infrastructure.

D. Background on Existing Trucks

This section describes the diverse array of on-road vehicles typically used by fleets operating in California that would be subject to the proposed ACF regulation. It includes an overview of affected vehicle classes, vehicle descriptions, manufacturing practices, as well as an overview of vehicle populations and characteristics.

1. Overview of Truck Classifications and Manufacturing

Medium- and heavy-duty trucks operate throughout California in numerous vocations and are an essential part of the State's economy. On-road vehicles are grouped by their GVWR, which is the manufacturer's rated weight capacity of the vehicle and ranges from Class 1-8. Class 1-2a are considered light-duty vehicles and have a GVWR at or under 8,500 lbs. Class 2b-8 are vehicles with a GVWR over 8,500 lbs. and are considered medium- and heavy-duty vehicles. Under California regulations, heavy-duty vehicles are those vehicles with a gross vehicle weight rating (GVWR) greater than 8,500 pounds, while medium-duty vehicles are a

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[79] California Energy Commission, *CEC Approves $384 Million Plan to Accelerate Zero-Emission Transportation*, 2020 (web link: https://www.energy.ca.gov/news/2020-10/cec-approves-384-million-plan-accelerate-zero-emission-transportation, last accessed August 2022).

[80] State Of California, *California State Budget FY 2022-23*v, 2022 (weblink: https://www.ebudget.ca.gov/FullBudgetSummary.pdf, last accessed August 2022).

subcategory of heavy-duty vehicles with a GVWR between 8,500 and 14,000 pounds. [81,82] Table 8 shows the weight classifications as defined by the U.S. Department of Transportation.[83]

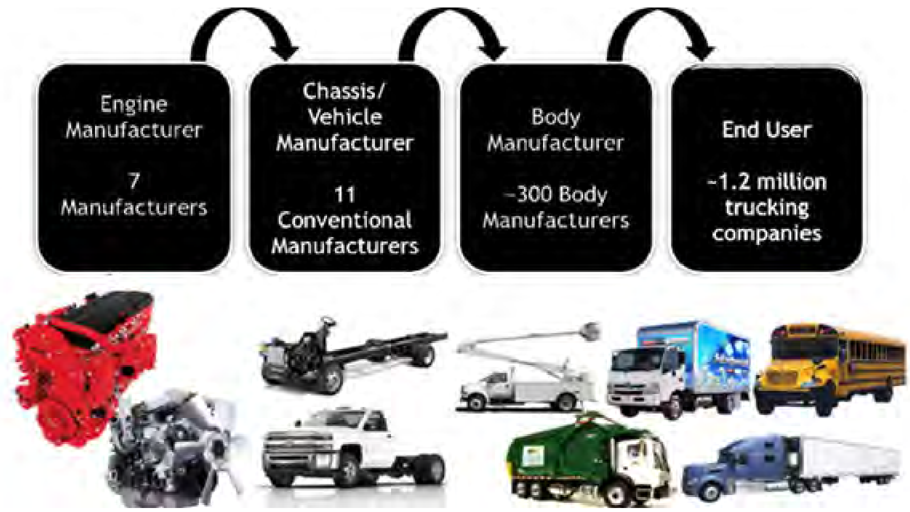
Table 8. Truck Weight Classifications (lbs.)

Category	Lower Weight	Upper Weight
Class 1	0	6,000
Class 2a	6,001	8,500
Class 2b	8,501	10,000
Class 3	10,001	14,000
Class 4	14,001	16,000
Class 5	16,001	19,500
Class 6	19,501	26,000
Class 7	26,001	33,000
Class 8	33,001	80,000 and up

Light-duty vehicles are typically manufactured as complete vehicles delivered from the factory. Medium- and heavy-duty vehicles can be produced as a complete vehicle or through multiple stages of assembly by multiple manufacturers. A truck tractor, or semi-truck, is produced as a complete vehicle and is designed primarily for the purpose of pulling trailers. Vocational trucks, however, originate as a cab-and-chassis which is typically fitted with a body and will be finished into one of many final configurations depending on use. Examples include box trucks, construction trucks, dump trucks, refuse trucks, and school buses. The majority of Class 4-8 (and some Class 3) vehicles, excluding tractors, are built by one or more manufacturers that are not vertically integrated, which means the manufacturer that produces the drivetrain and chassis likely does not produce the body. The incomplete chassis is built out, or upfitted, to the final configuration. Figure 12 illustrates the fragmented nature of the typical truck manufacturing process.

[81] Cal. Code Regs. tit. 13, section 1900(b)(6).
[82] Cal. Code Regs. tit. 13, section 1900(b)(13).
[83] Advanced Fuels Data Center, *Vehicle Weight Classes & Categories*, 2012 (web link: https://afdc.energy.gov/data/10380, last accessed August 2022).

Figure 12: Typical Truck Manufacturing Process

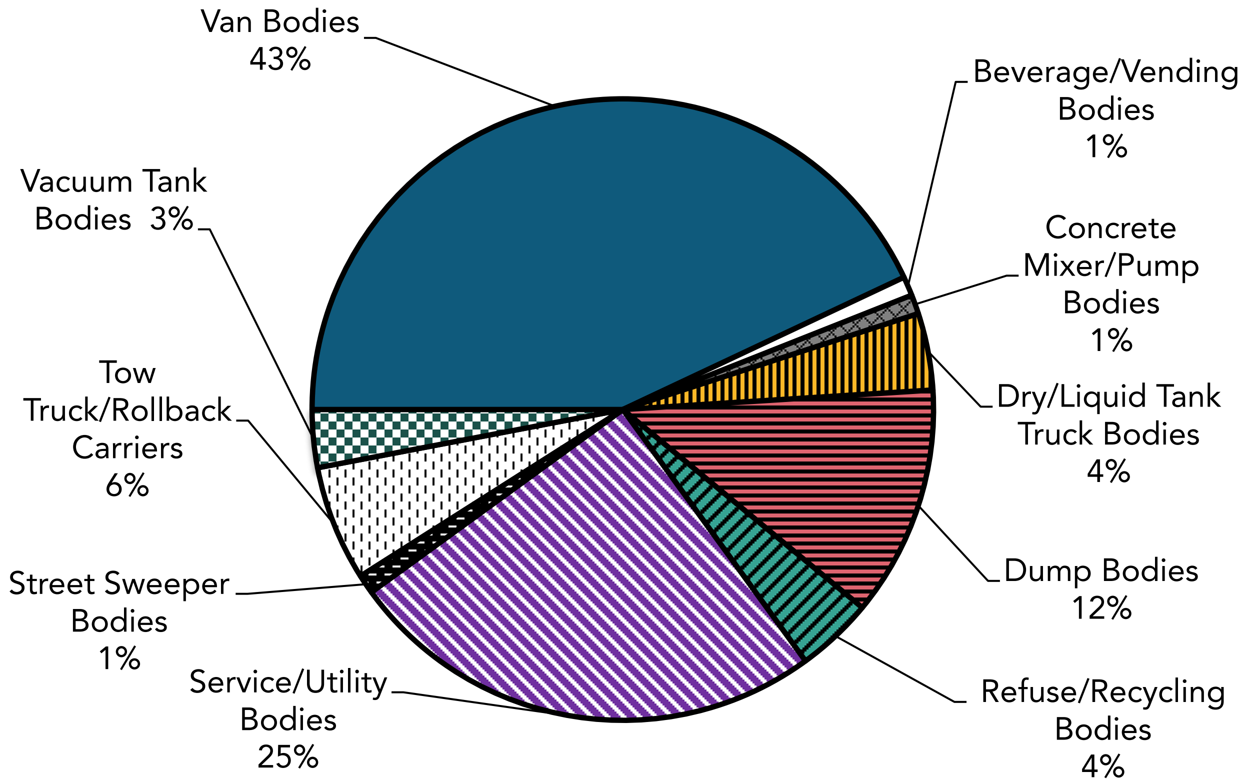


All Class 2 and most Class 3 medium-duty trucks and vans are manufactured as complete vehicles with fully integrated bodies. Full-size vans, chassis cabs and cutaways, and heavy-duty pickup trucks comprise most of the Class 2b sales. Examples of full-size vans include the Ford Transit, Mercedes Sprinter, and Chevrolet Express, and examples of heavy-duty pickup trucks include the Ford F-250 and RAM 2500. Class 3 includes the same types as Class 2b with a higher payload, but also includes a higher fraction of incomplete vehicles and stripped chassis vehicles (with a frame and engine but has no cab or body) that often become walk-in vans and box trucks with final assembly by a body manufacturer.

Class 4-8 trucks mainly function in vocational applications as urban delivery vehicles, work site trucks, and numerous other fields. The majority of these trucks are manufactured in segments and not in a vertically integrated process. For instance, vocational vehicle manufacturers such as Hino, Navistar, Ford, and General Motors (GM) produce the powertrain and chassis of the vehicles in a vertically integrated process, but do not produce or assemble the final body to the vehicle.

Vocational trucks can be configured as a flatbed, box truck, a passenger shuttle or a wide range of other configurations. The body elements are manufactured by a variety of companies and assembled based on the specifications of the end user for the primary intended function of the vehicle. Thus, the number and types of vocational bodies are highly varied. Figure 13 shows the market share by body type in 2011 for vocational trucks and does not include tractors.

Figure 13: Vocational Truck Body Types by Market Share 2011



There are over 280 individual body manufacturers engaged in the production of truck bodies in North America. The industry is highly disaggregated with hundreds of small body manufacturers competing in the same market as large national body manufacturers. Most body manufacturers produce less than 1,000 body units annually, with 74 percent manufacturing less than 500 body units annually.[84]

Class 7-8 tractors are typically manufactured as complete vehicles, though like most heavy-duty trucks, are assembled as custom orders and with parts from a variety of suppliers, which can often be mixed and matched for a given truck model depending on the customer needs. Several manufacturers supply their own engines, but also accept engines from other manufacturers.[85]

Ten major original equipment manufacturers (OEM) and their subsidiaries make up the majority of Class 2b-8 vehicles sold in the United States. Figure 14 breaks down the ten major manufacturers and shows which vehicles they produce by each weight class. These major manufacturers have largely been absent from the ZEV market until recently. Manufacturers have dedicated more resources towards ZEV technologies in part due to upcoming requirements such as the ACT regulation. Many of these manufacturers have announced plans or have already released commercial ZEVs.

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[84] SpecialtyResearch.net, Truck Body Manufacturing in North America, 2018 (web link: https://www.specialtyresearch.net/, last accessed August 2022).
[85] Oak Ridge National Laboratory, *2016 Vehicle Technologies Market Report*, 2017 (web link: https://tedb.ornl.gov/wp-content/uploads/2019/04/2016_Vehicle_Technologies_Market_Report.pdf, last accessed August 2022).

Figure 14: Truck and Engine Manufacturers by Class

	Class 2b	Class 3	Class 4	Class 5	Class 6	Class 7	Class 8
Nissan							
FCA							
Isuzu							
GM							
Ford							
Daimler							
Daimler Trucks							
Navistar/International							
Hino							
Paccar							
Volvo							

In addition to the 10 major manufacturers listed above, there are more than 40 truck manufacturers developing and producing medium- and heavy-duty ZEVs. Figure 15 shows a list of all manufacturers that have ZEVs commercially available and the weight class of their products.

Figure 15: Zero-Emission Vehicle Manufacturers by Class

Manufacturer	Class 2a	Class 2b	Class 3	Class 4	Class 5	Class 6	Class 7	Class 8
Blue Bird							■	■
BYD Motors				■	■	■	■	■
Canoo		■	■					
EVTV			■	■				
Ford	■		■					
Freightliner						■	■	■
GILLIG								■
General Motors		■	■					
GreenPower Motor				■	■	■		■
Kenworth						■	■	■
Kalmar								■
Lightning eMotors			■	■	■	■		■
Lion						■	■	■
Lonestar SV								■
May Mobility					■	■		
Micro Bird				■	■			
Motiv Power Systems				■	■	■		
Navistar (IC Bus)						■	■	■
NFI Group (MCI)								■
Nikola Motors								■
Optimal EV				■				■
OrangeEV								■
Peterbilt							■	■
Phoenix Motorcars				■				■
Proterra								■
REV-Collins Bus					■	■		
Rivian		■	■					
ROUSH CleanTech						■		
SEA Electric				■	■	■	■	■
US Hybrid			■	■				■
Van Hool NV								■
Volvo							■	■
Workhorse			■					
XOS Trucks					■	■	■	■

2. Overview of Truck Configurations and Operating Characteristics

Trucks are differentiated and categorized by a number of factors, including physical features, operating characteristics, configurations, and the types of fleets they're utilized in. By identifying and distinguishing these factors, electrification suitability is more easily realized amongst vehicle types. This section illustrates a sampling of the vehicle types and categories that would be affected by the proposed ACF regulation and also incorporates a brief truck inventory and operation synopsis. Table 9 provides an illustration of the different truck types and configurations, by truck class, and is presented in four distinct truck groups.

Table 9: Illustration of Various Truck Configurations by Truck Class Affected by the Proposed ACF regulation

Class 1-2a	Class 2b-3	Class 4-8	Class 7-8 Tractors
 	   	  	  

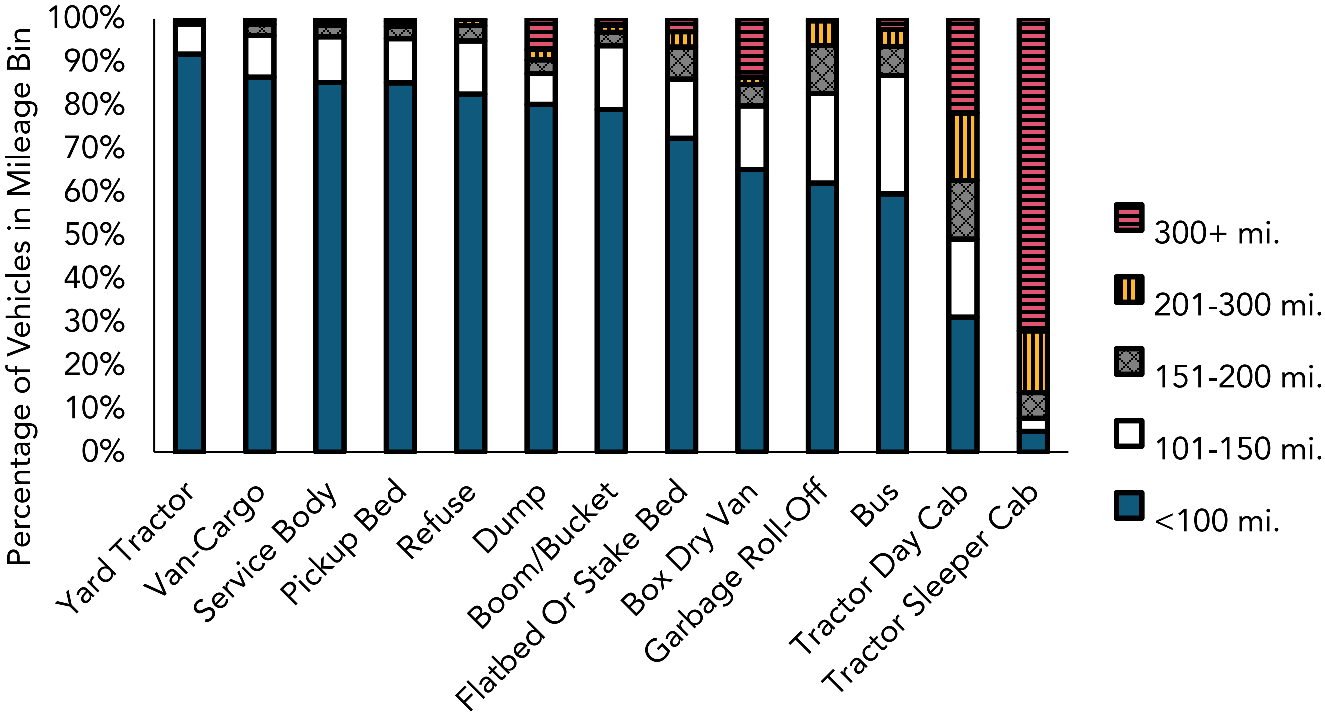
Each classification contains vehicle types with varying truck operating characteristics. Class 8, for example, contains truck tractors as well as an array of specialty vehicles that are designed for a specific job function. Their operating characteristics differ and are distinguished by a number of factors, including local vs long-haul application, stationary work capability, and utilitarian attributes. Truck configurations within these four groups tend to have relatively similar truck operating characteristics as these configurations suit the intended work function of the vehicle.

Collected by CARB in 2021, the LER data describes detailed fleet, vehicle life, operating, and facility characteristics of specific entities that met the required reporting criteria. In this section, the LER data illustrates population estimates and truck operating characteristics such as daily mileage of identified common vehicle types that fall under these classifications and whether they are regularly parked onsite at their respective facility.[86] These characteristics are quantified by the LER data for a sample of targeted vehicle populations in California.

[86] California Air Resources Board, *Large Entity Reporting Data*, 2021 (web link: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks/large-entity-reporting, last accessed August 2022).

Figure 16 demonstrates an overview of the estimated daily mileage percentages for the top ten vehicle types with the largest surveyed populations in the LER.[87]

Figure 16: Estimated Average Daily Mileages for Select Vehicle Categories in Large Entity Reporting



The following sections provide more detailed information on truck configurations and their operational characteristics within each of the four truck groups outlined in Table 9 above. This information is being presented because all trucks discussed below provide a sampling of the trucks that would be affected by the proposed ACF regulation.

3. Class 1-2a Light-Duty Parcel Delivery Vehicles

Light-duty delivery vehicles categorized under Class 1-2a are typically manufactured as complete vehicles delivered from the factory and are designed to transport goods directly to customers or businesses. The proposed ACF regulation would include light-duty vans used for mail and package delivery. Figure 17 provides examples of Class 1-2a light-duty parcel delivery vehicles.

[87] California Air Resources Board, *Large Entity Reporting Data*, 2021 (web link: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks/large-entity-reporting, last accessed August 2022).

Figure 17: Examples of Class 1-2a Light-Duty Parcel Delivery Vehicles

Light-duty package delivery vehicles are defined as having a GVWR less than 8,501 lbs. with enclosed cargo space equal to or greater than 100 cubic feet of that is used to deliver packages, parcels, or mail to the final destination from the last point of distribution.

These vehicles are small enough to traverse narrow city streets and traffic compared to larger trucks, which make them popular as delivery vehicles in metropolitan areas. Light-duty package delivery vehicles are frequently used for small package and post delivery services, most commonly part of delivery fleets such as Amazon and the U.S. Postal Service.

4. Class 2b-3 Pickup Trucks, Service Trucks, and Cargo/Delivery Vans

Class 2b-3 vehicles include larger pickup trucks, service trucks, small box trucks, cargo and delivery vans. They can carry increased payloads and towing, which are significant needs for many fleets that purchase these vehicles. Typical Class 2b-3 vehicles may include full-size pickup trucks and lower tier commercial trucks. Route and range needs are less predictable for pickup trucks in this category but are less of a concern for vans that are typically not purchased to tow loads.

a) Pickups and Service Trucks

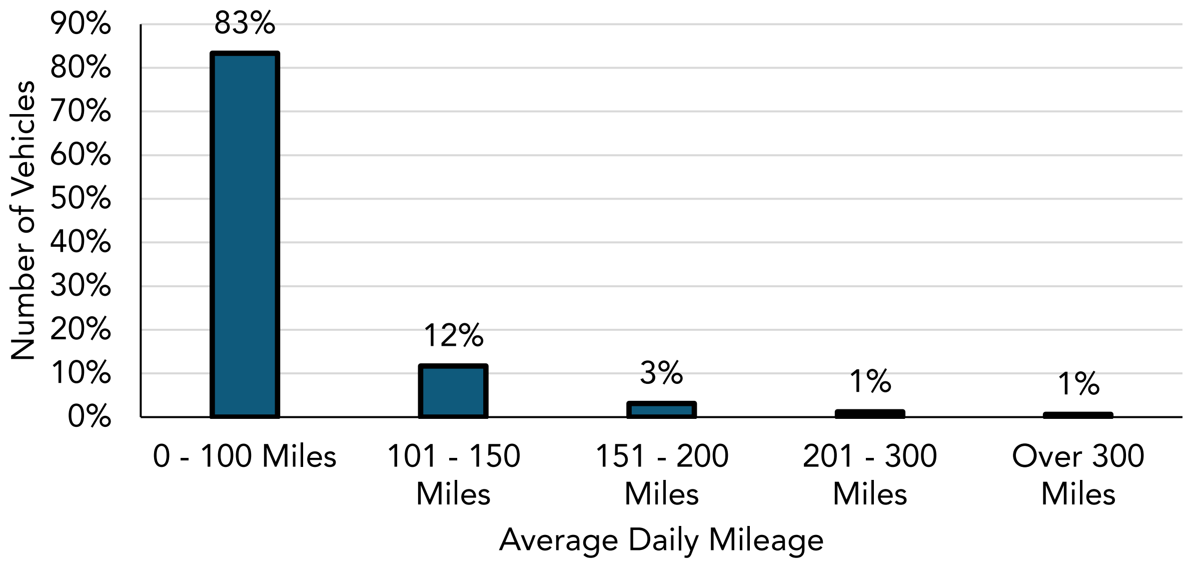
Pickups are light- and medium-duty vehicles characterized by their open bed. Service trucks are similar to pickups but have storage cabinets installed which offer more storage space and versatility to the fleet. Both vehicles are commonly equipped with towing hitches. Class 2b-3 pickups and service trucks are built with significantly higher towing and payload capacity than their light-duty counterparts. Many Class 2b-3 pickups are sold and used for personal use that would not be subject to the proposed ACF regulation until 2040. Figure 18 illustrates typical pickup and service trucks.

Figure 18: Typical Pickup and Service Trucks

These trucks are used by a variety of fleets including government, utility, commercial, and individual fleets. Pickups and service trucks are used for transporting passengers, towing, and hauling cargo, such as construction materials or waste for disposal. They are also commonly used to transport large goods, such as household appliances, and are favored by farmers, tradesmen, outdoor enthusiasts, and the like due to their versatility and capabilities for hauling equipment and tools.

Figure 19 illustrates the mileage distribution of pickup trucks in the LER data. Most notably, of the surveyed pickups, 83 percent drove an average of 100 miles or less daily. Additionally, 71 percent were regularly parked onsite at their respective facility at least 8 hours of the day.

Figure 19: Estimated Average Daily Mileage of Pickup and Service Trucks Surveyed in Large Entity Reporting



b) Cargo/Delivery Vans and Step Vans

Class 2b-3 delivery vans and trucks are designed to transport larger packages and goods directly to customers or other businesses and incorporate a variety of vehicle types, including full-size cargo vans and step vans. Parcel delivery vans such as those used by FedEx and UPS operate on regular routes with more than 100 stops per day and return to a depot at the end of the shift. Figure 20 shows an example of delivery and step vans.

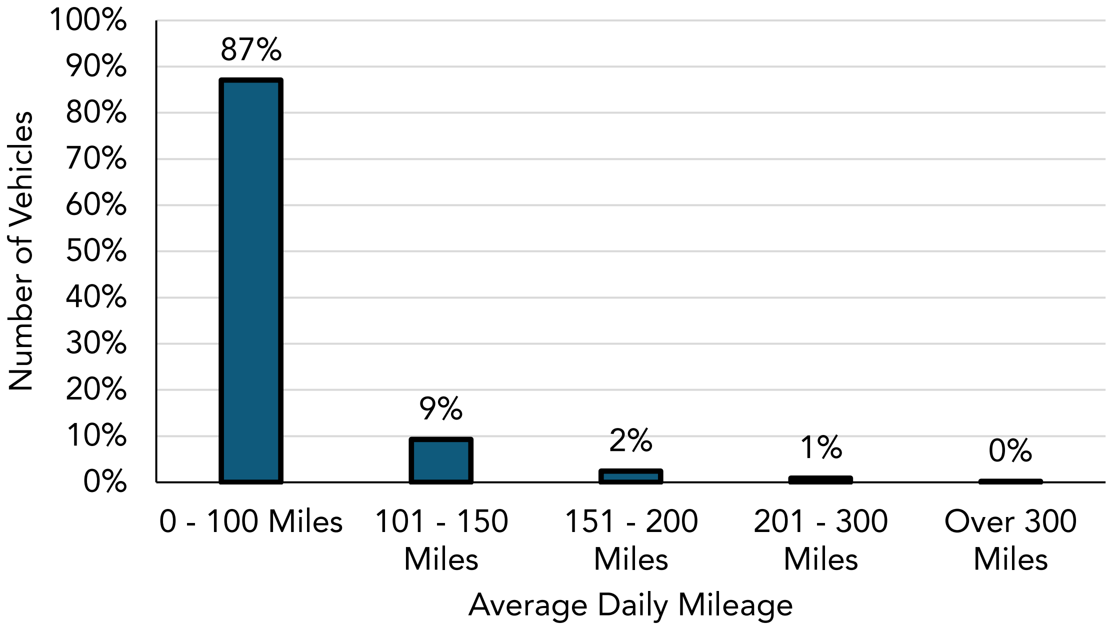
Figure 20: Example of Delivery and Step Vans

Cargo vans have a cargo area that can be accessed from the inside of the vehicle and commonly have a sliding side door and rear doors to load and unload cargo. Step vans are more rectangular in shape and are designed so the driver can easily enter the cargo area from inside the vehicle enabling frequent stops.

Generally, delivery vans and trucks are utilized in high priority and federal fleets as well as State and local government fleets to transport goods and for many businesses are the "last mile" delivery of goods in urban areas in the supply chain. Cargo vans are frequently used to transport household goods, tools and equipment, food or catering supplies, and more. Primarily used by non-public fleets, they are small enough to traverse narrow city streets and traffic compared to larger trucks, which make them popular as delivery vehicles in metropolitan areas. Step vans are frequently used for small package and parcel delivery services, most commonly part of delivery fleets such as Amazon, FedEx, and UPS.

Based on LER data, cargo and step vans account for approximately 4.5 percent of the surveyed vehicle types in the LER. Of the surveyed cargo and step vans, 87 percent drove an average of 100 or less miles daily, 10 percent drove an average of between 100 and 150 miles daily, 2 percent drove an average of between 150 and 200 miles daily and 1 percent drove an average of over 200 miles daily as shown in Figure 21. Additionally, about 63 percent were regularly parked onsite at their respective facility at least 8 hours of the day.

Figure 21: Estimated Average Daily Mileage of Cargo and Step Van Surveyed in Large Entity Reporting



5. Class 4-8 Vocational Trucks

Class 4-8 vocational trucks include a variety of vehicles purpose built to their application such as box trucks, refuse haulers, buses, and more. Many of these vehicles have operational characteristics that are more favorable for electrification, such as predictable routes, less concern regarding payload, short daily range needs, stop-and-go operations, and returning to a centralized location daily where they can be refueled. Additionally, vocational trucks, primarily service and boom trucks, are often used by State and local governments.

a) Box Trucks

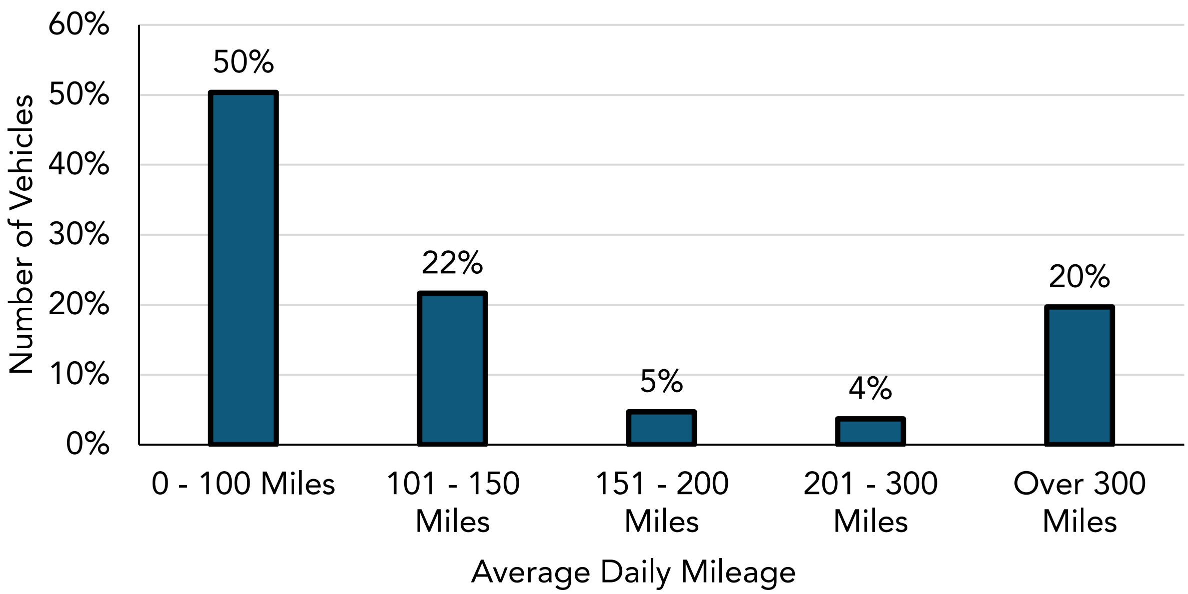
A box truck is a commercial vehicle wherein the box-shaped cargo area and cab are separated. The cargo box most commonly can only be accessed from the rear or side doors, as opposed to accessing it from the cab, which distinguishes box trucks from step or delivery vans. Common types of box trucks include reefers, box dry vans, and beverage trucks as shown in Figure 22.

Figure 22: Common Types of Box Trucks

Dry vans are another type of box truck in which the cargo box is not temperature-controlled and are used to haul dry goods, such as furniture, electronics, and non-perishable food. Reefer vans are another type of box truck that contain a temperature-controlled refrigerated cargo box with the purpose of hauling perishable goods, such as food, medicine, and cosmetics. Box dry vans are another type of box truck in which the cargo box is not temperature-controlled and are used to haul dry goods, such as furniture, electronics, and non-perishable food. Beverage trucks have a cargo box divided into bays for transport of various bottled beverages and are often refrigerated. Generally, box trucks are most widely deployed in urban areas, as their smaller size allow them to navigate narrower roads more easily compared to larger Class 8 vehicles.

Of the surveyed box trucks, 65 percent drove an average of 100 miles daily, 15 percent drove an average of 150 miles daily, 5 percent drove an average of 200 miles daily, and 15 percent drove an over an average of 200 miles daily. Additionally, 47 percent were regularly parked onsite at their respective facility at least 8 hours of the day. Figure 23 shows the estimated average daily miles of box trucks.

Figure 23: Estimated Average Daily Mileage of Box Trucks Surveyed in Large Entity Reporting



b) Vocational Trucks with Power Take-Off

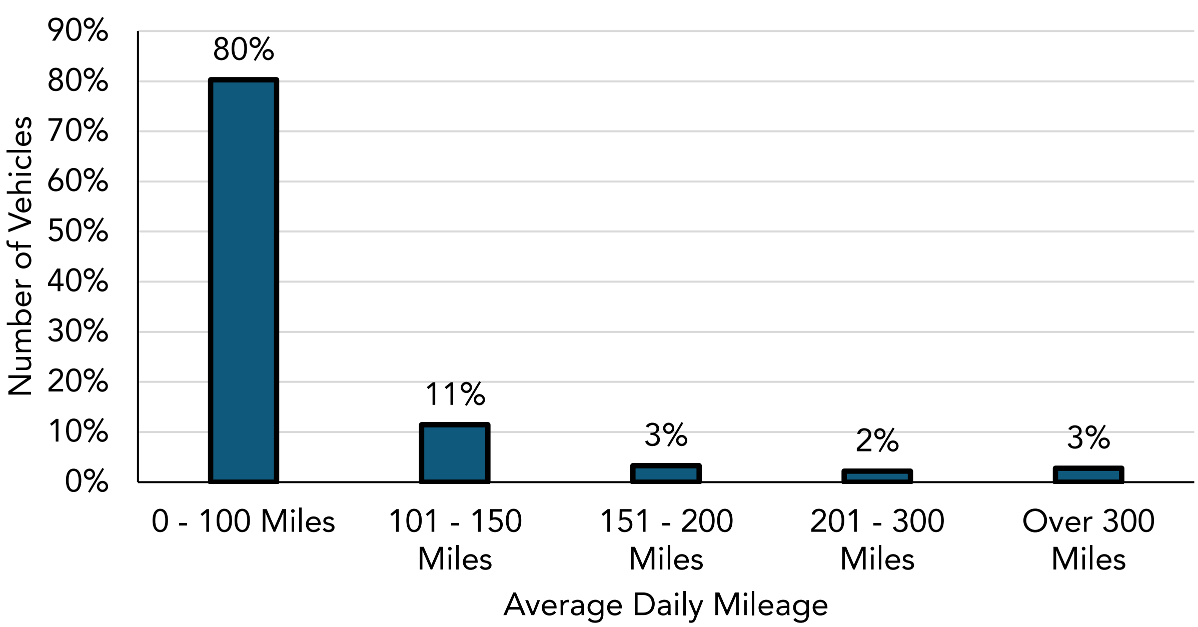
Vocational, or work, trucks are commonly built to handle a specific task or job, such as concrete mixing, dumping, sweeping, towing, etc. These trucks are often equipped with a power take-off (PTO) to operate auxiliary equipment and perform work while stationary. As shown in Figure 24, vocational trucks can use a PTO to tilt the bed or for lifting workers in a bucket.

Figure 24: Images of Trucks Equipped with a Power Take-Off

The most common types of PTO vocational vehicles are tow trucks and dump trucks, but this classification also incorporates cranes, concrete mixers, vacuum trucks, and more. For example, dump trucks consist of an open-box bed placed on the rear chassis and are operated by hydraulic lifts that dump waste at the rear through a hinged flap or door. Flatbed tow trucks utilize hydraulics to tilt the bed into a ramp and employ machine-powered winches that attach to a car and pull it onto the flatbed. Vehicles with service bodies or flatbeds are common types of non-PTO vocational trucks, but the category also extends to those with stake beds, utility beds, and more.

Of the trucks surveyed in the LER, 29 percent were identified as PTO and 71 percent were identified as non-PTO. As shown in Figure 25, 81 percent of these vehicles drove an average of 100 miles daily, 11 percent drove an average of 150 miles daily, 3 percent drove an average of 200 miles daily, and 5 percent drove an average of over 200 miles daily. Daily mileage alone, however, underrepresents the energy a PTO vehicle requires. Additionally, 73 percent were regularly parked onsite at their respective facility at least 8 hours of the day. Figure 25 shows the estimated daily mileages of vocational trucks in the LER.

Figure 25: Estimated Average Daily Mileage of Vocational Trucks Surveyed in Large Entity Reporting



c) Buses and Motorcoaches

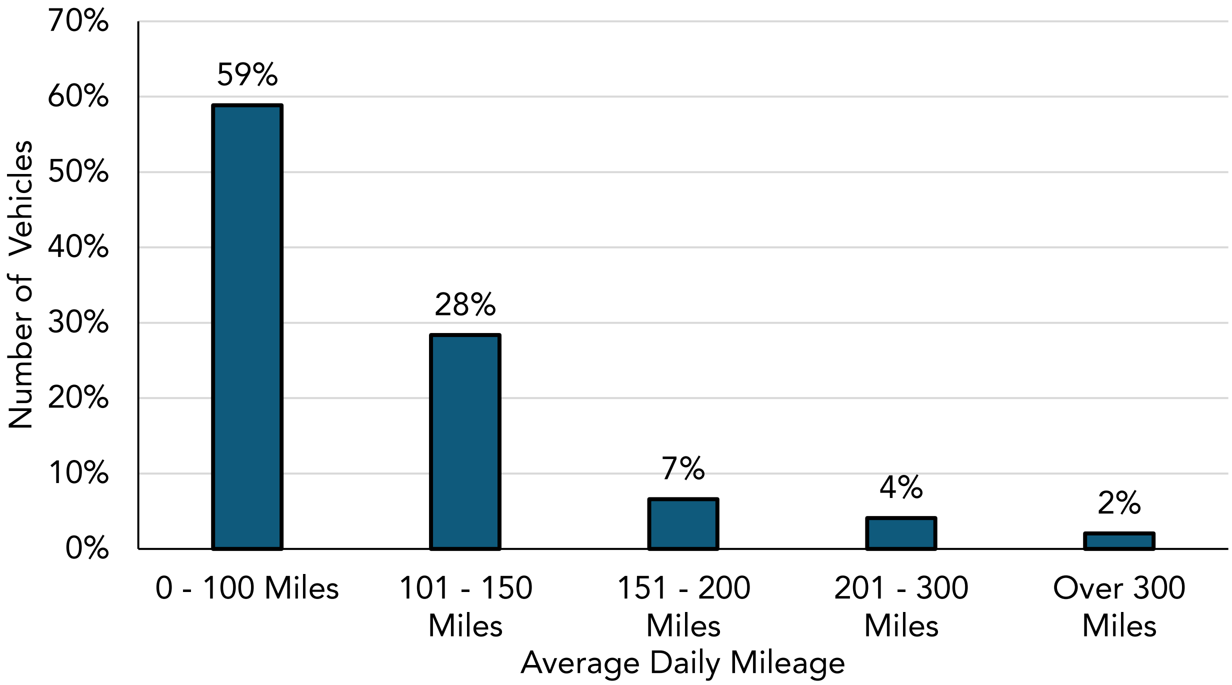
Buses range from Class 4-8 and are distinguished by their long bodies equipped with several seats or benches for passengers. Most buses range from 20-45 feet in length with some as long as 60 feet, and normally have multiple entry doors that are in the front, side, or back of the vehicle. Some have capacities as high as 300 passengers, but most usually carry between 30 and 100. There are different types of buses, such as motorcoaches and tourism buses, shown in Figure 26, with varying characteristics suited to their designated uses, but are often similar in shape and style.

Figure 26: Motorcoach and Tourism Buses

A motorcoach is a specific type of bus in which the differences in both use and travel distance distinguish it as a separate form of transportation compared to other buses. Motorcoaches are designed with an elevated passenger deck located over a baggage compartment and prioritize comfort on the interior, whereas other buses typically have more standing room to maximize passenger capacity. Buses primarily used for tourism or mass transportation can also have multiple decks. In general, buses are most widely used for transportation in urban areas, or to and from the suburbs to population centers in which they operate on fixed routes and multiple stops are taken. Motorcoaches are utilized for longer-distance travelling.

Of the surveyed buses, 59 percent drove an average of 100 miles daily, 28 percent drove an average of 150 miles daily, 7 percent drove an average of 200 miles daily, and 6 percent drove an average over 200 miles daily. Figure 27 illustrates the estimated average daily miles of buses from LER survey. Additionally, 87 percent were regularly parked onsite at their respective facility at least 8 hours of the day.

Figure 27: Estimated Average Daily Mileage of Buses Surveyed in Large Entity Reporting



d) Refuse Trucks

Refuse trucks are used for the collection and/or transport of solid waste. Common types of refuse vehicles include garbage front loaders, garbage packers, garbage roll-offs, and garbage side loaders. Some examples of battery electric models as shown in Figure 28.

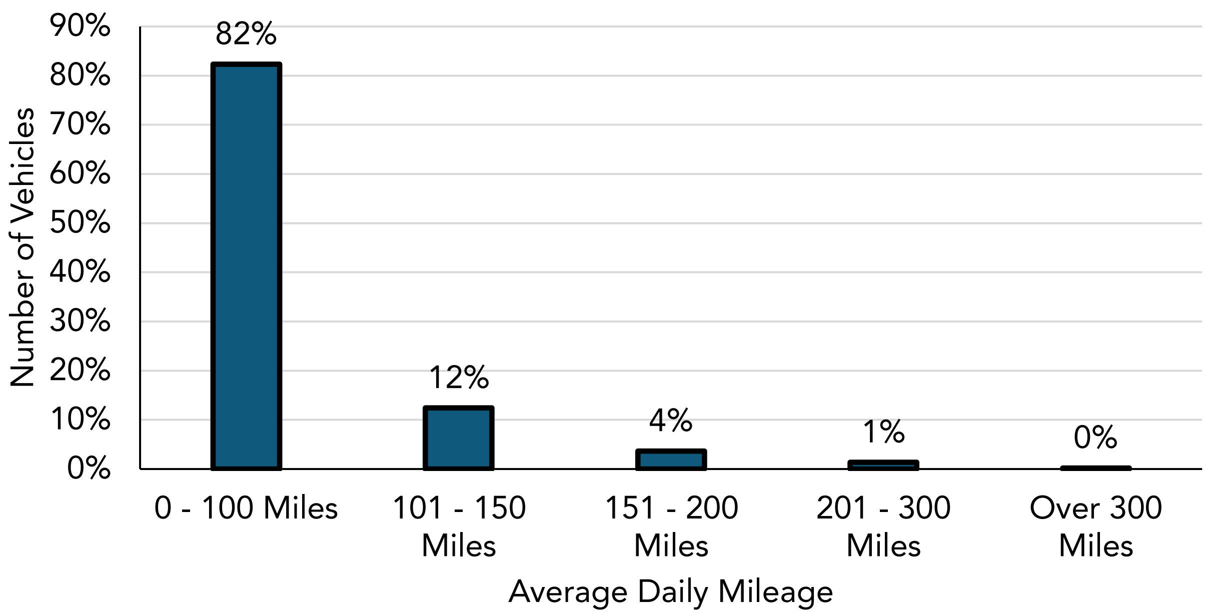
Figure 28: Example Refuse Vehicles

Garbage packers compact waste after it has been loaded into the hopper by a hydraulic moving wall that moves forwards and backwards to push the waste towards the rear of the vehicle. Garbage roll-offs transfer open top containers to local landfills and recycling centers through the use of a hydraulic bed that lifts up and down, which allows these containers to roll on and off the truck. Garbage side loaders load waste from the side of the vehicle either manually or through the use of a retractable and often articulated arm with a grappling hook or jaw that lifts and tips waste bins to empty waste into the hopper.

Refuse vehicles are generally used in the collection of residential and commercial solid waste for disposal by utilities. The route and area of service largely affects the type of refuse vehicle used. Garbage side loaders are most commonly used in residential areas for the removal of household waste. Garbage front loaders mainly collect waste from businesses that use dumpsters, typically from industrial and commercial properties, and garbage packers are deployed for both household and commercial waste removal. Additionally, due to the significant number of stops as part of the duty cycle, refuse vehicles have high energy use per mile.

Of the surveyed refuse vehicles, 83 percent drove an average of 100 miles daily, 12 percent drove an average of 150 miles daily, 4 percent drove an average of 200 miles daily, and 1 percent drove an average of over 200 miles daily as shown graphically in Figure 29. Additionally, 98 percent were regularly parked onsite at their respective facility at least 8 hours of the day

Figure 29: Estimated Average Daily Mileage of Refuse Trucks Surveyed in Large Entity Reporting



e) Specialty Trucks

There are a small number of specialty trucks that are larger than a typical vocational truck and built for a unique purpose. All specialty trucks are Class 8, usually have a heavy front axle, and are configured to perform work that can only be done while the vehicle is stationary. The auxiliary mechanism to perform this work is an integral part of the vehicle design. Examples of specialty vehicles include vehicles commonly known as vacuum trucks, digger derricks, and concrete pump trucks, but the category further extends to concrete mixers, heavy cranes, and more. Figure 30 shows an example of two types of specialty trucks: a vacuum truck (left) and a heavy-duty crane (right).

Figure 30: Specialty Truck Types

The body types of specialty vehicles vary significantly depending on the specific function they were designed for. For example, vacuum trucks feature a powerful pump that creates a vacuum inside the vehicle by removing the air from the holding tank, which allows for liquids and sludges to be drawn up. Digger derricks contain an auger powered by hydraulics that allow for large holes to be drilled into the ground and other surfaces or materials. Further, a concrete pump truck contains a hopper with an auger to churn concrete as well as a valve system that draws concrete from the hopper in intervals until it reaches the end of the concrete hose for dispersal.

Also part of the specialty truck category, two-engine vehicles are specially constructed Class 8 vehicles designed to be equipped with two engines integrated into the design of the vehicle to perform a specific function, which includes providing auxiliary power to attachments, performing special job functions, or providing additional motive power. These vehicles have unique duty cycles and low manufacturing volumes which are factors that make them unlikely candidates for early electrification or ZE conversion.

Specialty vehicles are primarily utilized in construction and for public works and maintenance projects. Concrete pumps and mixers primarily assist with road work and in concrete distribution in construction sites. Also mainly used in construction, cranes have the ability to transport heavy loads, machines, goods, and materials for various purposes. Digger derricks are commonly operated for electrical work, telephone pole installation, road work, and tree trimming. Other applications for specialty vehicles extend to sewer sanitation or storm drain cleaning, lifting and moving ships in shipyards, sample extraction from mineral deposits, and more.

6. Class 7-8 Truck Tractors

Categorized under Class 7-8, truck tractors, or tractors, are primarily designed for the purpose of pulling trailers and commonly have a single or tandem rear axle. They are a combination of a tractor unit and one or more semi-trailers, which attach through a hitch called a fifth wheel. Gross combination weights of these vehicles are typically up to 80,000 lbs. but can be higher depending on State law. Tractors are often characterized by hauling heavy loads with long and unpredictable routes, but increasingly more Class 8 vehicles are operated on short and predictable routes from centralized locations. Figure 31 shows common types of truck tractors include day cab tractors and sleeper cab tractors.

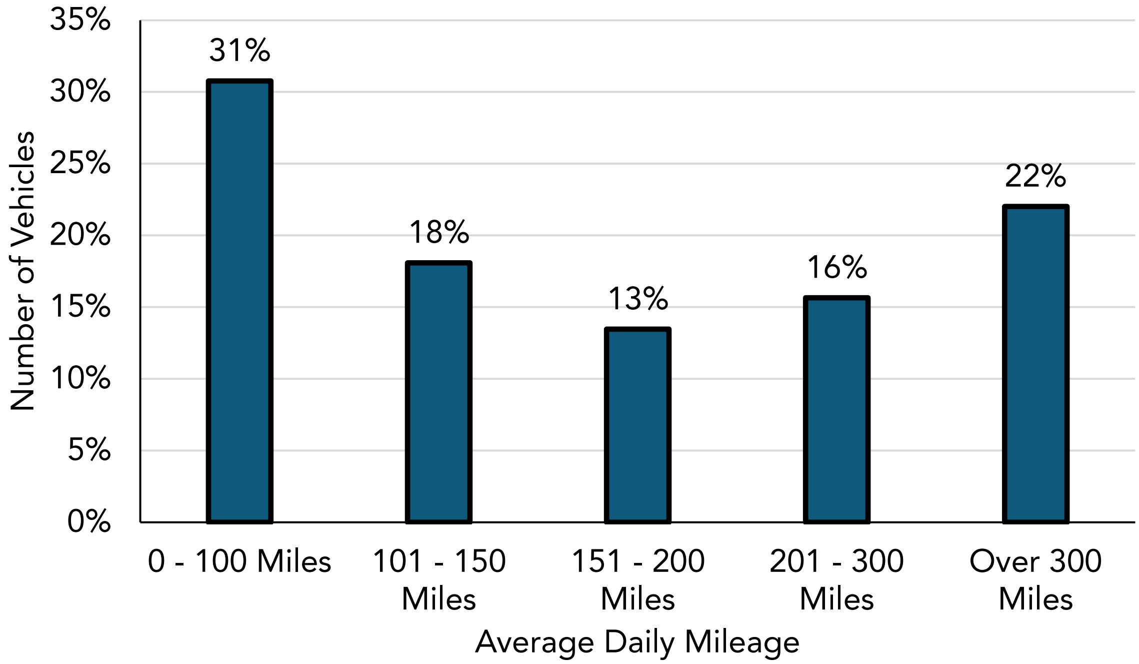
Figure 31: Common Types of Tractors

Used to transport trailers and equipment, tractors have large, high horsepower engines, heavy frame and axle construction, and a high-geared transmission. Depending on the climate and cargo, the large trailers pulled by the tractor unit vary in length, shape, and style, and may be heated, refrigerated, pressurized, or ventilated. Day cab tractors are on-road tractors without a berth designed for resting or sleeping at the back of the cab. These vehicles are deployed to haul large loads on short trips within the same day. Sleeper cab tractors are tractors with a berth designed for resting or sleeping at the back of the cab and are generally deployed in long-haul applications.

Typically, tractors are purchased new for use in both short- and long-haul operations and then high mileage tractors are commonly sold on the secondary market for regional or local operations after 4-6 years. Once in local service, annual mileage drops. Similarly, food and beverage delivery tractors typically use hub-and-spoke operations and do not travel long distances each day, returning to a home base at the end of the shift. In the early ZE market transition staff expect these vehicles to be used in short-distance operations where infrastructure can be installed at a home base location. Long-haul applications are expected to be served through a mixture of depot charging and high-speed public ZE infrastructure (charging and hydrogen fueling), both of which are expected to become commonplace over time.

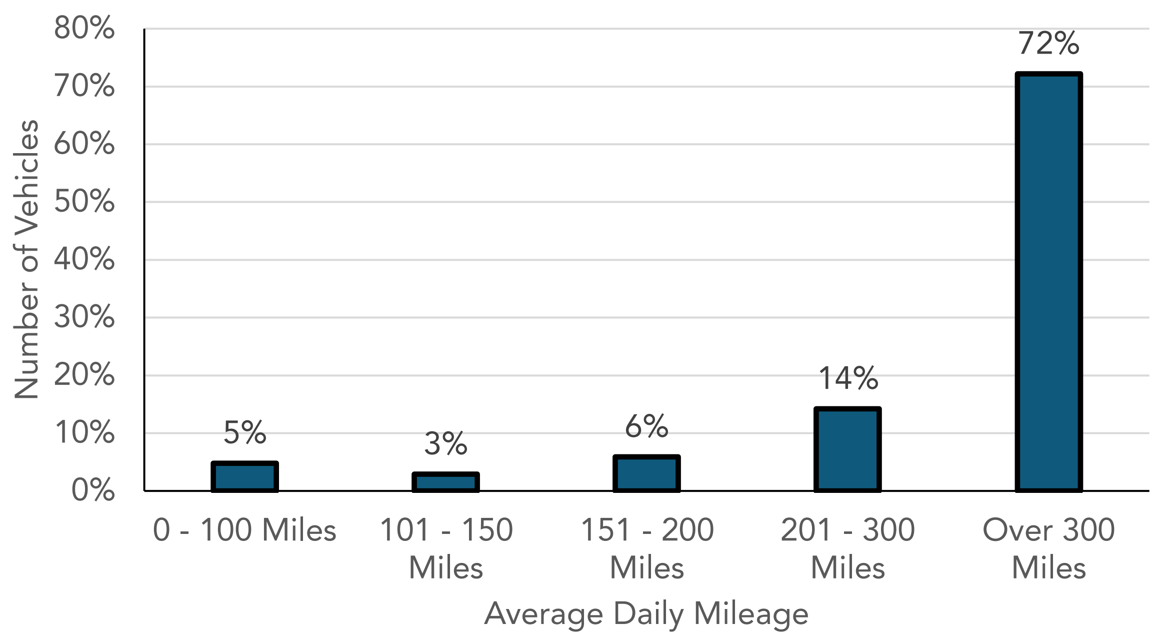
Of the surveyed day cab tractors, 31 percent drove an average of 100 miles daily, 18 percent drove an average of 150 miles daily, 13 percent drove an average of 200 miles daily, and 28 percent drove an average of over 200 miles daily as displayed in Figure 32. Additionally, 58 percent were regularly parked onsite at their respective facility at least 8 hours of the day.

Figure 32: Estimated Average Daily Mileage of Day Cab Tractors Surveyed in Large Entity Reporting



Of the surveyed sleeper cab tractors, 5 percent drove an average of 100 miles daily, 3 percent drove an average of 150 miles daily, 6 percent drove an average of 200 miles daily, and 86 percent drove an average of over 200 miles daily as displayed in Figure 33. Additionally, 10 percent were regularly parked onsite at their respective facility at least 8 hours of the day.

Figure 33: Estimated Average Daily Mileage of Sleeper Cab Tractors Surveyed in Large Entity Reporting



a) Yard Trucks

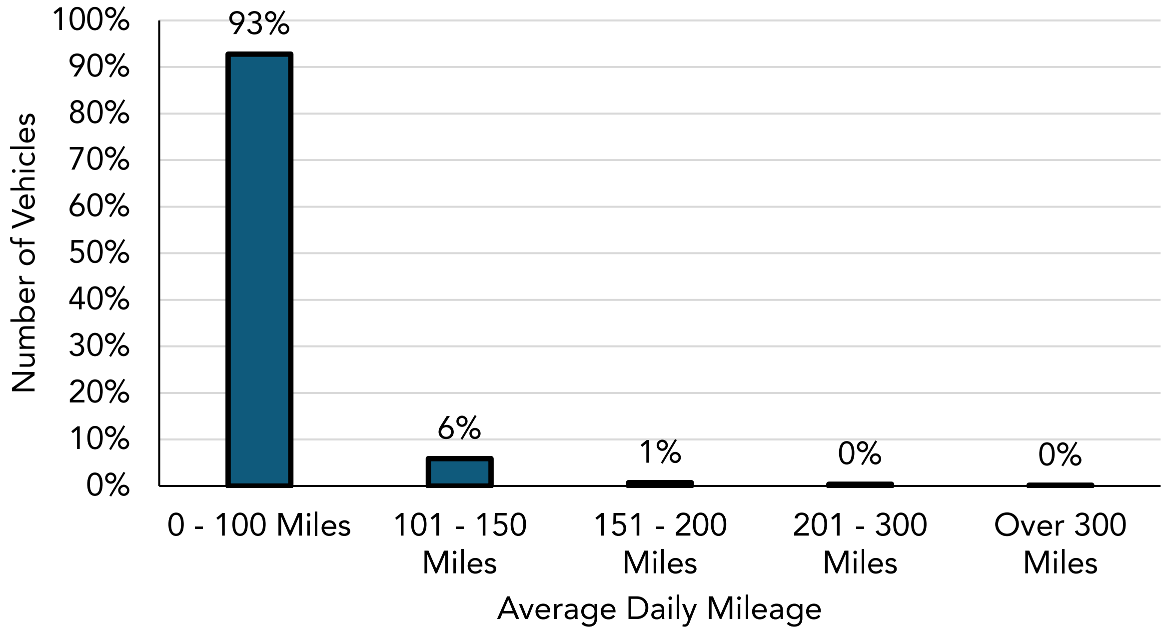
A yard truck is a vehicle with an off-road or on-road engine that is specifically designed for moving trailers and containers over short distances in or around commercial freight yards. These vehicles feature an offset single-person cab that allows for greater visibility during operation and most also have a sliding door with a catwalk on the back of the cab to provide for better trailer connection accessibility. Additionally, these vehicles have a shorter wheelbase for a small turning radius to optimize maneuvering in congested areas. Figure 34 provides examples of yard trucks.

Figure 34: Examples of Yard Trucks

Yard trucks also feature an integrated lifting mechanism and a movable fifth wheel for lifting and moving trailers. These vehicles fall under Class 7-8 and are additionally known as yard goats, trailer spotters, terminal/port tractors, stevedoring tractors, utility tractor rigs, or jockeys in the industry.

Of the surveyed yard trucks in the LER, 9 percent were classified as off-road, and 14 percent were classified as on-road. Additionally, 93 percent drove an average 100 miles daily, 6 percent drove an average of 150 miles daily, and 1 percent drove an over 150 miles daily. A graphical illustration of the estimated average daily miles is shown in Figure 35. Further, 66 percent were regularly parked onsite at their respective facility at least 8 hours of the day.

Figure 35: Estimated Average Daily Mileage of Yard Trucks Surveyed in Large Entity Reporting

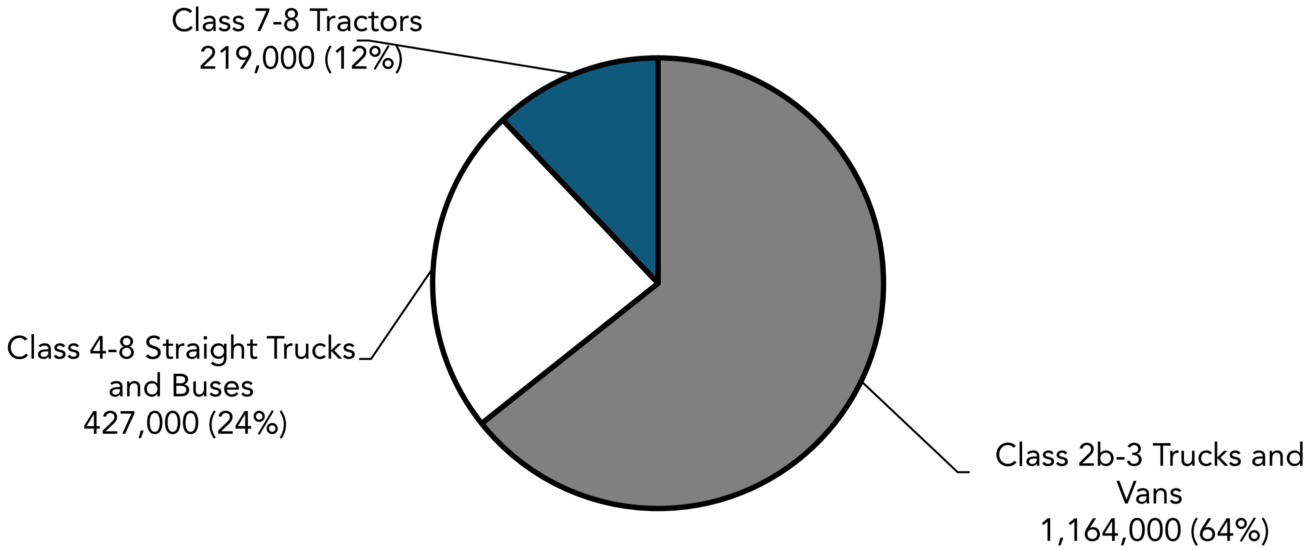


E. Characteristics of Regulated Fleets

This section provides an overview of the inventory of trucks and summary information about the regulated fleet vehicles and operating characteristics. Based on Emission Factor Inventory Model (EMFAC) 2021 data, there are approximately 1.8 million trucks operating in California on a daily basis. These trucks encompass a diverse range of vehicle types, including tractors, utility vehicles, vocational trucks, vans and pickup trucks. Figure 36 provides an overview of the population distribution of van, truck, bus, and tractor vehicle types from Class 2b-8.[88] This distribution includes in-state and out-of-state International Registration Plan trucks, but excludes motorhomes, transit buses, and school buses.

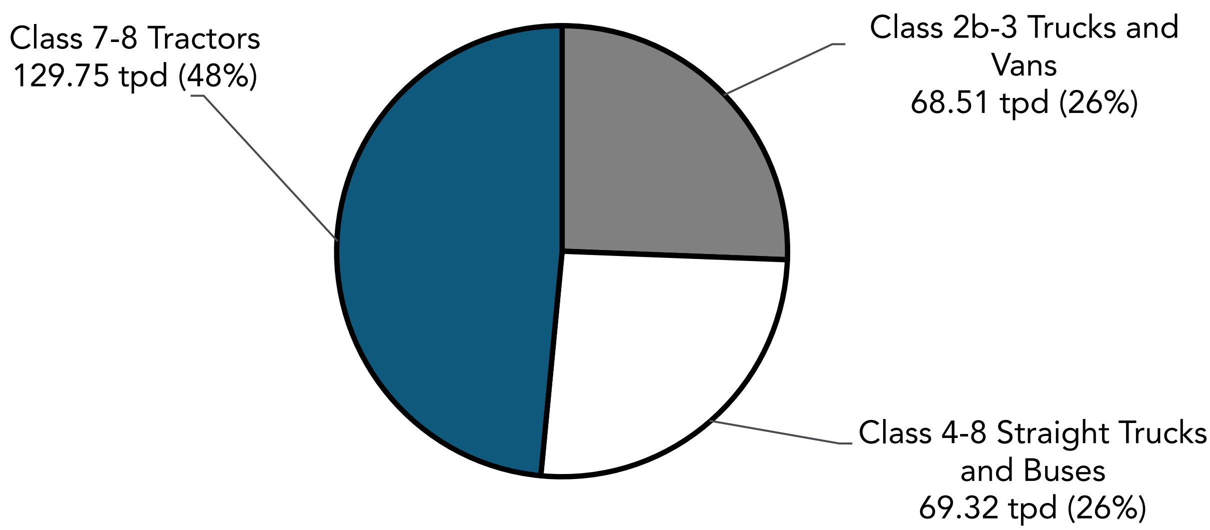
[88] California Air Resources Board, *EMFAC 2021 Database*, 2021 (web link: https://arb.ca.gov/emfac/, last accessed August 2022).

Figure 36: California Medium- and Heavy-Duty Vehicle Population, 2021



Although only roughly 12 percent of vehicles fall within Class 7-8, they account for almost half of California's NOx emissions in the medium- and heavy-duty space, as shown in Figure 37. They also make up a significant portion of PM2.5 and GHG emissions.

Figure 37: California Daily NOx Emissions of Medium- and Heavy-Duty Vehicles, 2021



Due to the disproportionate contribution of emissions from Class 7-8 vehicles compared to their population, the proposed ACF regulation prioritizes vehicles falling under this weight class. As shown in Figure 38 and Table 10, the majority of Class 7-8 vehicles would be affected under the proposed ACF regulation, including the 100 percent ZEV sales requirement.

Figure 38: Breakdown of Vehicles Affected by Proposed ACF Regulation by Vehicle Group and Fleet Type

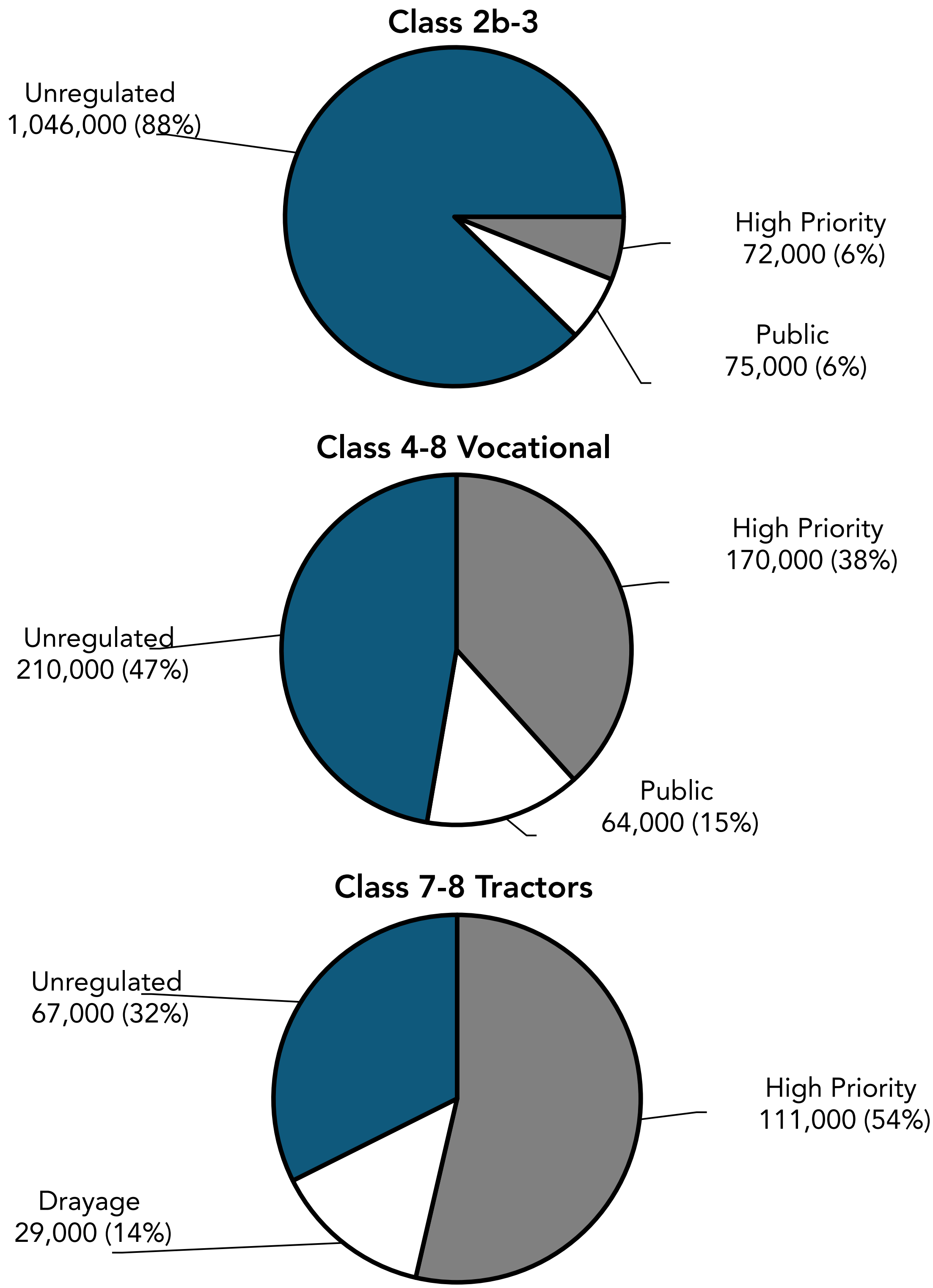


Table 10: Projected Percentage of Vehicles Affected by Proposed ACF Regulation

Vehicle Group	Total Vehicles	Subject to Regulation	Percentage Affected
Class 2b-3	1,193,000	147,000	12%
Class 4-8 Vocational	444,000	234,000	53%
Class 7-8 Tractor	204,000	137,000	68%

Targeting the disproportionate emissions of Class 7-8 vehicles means that the proposed ACF regulation also targets fleets that have been identified as major emitters of GHG and NOx within the State of California. In general, these are a relatively small number of larger fleets operating 50 or more Class 7-8 vehicles with a high number of miles travelled. As such, the high priority portion of the proposed ACF regulation affects fleets who own or dispatch 50 or more vehicles under common ownership or control.

While generally larger fleets would be subject to the proposed ACF regulation, this is not always the case. Due to the nature of how companies and fleets operate, the high priority requirements of the proposed ACF regulation take into account subsidiaries, hired fleets, and other combinations of service vehicles which total 50 or more vehicles, including vehicles and fleets under common ownership and control. The proposed high priority requirements also target companies with total gross annual revenues of at least $50 million that operate at least 1 vehicle as larger corporate bodies are more able to absorb the early impact of transitioning to a ZE fleet.

Alongside high priority fleets, State and local government fleets that operate medium- and heavy-duty vehicles, regardless of size, would have to comply with the proposed ACF regulation. Similarly, all federal fleet and drayage vehicles operating in California would be subject to the proposed ACF regulation. A breakdown of the projected number of vehicles subject to each of the high priority and federal, State and local government, and drayage fleet portions of the proposed ACF regulation is shown in Table 11. The affected fleet composition and characteristics are further discussed in the sections below.

Table 11: Breakdown of Vehicles Affected by Proposed ACF Regulation by Vehicle Group and Fleet Type

Vehicle Group	Number of State and Local Government Vehicles	Number of Drayage Vehicles	Number of High Priority and Federal Vehicles	Number of Vehicles Subject to ACF Fleet Requirements
Class 2b-3	75,000	0	72,000	147,000
Class 4-8 Vocational	64,000	0	170,000	234,000
Class 7-8 Tractor	0	29,000	108,000	137,000
Total	139,000	29,000	350,000	518,000

1. State and Local Government Fleets Overview

This section provides an overview of the many types of State and local government fleets as well as the vehicles owned or leased by municipalities and public utilities. A municipality is a city, county, city and county, special district, or a public agency of the State of California, and any department, division, public corporation, or public agency of this State, or two or more entities acting jointly. Public agencies include public schools and universities, local governments, county landfills, municipal utilities, wastewater treatment facilities, defense, military installations, public works departments, and transportation agencies. Publicly owned utilities (POU) in California provide water, electric, and gas and oil services to agricultural, urban, desert, and mountain communities.

These fleets have a diverse range in vehicle classes, operational uses, and vehicle body types. State and local government fleets consist of a variety of vehicle types, such as buses, trucks and vans, that are distributed amongst Class 2b-8 and are widely used across the different areas of the transportation sector, including public transportation and public works services.

State and local government fleets perform a wide variety of functions with diverse purposes, which include intercity and urban transport, public land management, public infrastructure construction and maintenance, and more. These fleets encompass a range of vehicle types that extend from pickups and vans to special function vehicles, such as buses, street sweepers, and vacuum trucks. Local cities and counties, for example, incorporate refuse vehicles for the collection of solid waste for disposal. Public utility fleets might use vocational trucks to fulfill water and electric service needs, but also extend to other vehicles for the purposes of passenger transportation and cargo hauling.

a) Types of Vehicles Owned/Used, Usage Characteristics Based on Large Entity Reporting

State and local government fleets consist of a variety of different body types, ranging from Class 2b pickups to Class 8 garbage packers, and are used for several different purposes. The reported State and local government vehicle type distribution is shown below in Table 12.

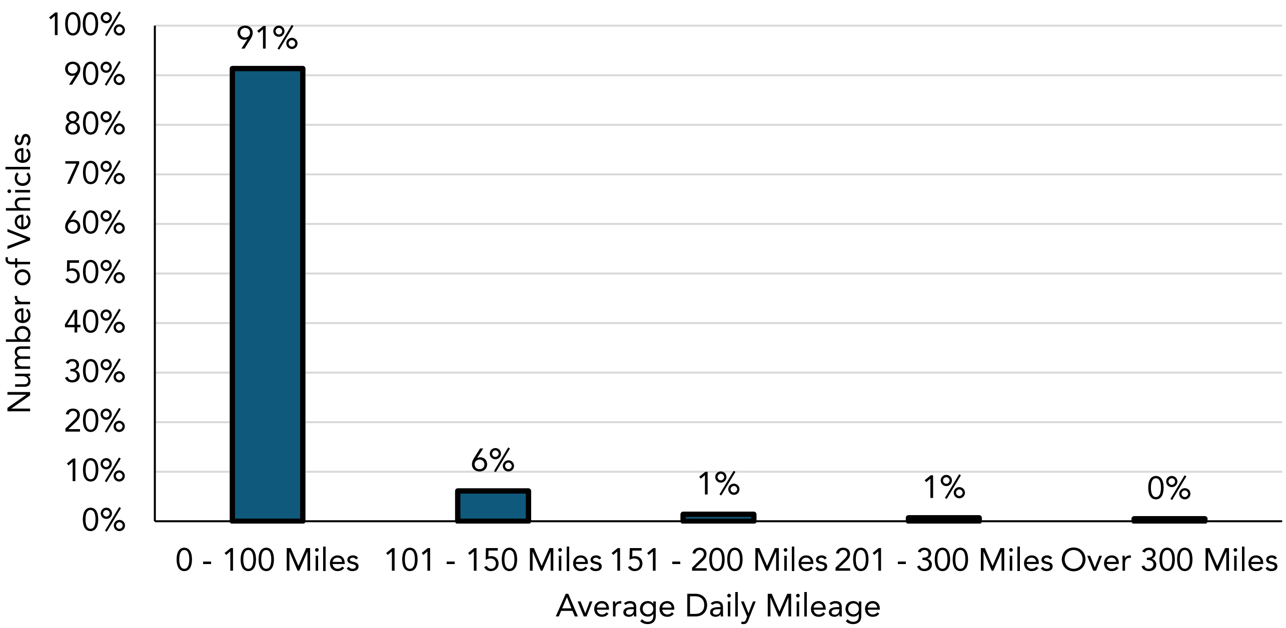
Table 12: Large Entity Reporting State and Local Government Vehicle Type Distribution

Vehicle Type	Percent of Vehicles
Service Body	25%
Pickup	20%
Dump	9%
Flatbed or Stake Bed	7%
Cargo Van	7%
Passenger Van	4%
Other Bus	4%
Garbage Side Loader	3%
Boom/ Bucket	3%
Box Dry Van	2%

According to the LER distribution, more than half of vehicles operating under State and local government fleets are either service body vehicles (25 percent) or pickup trucks (20 percent). Dump trucks (9 percent), flatbed or stake bed (7 percent), and cargo vans (7 percent) compose another 23 percent of the fleet. Passenger vans (4 percent), other buses (4 percent), garbage side loaders (3 percent), boom/bucket trucks (3 percent), and box dry vans (2 percent) constitute the remainder of State and local government fleets. The majority of the service body populations falls under Class 2b-3.

Based on the results of the LER, a 92 percent majority of State and local government fleet vehicles are estimated to operate for 100 miles per day or less, 6 percent are estimated to operate between 101 and 150 miles per day, 1 percent operate less than 200 miles daily and the remaining 1 percent are estimated to operate for more than 200 miles per day. Accounting for 88 percent of the reported State and local government fleet population in the LER, most vehicles are regularly parked at the home base facility for more than 8 hours each day and 51 percent of the vehicles typically return to their home base facility on a daily basis. Additionally, these vehicles are typically owned for 11-15 years and primarily operate less than 10,000 miles annually, according to the LER. Figure 39 shows the LER distribution of the estimated average daily mileage of vehicles in State and local government fleets.

Figure 39: Estimated Average Daily Mileage of State and Local Government Vehicles Surveyed in Large Entity Reporting



2. Federal Fleets

Federal entities located in California have a wide range of functions, including courthouses and post offices, and additionally incorporate public-domain land, military reservations, national parks, and national wildlife refuges.

Federal fleets have a variety of different body types, ranging from Class 2b cars and SUVs to Class 8 tractor day cabs, and are used for several different purposes. The U.S. Postal Service largely incorporates step vans to accomplish delivery services, but also uses other vehicles, such as cargo vans, and box trucks. Federal fleets also utilize specialty and vocational trucks as part of forestry service, for example, such as boom trucks and water trucks.

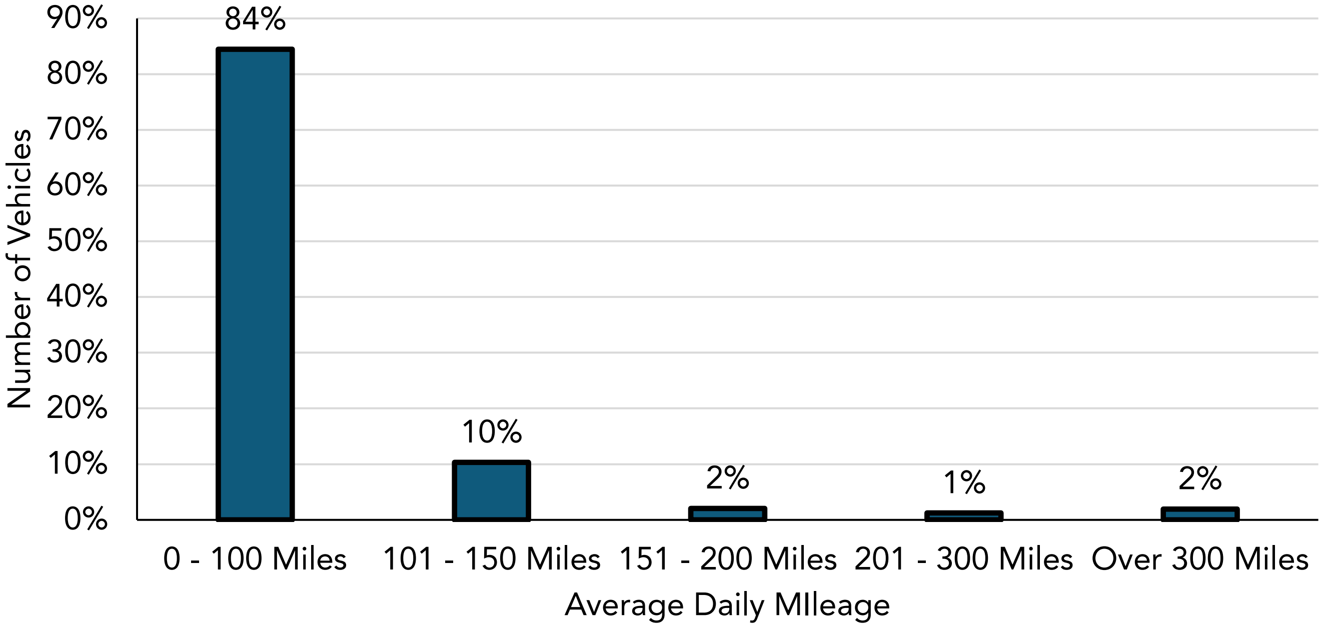
Table 13 demonstrates the ten largest LER populations amongst federal fleets across Class 2b-8, organized by vehicle type. Pickups are estimated to be the most widely used vehicle type amongst the federal fleets with the majority of the pickup populations falling under Class 2b-3.

Table 13: Large Entity Reporting Federal Fleet Vehicle Type Distribution

Vehicle Type	Percent of Vehicles
Pickup Bed	28%
Service Body	13%
Cargo Van	12%
Passenger Van	9%
Car/ SUV	7%
Flatbed or Stake Bed	5%
Tractor Day Cab	4%
Tractor Sleeper Cab	2%
Step Van	1%
Shuttle Bus	1%

The LER data also estimates that approximately 85 percent of reported federal fleet vehicles operate 100 miles per day or less, 10 percent of these vehicles average 150 miles per day or less, 2 percent average less than 200 miles per day, and the remaining 3 percent operate for more than 200 miles per day. It is also estimated that on a daily basis, about 10 percent of the vehicles reported in the LER return to their home base facility. Accounting for 50 percent of the reported federal fleet population in the LER, most vehicles are regularly parked at the home base facility for more than 8 hours each day. Additionally, these vehicles are reported to be typically owned for 11-15 years or 16-20 years and primarily operate for less than 5,000 miles annually, according to LER data. Below, Figure 40 shows the LER distribution of the estimated average daily mileage of vehicles in federal fleets.

Figure 40: Estimated Average Daily Mileage of Vehicles in Federal Fleets Surveyed in Large Entity Reporting



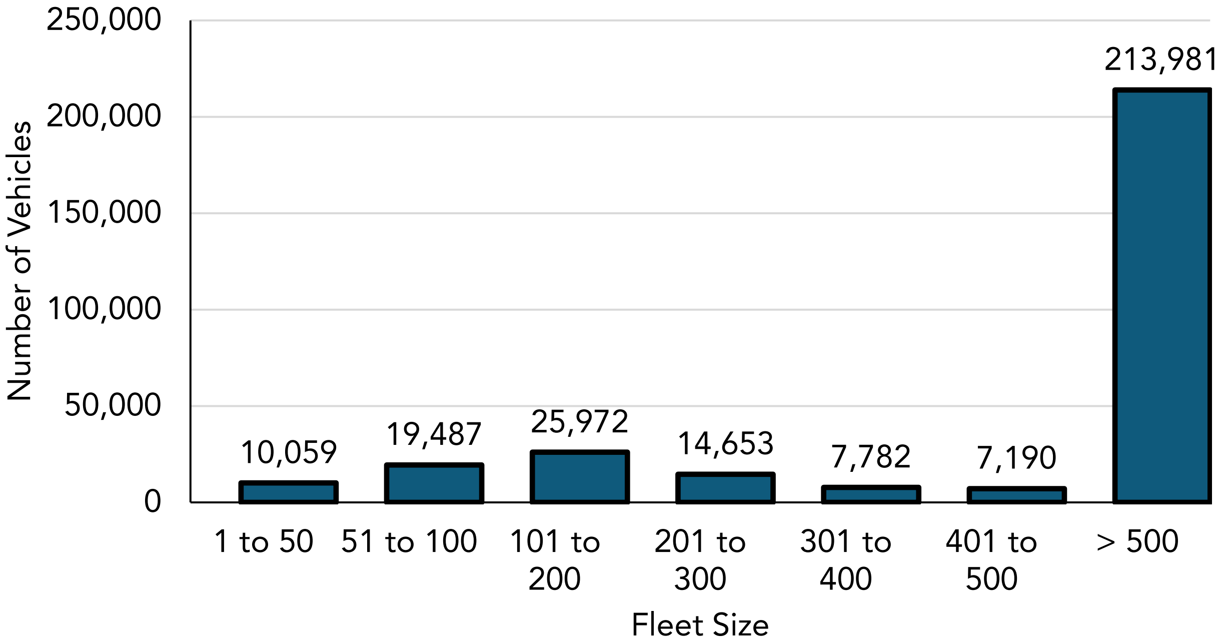
3. High Priority Fleets Commercial Fleets

High priority fleets are owned and operated by large commercial entities. Large commercial fleets typically fall into two categories: for-hire carriers and private carriers. For-hire carriers, such as FedEx and UPS, are fleets that provide goods transportation services for another company, whereas private carriers (e.g., Walmart, Pepsi Co.) transport their own cargo. The industries serviced by commercial fleets include, but are not limited to, grocery, petroleum, construction, manufacturing, retail and wholesale trade, household goods, waste management, beverage, and agriculture. Commercial fleet vehicles include a mix of trucks of different classes and various body types to meet the needs of the market segment. Body types can range from Class 2b delivery vans to Class 5 box trucks to Class 8 tractor-trailers and include many other truck types in between.

a) High Priority Fleet Representation Based on Large Entity Reporting

According to LER data, 1,170 entities (63 percent of all participants) reported as a non-governmental agency which accounted for approximately 300,000 vehicles or 77 percent of vehicles reported. LER data shows that 85 percent of the vehicles reported were comprised of fleets with 100 or more vehicles and 70 percent of the vehicles were made up of fleets of 500 or more vehicles. This data shows that large fleets account for a majority of the vehicles subject to ACF, with most of these fleets falling under the high priority fleet segment. Below, Figure 41 shows the LER distribution of the number of vehicles by fleet size for non-governmental fleets.

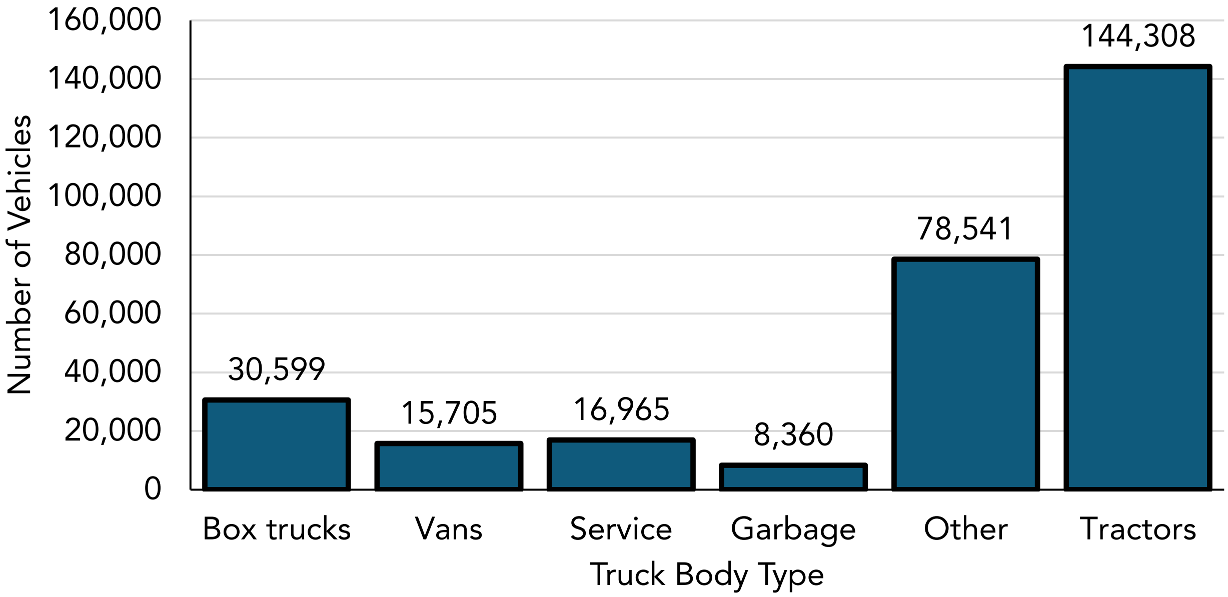
Figure 41: Number of Vehicles by Fleet Size (Non-Governmental)



b) Truck Body Type of High Priority Fleets Based on Large Entity Reporting

As described above, the industries serviced by commercial fleets are numerous which require several different truck body types to meet the specific needs of the market segment. Based on LER data, the various body types used by high priority fleets include vans, box trucks, dump trucks, garbage trucks, car carriers, water trucks, concrete mixers, and many more. However, Class 7-8 tractors make up the largest percentage (about 49 percent) of all the truck body types used by high priority fleets. Below, Figure 42 shows the LER distribution of the number of vehicles by vehicle type for non-governmental fleets.

Figure 42: Number of Vehicles by Truck Body Type (Non-Governmental)



c) Mileage by Truck Body Type Based on Large Entity Reporting

The truck types and market segments of vehicles included in the high priority fleet segment vary greatly across the many industries. As a result, the daily mileage of a truck is largely dependent on the market segment a fleet is servicing. Based on LER data, tractors are the group of trucks that have the highest daily mileage with about 44 percent of tractors traveling over 300 miles per day. However, long distance travel is not the norm for most truck operations. As shown in Table 14 below, most truck operations require travel of less than 150 miles per day.

Table 14: Daily Mileage by Truck Body Type

Truck Body Type	Percentage of Trucks Traveling 100 Miles or Less	Percentage of Trucks Traveling 150 Miles or Less
Pickup and Utility	83%	95%
Cargo and Step Van	87%	96%
Box Truck	50%	72%
Vocational	80%	91%
Refuse	82%	94%
Truck Tractor	19%	30%
Yard Truck	93%	99%

4. Drayage Fleets

Drayage trucks are defined as in-use on-road Class 7-8 trucks (trucks with a GVWR of greater than 26,000 lbs.) that are used for transporting cargo, such as containerized bulk, or break-bulk goods, that (1) operate on or transgress through seaport of intermodal railyard property for the purpose of loading, unloading, or transporting cargo, including transporting empty containers and chassis; or (2) operate off seaport or intermodal railyard property transporting cargo or empty containers or chassis that originated from or is destined to a seaport or intermodal railyard property.

Drayage trucks are typically part of a specialized fleet that primarily moves cargo to and from seaports and intermodal railyards to near-dock, local, or regional transloading facilities or warehouses to be stored or re-packaged before the cargo moves to the next destination. Staff estimates that approximately 57 percent of drayage fleet owners have 4 or more trucks. This percentage is based on CARB's analysis of drayage trucks registered at the San Pedro Bay and Oakland seaports, and California Department of Motor Vehicles (DMV) registration data. Most drayage truck owners work with and are dispatched by licensed motor carriers. Licensed motor carriers act as an intermediary business connection between the shippers and customers for which most drayage trucks are dispatched.

To estimate the number of drayage trucks subject to the proposed regulatory requirements, staff used data from the CARB Drayage Truck Registry, seaports, and intermodal railyards. The estimated population was then divided into an active or inactive fleet category. Staff assumed a truck to be a part of the active fleet if they visited an average of 2 or more times per week or 112 times per year. This visit frequency threshold provides a conservative baseline estimate of the number of active drayage trucks to ensure appropriate costs, infrastructure, and trucks are considered for current and future planning efforts.

From this analysis, staff estimates that approximately 33,310 drayage trucks service California seaports and intermodal railyards annually. Of those trucks approximately 28,700 actively service California seaports and intermodal railyards. Table 15 shows the estimated active drayage truck population in calendar year 2019, which serves as the baseline for the emissions and economic analysis.

Table 15: Active Drayage Truck Population 2019

Vehicle Category	Port of Oakland (POAK)	Port of LA/LB (POLA)	Other Seaports*	Intermodal Railyards**	Total
Instate Class 8† Active Trucks* **	4,200‡	14,000‡	1,500‡	9,000	**28,700**
Instate Class 8 Inactive Trucks* **	n/a***	2,800	n/a	n/a	**2,800**
Instate POAK Class 8 already in POLA	140	n/a	n/a	n/a	**140**
Out of State	820	850	n/a	n/a	**1,670**
Total	**5,160**	**17,650**	**1,500**	**9,000**	**33,310**

‡ T7 Port of Los Angeles and Port of Long Beach (POLA) Class 8, T7 Port of Oakland (POAK) Class 8, and T7 Other Ports Class 8 in EMFAC2021
* Estimate based on past surveys.
** Estimated based on information provided by Union Pacific Railroad and Burlington Northern Santa Fe Railway.
*** POLA trucks with more than an average 2 visits/week or 112 visits/year are considered as "active truck The 112 visit/year was determined based on POLA monthly active truck counts. POAK did not prov monthly visit data and therefore all POAK Class 8 in-state trucks were considered active.

a) Drayage Fleet Operational Characteristics

Drayage trucks generally travel a limited number of miles daily and then return to a home base. The 2018 Feasibility Assessment for Drayage Trucks, an operator survey, found that approximately 72 percent of trucks park overnight at a motor carrier home base, lot, or facility.[89] In addition, most drayage trucks typically perform 3 types of services or duty cycles:

- near-dock (6-8 miles one way),
- local or intermodal railyard (8-20 miles), and
- regional (20-120 miles).

Drayage trucks are generally part of a dedicated fleet that typically operate within these duty cycles. Table 16 shows the average operational parameters from the feasibility assessment.

[89] San Pedro Bay Ports, *2018 Feasibility Assessment for Drayage Trucks*, 2020 (web link: https://cleanairactionplan.org/download/222/other-documents/5029/final-drayage-truck-feasibility-assessment.pdf, last accessed August 2022).

Table 16: San Pedro San Pedro Bay Ports, 2018 Feasibility Assessment for Drayage Trucks Average Drayage Truck Operational Parameters

Operational Parameter	Units	Value
Average Shift Distance	Miles	160
Average Shift Duration	Hours	9.9
Average Shifts Per Day	#/day	1.6
Average Daily Operating Time	Hours	14.8
Average Daily Mileage	Miles	238

According to the I-710 Project Key-Performance Parameters for Drayage Trucks CALSTART 2013 survey, approximately 81 percent of drayage trucks that visit California's seaports report most trip distances under 60 miles.[90] This is consistent with other studies that have found that most drayage trucking companies being located within 10 miles of the port complex.[91] Truck operators also reported that they typically complete 3 roundtrips per day with 85 to 90 percent reporting only 1 shift per day. Table 17 shows the percentage of reported trip distances.

Table 17: I-710 Project Key-Performance Parameters for Drayage-Trucks, CALSTART 2013: Drayage Typical Trip Distance

Trip Distance	% of Trips	% Total
<10 miles	13%	13%
10-20 miles	23%	36%
20-40 miles	23%	59%
40-60 miles	22%	81%
60-100 miles	15%	96%
100+ miles	5%	100%*

*Exception due to rounding.

Currently available commercial ZE heavy-duty trucks can meet the average daily operations for drayage trucks based the findings from both the San Pedro Bay 2018, and CALSTART 2013 studies. Below, Section F provides an overview for both the current and anticipated availability of Class 7-8 ZE trucks and includes details for make, type, and commercial availability. The proposed ACF regulation provides a phase-in approach which provides opportunity for the longer or regional drayage trips to utilize the legacy fleet as both the technology and infrastructure develop.

[90] CALSTART, *Performance Parameters for Drayage Trucks Operating at the Ports of Los Angeles and Long Beach*, 2013 (web link: https://calstart.org/wp-content/uploads/2018/10/I-710-Project_Key-Performance-Parameters-for-Drayage-Trucks.pdf, last accessed August 2022).

[91] Port of Long Beach, *Fueling the Future Fleet: Assessment of Public Truck Charging and Fueling Near the Port of Long Beach*, 2021 (web link: https://polb.com/download/379/zero-emissions/12744/final-polb-charging-study-12-sep-2021.pdf, last accessed August 2022).

F. Medium- and Heavy-Duty Zero-Emission Vehicle Market

The ZEV market continues to rapidly evolve. A wide variety of ZE trucks and buses are available today with continued growth expected to expand options. Innovative start-up manufacturers have led the way for ZEV market development with major manufacturers also entering and contributing to the market. Major parts suppliers continue to introduce commercial components with a wave of prominent initial public offerings, mergers, and acquisitions in the industry. Both start-ups and mainstream equipment manufacturers have announced significant investments in new vehicle lineups. This section highlights the advances in the ZEV market and provides an overview of the ZEVs that are already manufactured and available in the market today.

BEVs and FCEVs are the most common examples of currently available ZEVs and are the foundation of staff's proposed ACF regulation. BEVs utilize batteries with an on-board charger to store energy from the electrical grid to power electric motors. Currently, medium- and heavy-duty BEVs with nominal ranges of 100-200 miles per charge are commonly available. A few models are available with a range over 300 miles. More longer-range BEVs are expected to become available as technology continues to improve.[92]

FCEVs use hydrogen stored on-board the vehicles to generate electricity for electric motors. The range and fueling time of these vehicles are comparable to conventional ICE technologies. FCEVs have demonstrated the feasibility of being integrated into regular fleet operations as they can provide similar capacity, range, and fueling capabilities as conventional vehicles. However, they tend to have higher curb weight compared to conventional vehicles and near-term costs are still high.

NZEVs are defined in the proposed ACF regulation as vehicles capable of operating as a ZEV for a certain number of miles as established in title 13, CCR section 1963(c)(16). Essentially, these vehicles are PHEVs powered by both an internal combustion and battery-electric powertrain that are capable of operating like a ZEV for a limited time. NZEVs are considered a bridge technology, which will assist in the development of the full ZEV market as they have the same electric drivetrain components. These vehicles provide flexibility to meet applications that are not well-suited for full ZEVs and promote the development of ZE component supply chains, training, and education as well as provide an opportunity for fleets to gain experience with electric drivetrains without range anxiety. Hybrid vehicles that cannot operate part-time as ZEVs, or vehicles powered solely by engines that do not allow the vehicles to comply with the proposed performance standards of emitting zero exhaust emissions of either criteria or greenhouse gases, i.e., vehicles powered only by internal combustion engines fueled by diesel, CNG, or gasoline, are not considered to be "near-zero."

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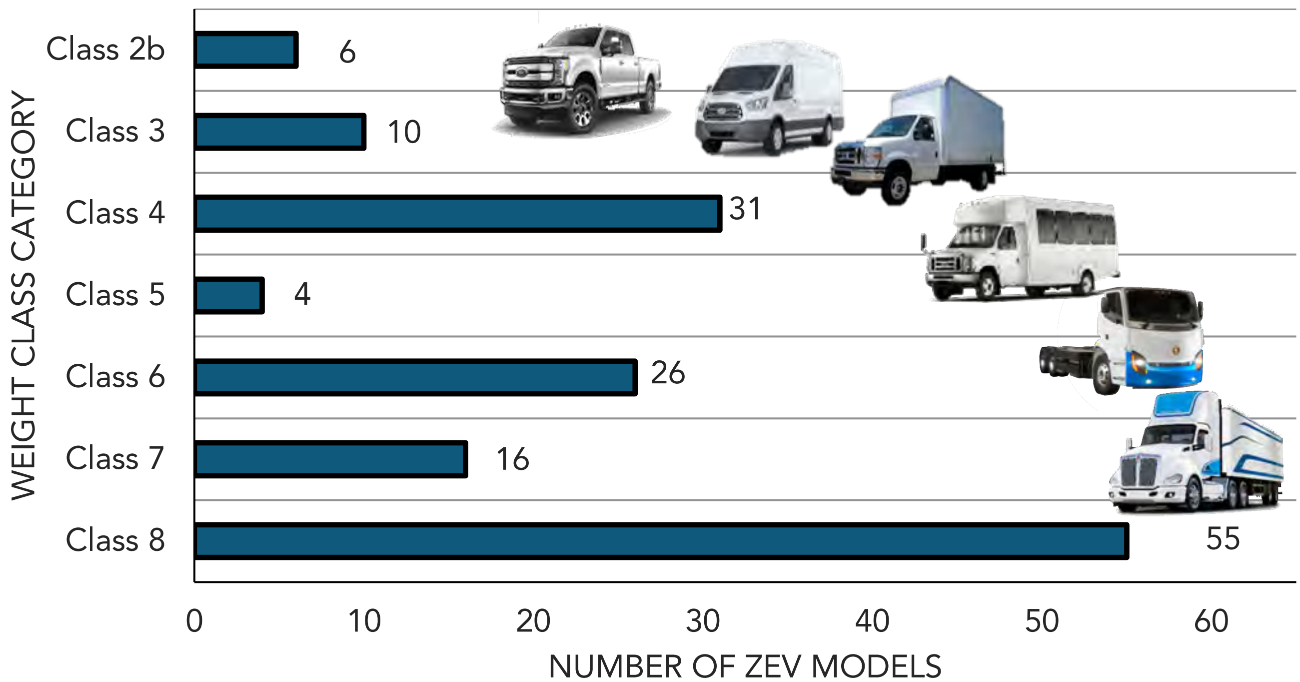
[92] CALSTART, *How Zero-Emission Heavy-Duty Trucks Can Be Part of the Climate Solution*, 2021 (web link: https://globaldrivetozero.org/site/wp-content/uploads/2021/05/How-Zero-Emission-Heavy-Duty-Trucks-Can-Be-Part-of-the-Climate-Solution.pdf, last accessed August 2022).

1. Currently Available ZEVs and Manufacturers

Technology developments as well as the number of participating manufacturers for BEVs and FCEVs have rapidly progressed over the last decade, which has led to the market introduction of ZEVs in every weight class. Within these weight classes, a wide range of vehicle configurations exist that can perform a variety of functions. Staff analysis shows there are 148 models in North America where manufacturers are accepting orders or pre-orders; 135 models are actively being produced and are being delivered to the customer. Figure 43 illustrates available ZEVs across every weight class category and each includes a considerable range of truck configurations. CARB staff verified the list by reviewing manufacturer press releases, articles, and in communicating with the manufacturer directly.

Figure 43: Number of Commercially Available ZEVs



There are currently 6 van models and 3 pickup trucks in Class 2b-3 that are commercially available, in which they are available to order or have had at least one model delivered to a customer. In addition, 2 other pickup truck model and at least 3 more vans are to be released by the end of 2022. In Class 4-5, there are 14 commercially available single-unit truck and 7 van models. In Class 6-7, there are 18 truck models and 3 van models that are commercially available. In Class 7 and 8, there are 28 truck models available. Of those, 8 tractor models are commercially available with another 5 tractors coming available by the end of 2023. Additionally, multiple new and existing truck parts suppliers have developed a variety of ZE drivetrain components including electric motors, batteries, and e-axles that are being deployed in ZEVs today.

In addition to options that are currently commercially available, the ZEV market is already expanding to include more models. California adopted the ACT regulation to ensure that manufacturers sell ZEVs as an increasing part of their total truck sales in California starting with the 2024 MY. At present, all major truck manufacturers have announced new ZEV models for North America, and most have plans to launch them prior to 2024. Other states are following suit and are adopting the same ZEV sales requirements. As ZEV sales increase with scale, the incremental costs are expected to decline faster ultimately resulting in greater ZEV attainability.

a) Manufacturers of Zero-Emission Vehicles

The number of available and announced models of new medium- and heavy-duty ZEVs is expected to grow. There are many manufacturers that have made investments in ZEVs with ZEV offerings in the market today that extend across each weight class in an array of configurations. Table 18 and Appendix J provides a current list of manufacturer and model of medium- and heavy-duty ZEVs that are commercially available.

Table 18: Vehicles Produced by Weight Class and Manufacturer

Parent Company	Class
Arrival	2b
Blue Bird	6, 7, 8
BYD Motors	4, 5, 6, 7, 8
Canoo	2b, 3
Daimler Trucks	4, 6, 7, 8
Envirotech Vehicles	3, 4
Ford	2b, 3
GILLIG	8
GM	2b
GreenPower Motor	4, 5, 6, 8
Hyundai	8
Kalmar	8
Lightning eMotors	3, 4, 5, 6, 8
Lion	6, 7 ,8
Lonestar SV	8
Motiv Power Systems	4, 5, 6
Navistar	6, 7, 8
NFI Group	8
Nikola Motors	3, 8
Optimal EV	4, 8
OrangeEV	8
PACCAR	6, 7, 8
Phoenix Motorcars	4, 8
Proterra	8
REV-Collins Bus	5-6
Rivian	2B
ROUSH CleanTech	6
SEA Electric	4, 5, 6, 7, 8
Tesla	2B, 8

Parent Company	Class
US Hybrid	3, 4, 8
Van Hool NV	8
Volvo	7, 8
Workhorse	3
XOS Trucks	6, 7, 8
Zeus	4, 5, 6, 7

Due to a higher ZEV demand from the ACT and proposed ACF regulation, production of ZEVs by businesses in California would likely expand, leading to increases in ZEV manufacturing, supply chains, and workforce development.

G. Zero-Emission Vehicle Infrastructure

This section discusses how the State is assessing the future demand and availability of ZE vehicle fueling stations including the electricity and hydrogen required. In addition, this section includes a discussion on how fleets and facilities may approach charging strategies and typical infrastructure costs. A discussion on hydrogen fueling in the context of production, distribution, and standardization is also included. Finally, this section discusses timeframes for infrastructure planning, development and deployment as well as other State agency actions and private investments.

CARB, in partnership with GO-Biz, CEC, CPUC and California Independent System Operator (CAISO) initiated a series of infrastructure-focused workgroup meetings to collaborate with fleets, facility owners, electric utilities, and fueling providers regarding the rollout and requirements of ZE refueling infrastructure. CEC is predicting the need for 157,000 chargers by 2031 in California and up to 258,000 by 2037.[93,94] CARB and CEC continue to collaborate to ensure that modeling is refined to better represent growth in ZE truck populations, both geographically and over time. Ongoing agency collaboration will ensure sufficient infrastructure is available for fleets.

1. ZEV Infrastructure Planning and Deployment

1. Depot and public charging options

Commercial vehicles engage in a wide variety of daily operations and the two most common types of operations include a hub and spoke operation where vehicles return to a home base or a long-haul operation where vehicles tend to be more transient. Different types of vehicles and infrastructure are required to address this variety.

Depot or home-base refueling is ideal for fleets that utilize a hub and spoke operation where vehicles return to a home base at the end of the shift. Postal delivery operations, last mile and regional delivery operations, bus operations, and governmental organizations fit this

[93] California Energy Commission, *2127 Report*, 2021 (web link: https://efiling.energy.ca.gov/getdocument.aspx?tn=238853, last accessed August 2022).
[94] California Air Resources Board, *Draft 2022 State Strategy for the State Implementation Plan*, 2022 (web link: https://ww2.arb.ca.gov/sites/default/files/2022-01/Draft_2022_State_SIP_Strategy.pdf, last accessed August 2022).

usage model where fleets can park their vehicles at a depot when off-shift. These situations are well suited for initial electrification because infrastructure for overnight charging operations can be centralized and managed. Fleets may also augment daily operations with an opportunity charge at a public or private charger during the day.

Fleets operating longer distances and those without access to home base charging, will benefit from high-speed public charging infrastructure of up to 350 kW capable of charging a vehicle in 1-3 hours. Staff is assuming that non-tractor trucks traveling under 200 miles per day will rely solely on depot charging until 2030, while Class 7-8 tractor trucks will rely on depot charging for 25 to 75 percent of the time, depending on vehicle range, duty cycles, and access to infrastructure both at home and away. The proposed ACF regulation provides flexibility for fleets to initially target the best suited use cases.

Today commercial high powered public charging is still developing and will eventually play a role in enabling longer-range battery-electric trucks (e.g., sleeper cabs). Freight and drayage truck drivers may want to rely on solutions that emulate what they are accustomed to—a public truck stop model. Conventional fuel suppliers are working with industry to develop fast charging solutions at/or near truck stops, and hydrogen station developers are currently adding hydrogen fueling to several retail heavy-duty diesel stations.[95,96] As more fuel cell trucks become commercially available, they will likely rely solely on publicly accessible high-speed hydrogen refueling infrastructure.

California Department of Transportation's (Caltrans) ongoing parking study work will inform and assist funding programs to identify priority locations for new charger investments that will support publicly accessible charging and increase operator safety. In addition, improving signage to help drivers locate charging facilities is also being addressed.

Technological improvements like mobile applications also have the potential to assist fleets to identify and potentially reserve charging locations that are suitable for commercial vehicles, such as by having driver facilities and room for vehicles to comfortably navigate. CARB is piloting a program designed to assist small fleets in successful ZEV deployment and lessons learned will help shape charging strategies.

a) High-Powered Public Charging

An extreme high-powered charging system is under development with the promise of up to 3.75 megawatt of charging capacity that could greatly reduce charging times to well under an hour and enable ZE adoption in some of the most demanding duty cycles. The majority of the major truck OEMs and infrastructure providers are participating in a Megawatt Charging System Task Force led by the Charging Interface Initiative.[97] The Task Force was formed to create a common solution for high-power charging of fully commercial heavy-duty EVs and is

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[95] California Energy Commission, *See projects awarded through GFO-20-605 BESTFIT Innovative Charging Solutions*v, 2020 (web link: https://www.energy.ca.gov/solicitations/2020-08/gfo-20-605-bestfit-innovative-charging-solutions, last accessed August 2022).
[96] California Air Resources Board, *2021 Annual Evaluation of Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development*, 2021 (web link: https://ww2.arb.ca.gov/sites/default/files/2021-09/2021_AB-8_FINAL.pdf, last accessed August 2022).
[97] CHARIN, *CharIN and the Megawatt Charging System*, 2022 (web link: https://www.charin.global/technology/mcs/, last accessed August 2022).

working out the requirements for connectors, EVSEs, vehicles, communications, safety and related hardware. The promise of a global high-powered charging standard would ensure widespread compatibility and minimize any stranded assets in vehicles, connectors and chargers. CEC has funded two high powered charging demonstration projects that are currently under development via the Research Hub for Electric Technologies in Truck solicitation.

b) Rural Charging Infrastructure

Rural parts of California, with their lower population densities and dispersed geography, have unique challenges when it comes to fueling infrastructure. The State has recognized these challenges and taken multiple actions to ensure reliable and affordable infrastructure access. CEC continues to study the availability of public chargers across California and examine the location and distance vehicle owners would need to travel to publicly charge. This ongoing work overlaps with both the light-duty and heavy-duty focus and serves as a foundation to inform rural investment needs. In addition, significant new federal funding targets rural infrastructure improvements that can assist with State efforts.

The dispersed nature of stations can make service more challenging, and rural electrical distribution often lacks the redundancy of urban centers where distribution costs and benefits can be more widely shared. Assembly Bill 841 requires investor owner utilities to provide certain utility upgrades to customers free of charge which ensures that rural projects will not face potentially expensive utility grid upgrade costs for their projects.[98] In response to station uptime concerns, CEC is working to include minimum station reliability standards in all funded projects with a potential 97 percent uptime requirement.

Rural communities continue to face significant power outages due to public safety power shutoff (PSPS) events, which are planned grid outages designed to mitigate fire hazards. CPUC has directed impacted utilities to implement mitigation strategies during outages and a detailed discussion is included in the grid resiliency section below. CARB staff will continue to monitor the situation as grid hardening continues.

c) Border Ports of Entry

Infrastructure issues at ports of entry at the Southern border are similar to those in all areas of California with the exception of the potential for availability on the Mexican side of the border. In addition, many of the fleets that operate at, and across the border are small fleets, and will need to rely on public charging.

Cross-border commerce is an important part of the economies of both Mexico and California. In addition, the two border crossings, one in Otay Mesa and one in Calexico, lie on or near the major East/West and North/South goods movement corridors of Interstate 8 and Interstate 5, respectively. Given the needs for infrastructure at these locations, CARB staff has worked with the Otay Mesa Chamber of Commerce, as well as other State agencies, including, GOBIZ, CPUC, CEC, and Caltrans, as well as with the San Diego Area

[98] AB 841 (Ting, Stats, 2020, ch. 372). Public Utilities Code new sections 740.18, 740.19, 740.20, 1600, 1601, 1610 through 1618, 1620 through 1627, 1630 through 1633, 1640. Amendments to Public Utilities Code section 740.12.

Governments local planning agency, on possible assistance and solutions, including discussions of available funding for infrastructure in the area.

d) Infrastructure Cost

CARB staff has extensively analyzed cost data from a multitude of pilot and demonstration projects as well as published reports to determine accurate cost data. Individual fleet costs may vary because each has a different set of conditions based on their own unique situation.

Staff's analysis assumes that the majority of fleets using BEVs will install chargers at their facilities. This analysis includes the cost of the charger itself plus the necessary upgrades on the customer's side of the meter, which includes the charger, trenching, laying conduit, and other site upgrades. Data on these costs has been gathered from a variety of sources including various CARB-funded projects and published reports, including the International Council of Clean Transportation (ICCT) 2019 report, which assesses the cost of installing chargers at a variety of power levels across the United States.[99] Generally, infrastructure and charging costs vary proportionally based on how much power the vehicle(s) needs to recharge.

In many cases a local fleet can utilize overnight charging using a level 2 charger (up to 19.2 kW) that can add about 200 miles of range overnight and then occasionally top off at public fast charging stations. Only in higher mileage situations like a regional or long-haul tractor would high powered charging be required. A level 2 charger and installation costs approximately $25,000 while a 150 kW direct current fast charger costs roughly $88,000 and extreme high powered charging significantly higher. However, a high-powered charger is capable of refueling multiple vehicles a day while a lower powered charger is limited.

Programs from the utilities and the State are available to cover the cost of installing infrastructure. CARB does not include these programs in our regulatory analyses, but they can help fleets install infrastructure at a lower cost to them. Costs are not incorporated on the utility's side of the meter as those are the responsibility of the utility as specified in Assembly Bill 841 and are implemented by each IOU. In addition to retail charging, staff's analysis assumes a portion of the battery-electric trucks and all hydrogen FCEVs will use retail refueling. In these instances, staff assumes the infrastructure cost is included within the fuel cost the fleet pays at the retail charger or pump. A detailed accounting on infrastructure costs and assumption can be found in the Chapter VIII cost analysis.

e) Future Cost Reductions

There are several factors that staff believes will lead to reductions in infrastructure costs over time. While the cost of labor, basic construction materials, and electrical equipment are not expected to decline, as more ZEV deployments take place, learning from past experiences will inform more efficient site design and improved economies of scale. Staff expects charging stations and storage technologies to continue to fall in price as demand increases and economies of scale improve. In addition, significant work is underway to streamline project design and permitting processes. For example, pre-planning for full fleet

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[99] International Council on Clean Transportation, *2019 Annual Report*, 2019 (web link: https://theicct.org/sites/default/files/ICCT-AnnualReport-2019.pdf, last accessed August 2022).

deployments will allow construction to be intelligently planned where trenching only occurs once or electrical panels are oversized initially with load catching up over time. Recently approved CalGreen building code requirements for certain new warehouses, retail stores, and commercial stores with off-site loading zones will be required to have additional minimum electrical capacity installed during construction to help ensure the site is prepared for ZE vehicles, which lowers infrastructure costs significantly.[100]

Creative and innovative technologies like smart charging and fleet management software will also give more flexibility to adjust power demands, which may allow the sizing of smaller equipment and fewer upgrades, while still meeting the fleet needs. In addition, some fleets may choose to use on-site solar and storage to minimize the need for costly upgrades. Finally, the Draft 2022 Scoping Plan recommends that the Agency provide capacity credits for heavy-duty ZEV refueling within the LCFS program. If such a provision was adopted in a future LCFS rulemaking, these capacity credits could also play a role in reducing costs for building out public hydrogen refueling or fast charging infrastructure.[101]

f) Infrastructure Installation Timing

CARB staff have worked with the utilities to understand the general timeframes and schedules for infrastructure installation. However, each installation is unique to the facility and dependent on site-specific factors, such as the existing electric panel capacity and installation location. California law requires permitting agencies to meet minimum processing standards to ensure timely approval.

CARB staff has learned from many demonstrations, pilot projects, webinars, workshops and outreach efforts that allowing sufficient time for a project to be envisioned and completed is key. The entire process, which includes planning, developing, and deploying zero-emission fueling stations, can often take from 6-18 months. The amount of required infrastructure may vary with the fleet size as small deployments of a couple vehicles may need minor facility upgrades whereas major expansions may need extensive facility rework or relocation. Ultimately a strong team and utility partnership is critical for success.

A general timeline for charging infrastructure and hydrogen station installations is as follows: (1) Planning and permitting: 3-12 months; (2) Site preparation, construction, installation, and commissioning: 3-12 months or longer; and (3) Deployment and vehicle integration: 1-3 months.

Installing charging infrastructure requires planning and early discussions with the local utilities, many of which have set up dedicated staff to assist. Infrastructure upgrades may require service line extensions, power line reconductoring, or distribution substation upgrades which should be considered early in the planning process. However, utilities have indicated that project phasing and temporary service commonly allows fleets to deploy initial

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[100] California Department of Housing and Community Development, *2019 California Green Building Standards Code, Title 24, Part 11, California Code of Regulations*, 2019 (web link: *https://www.hcd.ca.gov/calgreen*, last accessed August 2022).

[101] California Air Resources Board, *The AB 32 Scoping Plan (draft)*, 2022 (web link: https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents, last accessed August 2022).

ZEVs quickly using existing infrastructure and that transmission upgrades can be made while a fleet expands ZEV deployments over time.

Facility leasing agreements may complicate site upgrades, but staff believes the clear regulatory and policy signals from the proposed ACF regulation, along with other ZEV related policies and executive orders issued by the Governor, would provide assurance to facility owners that site upgrades to support electrification are sound investments.

2. Electricity Supply Impact and Reliability

Concerns have been raised around the availability and rollout of public ZEV infrastructure, including both charging and hydrogen stations, and the grid's ability to meet the steadily growing electrical demand generated by the proposed ACF regulation and other rules promoting electrification. This section assesses the impact that transportation electrification (TE) will have on the State's electrical power grid and the established processes in place for planning future growth in demand on the electrical system over time, including that from demand from light-, medium-, and heavy-duty vehicles. It also discusses how electrical utilities are working to minimize disruptions to customers during unplanned outages and PSPS events.

a) Electric Grid Load Expansion

California's electric grid is in a period of transition, with several thousand megawatts of firm and dispatchable resources currently slated to be retired over the next few years, including the gas-fired once-through cooling coastal power plants and the Diablo Canyon Nuclear Power Plant. At the same time, the State continues to rapidly expand deployment of renewables and plans for greater electrification – which, paired with Senate Bill 100's[102] clean electricity grid target[103] – is designed to help achieve carbon neutrality no later than 2045. Because the State is proposing to lean heavily on the electricity sector to transition away from fossil fuels in the transportation, buildings, and industrial sectors, the demand for electricity will be increasing between now and 2045.[104] This load increase must be supported by sustained and significant build-out of electricity infrastructure in the form of generation, energy storage, and transmission and distribution infrastructure. At the same time, the integration of greater amounts of variable renewable resources (e.g., wind, solar photovoltaic) and the increasing and unpredictable extreme-weather impacts of *climate change* mean that strategies for ensuring grid reliability are also needed. New dispatchable capacity, storage and other zero-carbon resources, as well as demand-side management, can be utilized to maintain grid reliability with high concentrations of renewables. Vehicle smart charging systems can also help manage load to ensure that only critical charging is done during peak demand hours. At the individual project level, charging must be analyzed on a neighborhood distribution circuit specific basis to understand the specific and cumulative

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[102] SB 100 (De León, Stats. 2018 ch. 312). Public Utilities Code new section 454.53, amendments to Public Utilities Code sections 399.11,399.15, and 399.30.

[103] California Energy Commission, *2021 SB 100 Joint Agency Report, Achieving 100 Percent Clean Electricity in California: An Initial Assessment*, 2021 (web link: https://www.energy.ca.gov/publications/2021/2021-sb-100-joint-agency-report-achieving-100-percent-clean-electricity, last accessed August 2022).

[104] California Air Resources Board, *The AB 32 Scoping Plan (draft)*, 2022 (web link: https://ww2.arb.ca.gov/our-work/programs/ab-32-climate-change-scoping-plan/2022-scoping-plan-documents, last accessed August 2022).

impact locally. The potential for vehicle-to-grid technology, where vehicles can support electricity load, hold the promise to support grid resiliency in the future.

b) Electric Grid Planning

The State's process to plan for future electricity demand is robust. CPUC has a comprehensive Integrated Resource Plan and Long-Term Procurement Planning process that evaluates electricity needs on a ten-year time horizon and then authorizes the procurement. The process evaluates reliability needs of the overall electric system, local reliability needs specific to areas with transmission limitations, and flexibility needs like the resources required for renewable energy integration. Using inputs from the CEC's Energy Demand Forecast and the California Independent System Operator, new needs are identified, and additional procurement is authorized. Each IOU then solicits and eventually contracts for the required resources. The process is ongoing and in February 2022, CPUC approved under the 2021 Preferred System Plan procurement of potentially $49 billion in electric system upgrades by 2032.[105]

The CEC's Energy Demand Forecast is updated annually as part of the Integrated Energy Policy Report and uses various data sources such as CARB's Mobile Source Strategy, vehicle inventory, approved electrification regulations, and CEC forecasting from the AB 2127 EV Charging Infrastructure Assessment.[106] The CEC's HEVI Load model was developed in conjunction with Lawrence Berkeley National Laboratory to analyze demand for heavy-duty charging infrastructure in support of the AB 2127 assessment and is a critical input to inform the Integrated Energy Policy Report. CARB collaborates closely with CEC to ensure that data is supplied to the HEVI-Load model to capture changes in vehicle populations both geographically and over time. In addition, each utility creates an Integrated Resource Plan, which is a comprehensive planning document for the utility, that also feeds into the procurement planning process. All these inputs allow for a comprehensive assessment and a better understanding of grid impacts and infrastructure needs at the regional and local level.

c) Grid Reliability

Staff recognizes that as wildfire risk in California has grown, CPUC and IOUs have implemented a significant number of power outages to mitigate the risk of accidental ignition from damaged utility equipment. While CPUC considers PSPS outage events as safety-related (as opposed to an unplanned outage from an equipment failure or traffic accident), all grid outages create uncertainty for fleets considering adoption of ZEVs. Therefore, understanding how utilities are addressing and mitigating supply disruptions is critical.

CPUC has directed the establishment of PSPS event policies to guide the behavior of the major IOUs, such as Pacific Gas and Electric (PG&E), Southern California Edison (SCE), and San Diego Gas and Electric (SDG&E). Efforts are underway at the major IOUs to address PSPS impacts on charging infrastructure, including:

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[105] California Public Utilities Commission 2022, *Decision Adopting 2021 Preferred System Plan Rulemaking 20-05-003*, 2021 (web link: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M449/K173/449173804.PDF, last accessed August 2022).

[106] AB 2127 (Ting, Stats. 2018 ch. 365).Public Resources Code section 25229.

a. Improving communication both before and during potential or active de-energization events regarding the location and accessibility of charging stations near impacted areas;
b. Studying the feasibility of grid-independent EV charging stations (e.g., mobile charging stations), which can be used to charge EVs during PSPS and other emergency events; and
c. Coordinating with EV charging providers to reinforce EV charging networks with backup generation.

The expectation is that the frequency and duration of planned PSPS events will gradually diminish as the grid is hardened to wildfires. Outside of PSPS events, the utility industry follows reliability, outage, and resource adequacy standards from various regulators like the North American Electric Reliability Council, broadly known as NERC, as well as CPUC and other sources. Following these resource adequacy standards to ensure outages do not occur, the utilities must keep a minimum 15 percent buffer between supply and demand at all times in case of an unexpected shortfall.[107]

In addition, utilities have adopted short-term reliability standards to help monitor unscheduled power outages locally, such as from a storm, car-pole accident or equipment failure. These reliability standards are stringent and allow for an acceptable outage risk of typically one to two hours per year. In addition, CPUC uses a Loss of Load Expectation standard for determining and evaluating acceptable risk, which is currently one day per ten years.[108] Overall, electrical service is extremely reliable and it is worth noting that conventional fueling stations also cannot pump fuel during power outages.

d) Grid and Fleet Resiliency

Grid resiliency is generally the ability to adapt to changing conditions; withstand disruptions, and to rapidly recover from an adverse event. Due to the ongoing risk of wildfires and other natural disasters, summer supply shortages, as well and the rapidly evolving grid, significant work is ongoing to improve grid resiliency.

The electrical grid is actively managed by balancing authorities on a minute-to-minute basis to ensure supply and demand remained balanced at all times. The introduction of intermittent distributed energy resources like wind, solar and storage into the system are managed by ever evolving smart grid technologies that allow balancing authorities to better segment, control and optimize the system. Utilities and municipalities are looking at microgrids as a way to improve resiliency during major power disruptions because they can isolate from the main grid and manage energy resources at a local level. Microgrids can operate on a variety of power sources, including renewables, multi-fuel reciprocating engines and even stationary fuel cells—plus energy storage like batteries are often integrated to improve reliability and provide flexibility. This landscape provides both opportunities and

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[107] California Public Utilities Commission, *Resource Adequacy Homepage*, 2022 (web link: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/resource-adequacy-homepage, last accessed August 2022).
[108] California Public Utilities Commission, *Electric System Reliability Annual Reports*, 2022 (web link: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/electric-reliability/electric-system-reliability-annual-reports, last accessed August 2022).

challenges for improving system resiliency and ZEVs hold great potential to support grid resiliency through smart charging and vehicle to grid (or load) applications.

In addition to the potential ability for ZEVs to support grid resiliency, at the fleet level, similar on-site microgrid technology can ensure that vehicles stay fueled during power disruptions. The latest smart chargers can help the resiliency of fleet facilities as well as potentially tap onsite renewable generation, like solar and storage, to effectively manage energy costs.

Insulating fleets from safety-related de-energizing events can be accomplished with robust energy storage systems both within the utility distribution systems and at fleet sites. Designing charging infrastructure to include energy storage and clean back-up power generation can play an important role during emergencies.[109] CPUC with CEC support, leads ongoing efforts to develop standards, protocols, guidelines, methods, rates, and tariffs that serve to support and reduce barriers to microgrid deployment. In addition, similar to how conventional fleets do not keep every vehicle fully fueled at all times, ZEV fleets will also have ZEVs at various states of charge each day and advanced fleet management software can help lower outage risk by ensuring that fully charged ZEVs are always available or even by having mobile charges available.

3. Hydrogen Fueling

Heavy-duty hydrogen fuel cell vehicles hold the promise of range and refueling times consistent with today's conventional vehicles. Similar to how diesel is provided at truck stops, in most cases, drivers of fuel cell trucks will rely solely on public fueling stations. Today, thirteen dual-use fueling stations with light- and heavy-duty capabilities are under development utilizing CEC grant funding and will augment the existing demonstration and pilot stations. However, for a successful fuel cell truck market, high flow rate stations must reach commercial deployment and continued funding for station construction is needed to ensure sufficient refueling infrastructure will be in place when more trucks reach commercial availability. Focusing funding for heavy-duty hydrogen refueling infrastructure along high-use freight corridors and committing to build these stations ahead of projected demand sends the right signals to OEMs and their fleet customers.

a) Hydrogen Production

Increasing demand for hydrogen use as a transportation fuel is creating a strong business case for building hydrogen production facilities to supply the California ZEV market. Strong State policy signals via the Governor's Executive Order N-79-20, new electrification regulations, and the LCFS incentivizing low carbon fuels, are increasing demand for hydrogen with lower carbon intensity. Today, the limited number of in-state hydrogen producers for use in fuel cell vehicles means that product may occasionally be delivered to distant fueling stations at higher costs, especially during supply disruptions. In addition, most of today's demand is met by existing producers of merchant hydrogen that employ steam methane reformation processes and need to purchase renewable natural gas (RNG) at a premium to satisfy California's renewable hydrogen requirements. This creates intermittent market

[109] California Public Utilities Commission, *Resiliency and Microgrids*, 2022 (web link: https://www.cpuc.ca.gov/resiliencyandmicrogrids, last accessed August 2022).

disruptions where renewable hydrogen supplies do not meet current demand from light-duty fuel cell vehicles and transit buses.

The cost of clean electrolytic hydrogen is projected to decrease over the coming decade due to falling electrolyzer and renewable energy costs, coupled with inexpensive curtailed electricity.[110] Today, the approximately $15 per kilogram retail price of hydrogen (associated with light-duty fueling) limits the business case for fuel cell trucks; however, producers of renewable hydrogen believe that as production scales up, hydrogen can be offered at price parity with the historical cost of conventional fuels. Similarly, the high cost to develop public heavy-duty hydrogen fueling infrastructure will require some public support, which is available through CEC's EnergIIZE program.

b) Renewable Hydrogen

CEC has increased supply by funding 100 percent renewable hydrogen production facilities in recent years, and as the heavy-duty market grows more plants will be needed. State efforts to increase demand through vehicle incentives and LCFS credits will foster a self-sustaining industry where renewable hydrogen producers have sufficient business demand to justify the significant financial investment in new capacity thereby lowering the need for on-going financial assistance.

CEC's Investment Plan update for Clean Transportation each year includes funding for zero- and near-zero-carbon fuel production and supply, and CEC has funded in-state renewable hydrogen production in recent funding cycles. The 2021 Annual Evaluation of FCEV Deployment and Hydrogen Fuel Station Network Development report produced pursuant to Assembly Bill 8 identifies demand for renewable hydrogen exceeding supply in the near term and emphasizes the need to increase and maintain a consistent supply of renewable hydrogen. [111,112] Findings in the AB 8 report describe the value of annual funding for renewable hydrogen production in the CEC's Clean Transportation Investment Plan updates. In addition, the Governor's approved budget for FY 2021-22 includes $100 million for production of green hydrogen over 2 years.

c) Hydrogen Distribution

Today, hydrogen is either delivered to fueling sites as a compressed gas or as cryogenic liquid. With increasing demand and higher station throughput, station operators and suppliers are trending more towards liquid delivery, which equates to significantly fewer truck trips and miles traveled. Limited hydrogen pipelines exist in the state and are associated with

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[110] Rocky Mountain Institute, *Fueling the Transition: Accelerating Cost-Competitive Green Hydrogen*, 2021 (web link: https://rmi.org/insight/fueling-the-transition-accelerating-cost-competitive-green-hydrogen, last accessed August 2022).

[111] AB 8 (Perea, Stats. 2013, ch. 401). Health and Safety Code new section 43018.9, repeal section 44299, amendments to Health and Safety Code sections 41081, 44060.5,44125, 44225, 44249, 44270.3,44271,44272, 44273, 44274, 44275,44280, 44281,44282,44283,44287,44299.1, and 44299.2; amendments to Public Resources Code section 42885 and 42889; amendments to Vehicle Code sections 9250.1, 9250.2, 9261.1, and 9853.6.

[112] California Air Resources Board, *2021 Annual Evaluation of Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development*, 2021 (web link: https://ww2.arb.ca.gov/sites/default/files/2021-09/2021_AB-8_FINAL.pdf, last accessed August 2022).

supply lines to industrial facilities like petroleum refineries. A project proposed by Southern California Gas Company (SoCalGas) dubbed Angeles Link, if approved, would support production of electrolytic hydrogen from solar and wind resources in the high desert and transported via pipeline to commercial and industrial centers in Southern California.[113] Pipeline delivery would help lower costs, but significant development hurdles exist and, until then, most hydrogen will continue to be delivered by truck—with some producers actively planning to use ZE delivery trucks. In addition, some companies are considering large-scale solar electrolytic hydrogen production near stations along highway corridors, which would help mitigate or minimize the need for trucking hydrogen.

In rural, less populated regions of the state, it is anticipated that most rural truckers' hydrogen refueling needs can be met at truck stops located along California's key freight highway corridors because of the projected range of FCEVs—up to 500 miles with the Hyundai XCIENT.[114] The California Fuel Cell Partnership produced the Fuel Cell Electric Trucks Vision Document that focuses specifically on the infrastructure and support needed for a successful Class 8 fuel cell truck market. [115] The report states, "with adequate policy support, by 2035, an interim milestone of 70,000 fuel cell electric trucks on the road supported by 200 heavy-duty hydrogen stations could be achieved." As a follow up to this vision, the California Fuel Cell Partnership is working on a heavy-duty hydrogen roadmap to determine and prioritize which of the freight corridors and existing diesel truck stop sites to target first for hydrogen infrastructure.

d) Hydrogen Fueling Standardization

While hydrogen refueling infrastructure and fueling protocols for light-duty cars and transit buses have been standardized, heavy-duty fuel cell truck and refueling technology is still under development. Truck OEMs are now working with national labs and standards organizations to culminate around performance standards to meet the on-board H2 storage needs, tank pressures, and refueling times that heavy-duty fleets will require. The standards organizations are focusing on a fueling rate target of 10 kg/minute, 350 and 700 bar storage systems, nozzles and receptacles, and operational characteristics including safety guidelines and communication hardware. At this time, the standards community is working toward harmonizing ISO standards with SAE and completing standards development in 2023.

4. Zero-Emission Infrastructure Coordination and Buildout

Electric vehicles rely on the electric grid to provide consistent, on-demand power to charge vehicles. The electric grid will have to expand and adapt to meet a new and more extensive demand of light-, medium-, and heavy-duty ZEVs.

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[113] SoCal Gas, *Angeles Link Shaping The Future With Green Hydrogen*, 2022 (web link: https://www.socalgas.com/sustainability/hydrogen/angeles-link, last accessed August 2022).
[114] Hyundai, *Hyundai's XCIENT Fuel Cell Hitting the Road in California*, 2021 (https://www.hyundainews.com/en-us/releases/3362, last accessed August 2022).
[115] CaFCP, *Fuel Cell Electric Trucks – A Vision for Freight Movement in California and beyond*, 2021, (web link: https://cafcp.org/blog/california-fuel-cell-partnership-envisions-70000-heavy-duty-fuel-cell-electric-trucks-supported#:~:text=Sacramento%2C%20California%E2%80%94Today%2C%20the,by%20200%20heavy%2Dduty%20truck, last accessed August 2022).

Historically, the state's electric grid has expanded and evolved as consumer demand for electricity services has grown, including with the recent emergence of plug-in electric vehicles. California's existing grid and approved investments occurring now will allow the state to handle millions of electric vehicles in the near-term, and projections show the broader western grid can handle up to 24 million electric vehicles without requiring any additional power plants.[116] However, electrification of California's entire transportation sector, particularly when combined with increased electrification of the state's building stock, will require further investments in transmission and local distribution systems and coordinated grid planning efforts.

Longer term, vehicle electrification is achievable with a gradual build out of clean energy resources - more gradual than during times of peak electricity sector growth in the past given electric vehicle loads can be distributed over non- peak hourly periods. Several studies have shown no major technical challenges or risks have been identified that would prevent a growing electric vehicle fleet at the generation or transmission level, especially in the near-term.[117,118] Additionally, based on historical growth rates, sufficient energy generation and generation capacity is expected to be available to support a growing electric vehicle fleet.[119]

State agencies and electric utilities have begun proactively planning for electrical distribution upgrades and new load for electric vehicles via statewide energy system planning processes, including CEC's Integrated Energy Policy Report forecasting, CAISO transmission planning, and CPUC's Integrated Resource Plan proceeding for ten-year grid enhancement strategies. Additionally, recent policy changes allow investor-owned utilities in California to establish rules and tariffs under general rate case proceedings for electrical distribution infrastructure on the utility side of the meter to support transportation electrification charging stations.[120] CPUC has already approved utility investments for upgrading the electric grid along with electricity rate changes to fund those investments. CPUC approved time-of-use rates which provides signals to electricity rate changes at different times of the day that would impact the cost to fuel for electric vehicle drivers that charge at home. This decision was made to optimize grid resources, maintain grid reliability, and provide reasonable rates for residential EV charging.[121] CPUC also opened a new proceeding to modernize and prepare the grid in

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[116] PNNL 2020. Kintner-Meyer, Michael, et al, *Electric Vehicles at Scale – Phase I Analysis: High EV Adoption Impacts on the Western U.S. Power Grid. Pacific Northwest National Laboratory*, 2020 (web link: https://www.pnnl.gov/sites/default/files/media/file/EV-AT-SCALE_1_IMPACTS_final.pdf, last accessed August 2022).
[117] US DRIVE 2019, *Summary Report on EVs at Scale and the U.S. Electric Power System. U.S. Driving Research and Innovation for Vehicle Efficiency and Energy Sustainability (DRIVE)*, 2019 (web link: https://www.energy.gov/sites/prod/files/2019/12/f69/GITT%20ISATT%20EVs%20at%20Scale%20Grid%20Summary%20Report%20FINAL%20Nov2019.pdf, last accessed August 2022).
[118] Muratori et al 2021. Matteo Muratori et al, *"The rise of electric vehicles—2020 status and future expectations,"* 2021 (web link: https://iopscience.iop.org/article/10.1088/2516- 1083/abe0ad/pdf, last accessed August 2022).
[119] DOE 2019.
[120] AB 841 (Ting 2020).
[121] CPUC, *"Electricity Rates and Cost of Fueling." California Public Utilities Commission*, 2022 (web link: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/transportation-electrification/electricity-rates-and-cost-of-fueling, last accessed August 2022).

anticipation of multiple distributed energy sources.[122] With this new proceeding, the CPUC aims to evolve grid capabilities to integrate distributed energy sources including electric vehicle charging, electric vehicle charging forecasts to improve distribution planning, and community input to optimize infrastructure investments for the grid.[123]

One of the key goals of this proceeding is to improve distribution planning, including charging infrastructure forecasting to support cost-effective and widespread transportation electrification. In parallel, CEC staff is developing the EVSE Deployment and Grid Evaluation tool, which currently uses the IOUs' Integration Capacity Analysis map data to understand existing grid conditions and capacity. This tool will not only help stakeholders identify suitable locations for charger deployments, but also act as an early warning system for utilities and grid planners to identify locations where grid upgrades may be required to support high charging demand. In most circumstances, electric vehicles do not draw energy at the same time they are operating, and charging time is usually much shorter than vehicle dwell time. This provides electric vehicles with the flexibility to charge at times that are less impactful to the grid and at times of abundant renewable generation availability.

Innovative solutions are emerging to help support charging infrastructure and manage loads at the local grid level. Since ZEVs are a unique electric load and are potentially advantageous compared to other types of load, State agencies and utilities are also actively planning for vehicle-to-grid integration services. These vehicle-to-grid services range from bi-directional charging to one-directional passive load shifting by price signals or rate design. Load shifting is valuable to the state to control peak loads by shifting a large portion of charging loads to hours that are less impactful to the grid. Load shifting strategies are also easy to implement for electric utilities and for vehicle owners and allow for better integration of renewable energy. Models suggest that electric vehicle charging can reduce renewables curtailment, which is when the output of a renewable energy resource is intentionally reduced below what it could produce, anywhere from 25 to 90 percent.[124,125] As vehicle-to-grid services move into bi-directional charging, where the power can flow to and from the vehicle battery, the benefit to the grid is greater with the potential to offset grid upgrades and further reduce overall strain at peak usage times. Bi-directional services can also provide emergency backup services in the event of grid shutoffs or general power failures. Overall, vehicle-to-grid services create opportunities to reduce system costs and facilitate renewable energy

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[122] CPUC, *California Public Utilities Commission. Proposed Decision: Order Instituting Rulemaking to Modernize the Electric Grid for a High Distributed Energy Resources Future*, 2022 (web link: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/transportation-electrification/electricity-rates-and-cost-of-fueling, last accessed August 2022).
[123] CPUC, *CPUC Takes Action to Modernize Electric Grid for High Distributed Energy Resources Future*, 2022 (web link: https://www.cpuc.ca.gov/news-and-updates/all-news/cpuc-takes-action-to-modernize-electric-grid-for-high-distributed-energy-resources-future, last accessed August 2022).
[124] CalISO, "*Impacts of renewable energy on grid operations*," 2017 (web link: https://www.caiso.com/documents/curtailmentfastfacts.pdf, last accessed August 2022).
[125] PNNL 2020.

integration, and electric vehicle resource adequacy can be doubled with these managed charging strategies.[126,127,128]

With the benefits electric vehicles can provide to the grid, State agencies in California have continued to collaborate on policies and programs to enable this integration. CEC, CAISO, CPUC, CARB, and other stakeholders are working to update the State's roadmap to integrate electric vehicle charging needs with the needs of the electrical grid. The update will reflect advancements in vehicle-to-grid technology and include actions the State can take to advance California's transportation electrification goals. Separately, in December 2020, CPUC adopted a decision on vehicle-to-grid which created metrics and strategies for advancing vehicle-to-grid and authorized almost $40 million for the investor-owned utilities to spend piloting vehicle-to-grid technologies and programs. In November 2021, CPUC adopted a resolution creating a pathway for alternating current interconnection for vehicle-to-grid and allowing some electric vehicles to enable bi-directional mode more easily. CPUC is continuing to consider streamlining procedures for both charging and bi-directional interconnections.

As the electric vehicle market expands, electricity demand will increase to provide the charging needs for these vehicles. To meet this anticipated demand, State agencies and electric utilities have begun planning and putting in place programs for electrical distribution upgrades. Although an increase in electricity demand is anticipated with the widespread adoption of electric vehicles, electric vehicles can aid in managing grid resources and can improve resilience of the grid.

To meet the demand for charging stations and hydrogen fueling as well as to ensure fueling will be conveniently located and available, significant coordination is occurring between California's agencies. CARB, CEC, and CPUC are the three primary California agencies responsible for early electric and hydrogen refueling infrastructure while a number of additional agencies also have important roles. Federal investments in charging and hydrogen stations are underway through the Infrastructure Investment and Jobs Act and the National Electric Investment Program. Ensuring requirements, such as related infrastructure build-out rates are technologically feasible, cost-effective, and support market conditions is a top priority for the implementation of the proposed ACF regulation.

a) State Agency Efforts

The following contains key actions by State agencies to address the growing need for ZE fueling infrastructure in California. While CARB engages in a number of actions aimed at expanding new and used ZEV markets and increasing access to clean mobility, CEC is the primary agency tasked with supporting infrastructure. CARB closely collaborates with sister agencies and assists in infrastructure development where appropriate to support ZE rule

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[126] Ibid.

[127] International Renewable Energy Agency*, Innovation Outlook: Smart charging for Electric Vehicles (Abu Dhabi: International Renewable Energy Agency*, 2019 (web link: https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2019/May/IRENA_Innovation_Outlook_EV_smart_charging_2019.pdf, last accessed August 2022).

[128] Zhang et al 2018a. Zhang J, Jorgenson J, Markel T and Walkowicz K, "*Value to the grid from managed charging based on California's high renewables study" IEEE Trans. Power Syst. 34 831–40*, 2019 (web link: https://www.osti.gov/pages/servlets/purl/1494793, last accessed August 2022).

development and implementation. CARB also partners with CEC via an interagency agreement to focus on ZEV workforce training and development to promote these activities in priority communities. The program supports career pathway development projects, including curriculum, ZEV manufacturing, pre-apprenticeship training, train-the-trainer activities, and more with an emphasis on priority communities.

(1) Governor's Office of Business and Economic Development

GO-Biz serves as the first point of contact for ZEV related businesses to engage with State government. California law requires permitting agencies to meet minimum processing standards and GO-Biz is the lead agency in the effort to streamline ZEV infrastructure development permitting and has published guidebooks on hydrogen station permitting and EV charging station permitting. The guidebooks are intended to help provide the resources necessary to alleviate the remaining development barriers and to encourage cities, counties, and developers to share information to streamline the development process.[129]

(2) California Energy Commission

CEC is the State agency primarily tasked with incentivizing development to meet the charging and refueling infrastructure needs and has launched multiple efforts to support those directives. CEC developed the State's ZEV Infrastructure Plan, which initiates a long-range planning through coordination with other State agencies. The ZEV Infrastructure Plan focuses on decision-making in the public and private sectors by documenting plans and strategies to deploy ZEV infrastructure for all Californians in an equitable manner as well as the public support needed. Additional efforts include, but are not limited to:

- The Clean Transportation Program provides funding to accelerate the development and deployment of advanced transportation and fuel technologies. The 2021-2022 State Budget included $500 million to deploy charging and fueling infrastructure for medium- and heavy-duty vehicles. One example of a successful project is the Joint CARB/CEC Zero-Emission Drayage Truck and Infrastructure Pilot program that funded Class 8 port trucks and infrastructure. Clean Transportation Program funding has historically been the primary means to fund hydrogen station projects.
- The EnergIIZE program provides funding for charging and hydrogen infrastructure to support medium- and heavy-duty battery-electric and hydrogen fuel cell commercial vehicles in California. The project provides a streamlined process with targeted incentives and specialized assistance. The program received $50 million in FY 2021-2022 to launch the program and is anticipated to receive additional funding in future years. EnergIIZE offers incentives through 4 funding lanes:
  - EV Fast Track provides charging infrastructure funding for commercial fleets that have already procured battery-electric trucks or have trucks on order.
  - EV Jump Start provides charging infrastructure funding for commercial fleets operating in disadvantaged communities, transit and school bus fleets, small fleet owners, and small business enterprises.

[129] Governor's Office of Business and Economic Development, *Electric Vehicle Charging Station Permit Streamlining Fact Sheet*, 2022 (web link: https://business.ca.gov/industries/zero-emission-vehicles/plug-in-readiness/, last accessed August 2022).

  - EV Public Charging Station lane provides competitive funding for publicly accessible charging infrastructure for commercial vehicles.
  - Hydrogen funding lane provides competitive funding for hydrogen fueling infrastructure for commercial fuel cell vehicles.
- BESTFIT Innovative Charging Solutions solicitation funds projects to demonstrate charging solutions for light- and heavy-duty vehicles and to accelerate commercial deployment. Heavy-duty funded projects have a greater than 1 to 1 private match.
- CEC's analytical work in forecasting and modeling is critical to ensure there is sufficient electricity and that infrastructure investments are made wisely. The 2020 Integrated Energy Policy Report provided an assessment that included a report on transportation trends, an update to the electricity demand forecast, and an assessment of microgrids. The 2021 Integrated Energy Policy Report included updates on electricity demand forecast, decarbonization, resilience and to further assess infrastructure requirements.
- AB 2127 required CEC to biennially assess EV charging infrastructure needed to support the States' 2030 goals. The CEC's initial August 2021 report indicated that 157,000 high powered chargers were needed by 2030 to support 181,000 medium- and heavy-duty vehicles.[130]
- Senate Bill 643[131] requires CEC, in consultation with CARB and CPUC, to prepare a statewide assessment of the FCEV fueling infrastructure and fuel production needed to support the adoption of ZE trucks, buses, and off-road vehicles, and complete the assessment by the end of 2023.
- Integrated Resource Plan review—Integrated Resource Plans are key electricity system planning documents that ensure utilities lay out their demand growth, resource needs, policy goals, physical and operational constraints, and proposed resource choices in the 10 to 20-year time horizon. SB 350, requires certain POUs to develop and submit an Integrated Resource Plan to CEC.
- 2020 Vehicle Grid Integration Roadmap identifies key next steps for advancing vehicle grid integration over the next 10 years. CEC is leading the effort to update the state's roadmap to integrate EV charging needs with the needs of the electrical grid.
- CEC's Load Management Standard rulemaking will improve demand-flexibility on the electricity grid by promoting a dynamic rate environment. By aggregating all utility rates, the database provides an accurate signal to appliances (including chargers) to conserve, or alternatively operate, at certain times of the day. This will support a reliable renewable and decarbonized electricity grid, as well as potentially lower charging costs.

(3) California Public Utilities Commission

The CPUC regulates California's 3 largest IOUs Pacific Gas and Electric Company (PG&E), Southern California Edison Company (SCE), San Diego Gas and Electric Company (SDG&E) and 3 smaller IOUs that operate in rural and/or unincorporated territories (Liberty Utilities, Pacificorp and Bear Valley). It has the authority over the cost and design of the IOUs' TE investment programs, the rates the IOUs establish to provide electricity as a transportation fuel, and other IOU expenditures associated with their TE programs such as pilots,

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[130] California Energy Commission, *Assembly Bill 2127 Electric Vehicle Charging Infrastructure Assessment*, 2021 (web link: https://efiling.energy.ca.gov/getdocument.aspx?tn=238853, last accessed August 2022).
[131] SB 643 (Archuleta, Stats. 2021 ch. 646). Health and Safety Code section 43871.

marketing, outreach, and education initiatives. Planning efforts include, but are not limited to:

- CPUC's 2020 draft TE Framework is a comprehensive long-term planning document intended to define the IOU role in deploying TE infrastructure and provide guidance and a structured process for IOUs to develop ten-year strategic TE Plans. This framework will streamline processes and accelerate TE growth, with a focus on DACs and addressing equity barriers.
- CPUC oversees the IOU adoption of TE Plans. IOUs will be required to adopt a TE Plan within one year of TE Framework finalization and focus on how IOUs will achieve State targets, overcome barriers and include long-term strategy for addressing medium- and heavy-duty sectors. TE Plans will include projected infrastructure needs in the IOU service territories, investment strategies, estimated budgets, as well as targets based on priority market segments and program descriptions.
- Recent CPUC decisions approved continued support of TE programs and the offering of subscription-based rates that remove direct demand charges.

(4) California Building Standards Commission

The California Building Standards Commission is the primary agency overseeing building standards in the state and works in conjunction with the Housing and Community Development Agency and others. CARB has assisted the Commission in the adoption of minimum infrastructure requirements for heavy-duty vehicles in new warehouses over 20,000 sq. ft. and new retail and grocery stores over 10,000 sq. ft. The new requirements would provide sufficient conduit and panel capacity to support a 200 to 400 KVA increase in load from future electrification.

(5) California Infrastructure and Economic Development Bank

The California Infrastructure and Economic Development Bank has broad authority to enable and increase financing opportunities for ZEV projects and bring more private capital into the market to stimulate ZEV market development and improve the viability of ZE investments. The Bank operates several programs, including the Catalyst Fund that provides low-interest loans, financial guarantees, and other economic tools to promote accelerated investment in ZEV infrastructure. To increase investments in Priority Communities the Bank will attempt to stimulate investment in ZEV infrastructure by leveraging its network of local lending partners. In addition, the Catalyst Fund was established as the state's counterpart, and recipient, to any federal climate stimulus funding that may become available.

(6) Strategic Growth Council

The Strategic Growth Council (SGC) provides California Climate Investments funding to support job development, mobility improvement, and create opportunities to enable ZEV adoption in priority communities. The SGC's Affordable Housing and Sustainable Communities Program targets 50 percent of significant funding to DACs, low-income communities, and low-Income households by increasing the accessibility to affordable housing, employment centers, and key destinations via low carbon transportation. The program typically funds ZEV transit vehicles, ZEV fueling infrastructure, and ZEV car sharing that serve low-income and DACs. The Program also emphasizes fewer VMT through reduced vehicle trip length as well as mode shift to transit, bicycling, or walking. This program is funded by the California Climate Investments Program and at least 50 percent of funds are dedicated to projects in DACs.

(7) California Department of Transportation

Caltrans is supporting local jurisdictions' transition to ZEVs by encouraging local transportation agencies to develop and adopt regional ZEV infrastructure plans and policies in their transportation plans. Locally, Caltrans is encouraging fueling efficiency via the joint use of ZEV fleets with transit agencies by coordinating efforts to identify opportunities to share charging or fueling infrastructure facilities.

Caltrans is developing a ZEV Infrastructure Handbook to establish processes and procedures for implementing workplace and public ZEV infrastructure. The Handbook will consider pricing signals and identify areas of responsibilities for workplace charging and fleet charging prioritization and builds off the experience gained in developing charging stations at its own facilities.[132] Caltrans is also collaborating with CEC to identify and address key gaps in DC charging and hydrogen fueling networks. The updated Truck Parking Survey identifies the operational characteristics of heavy-duty vehicles, such as downtime and routing, and helps inform the development of freight fueling corridors. Additional work includes development of a Dig Smart policy in order to advance best practices to lower the capital cost of infrastructure deployment and minimize disruptions caused by ongoing or duplicate construction.

b) Private Entity Infrastructure Investments

In addition to State efforts to accelerate the deployment of publicly available ZEV infrastructure, private companies have also advanced infrastructure rollout, sometimes as part of wider efforts to help fleets with the integration of ZE trucks as well as gathering data to improve their product offerings.

Industry partners are planning a network of charging sites on critical freight routes in three regions (West, East, and Texas) by 2026 with construction set to begin in 2023.[133] The initial funding is approximately $650M and will focus primarily on medium- and heavy-duty battery-electric charging infrastructure before expanding to hydrogen fuel cell and light-duty vehicles.

Hydrogen station developers including Chevron and Iwatani, who have been building hydrogen stations for light-duty vehicles with CEC funding assistance, are also committing to build stations without government funding.[134] While Chevron and Iwatani are initially focused on retail fueling or light-duty vehicles, they are retaining flexibility to service heavy-duty vehicles over the long-term. Over the past few years, the amount of private investment into

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[132] California Department of Transportation and California Energy Commission, *Final Project Report: "Installation of Electric Vehicle Charging Stations," January 2020, Document No. CEC-2020-014*, 2020 (web link: https://www.energy.ca.gov/sites/default/files/2021-05/CEC-600-2020-014.pdf, last accessed August 2022).
[133] HartEnergy, NextEra Energy, BlackRock Pitch $650 Million EV Charging Network, 2022 (web link: https://www.hartenergy.com/exclusives/nextera-energy-blackrock-pitch-650-million-ev-charging-network-198664, last accessed August 2022).
[134] Chevron, *Iwatani Agreement 30 Hydrogen Stations in CA — Chevron.com,* 2022 (web link: https://www.chevron.com/newsroom/2022/q1/chevron-iwatani-announce-agreement-to-build-30-hydrogen-fueling-stations-in-california, last accessed August 2022).

hydrogen stations has increased significantly. Information on the current status of all hydrogen stations in the state can be found at the California Fuel Cell Partnership's station map, including those that are operating, under some phase of development, and planned for future construction.[135]

In addition, several hydrogen producers are committing to develop renewable hydrogen production for the California market. While most are seeking government funding, Plug Power is planning to build a renewable hydrogen production facility in Mendota, California, without government funding. This 30-metric ton per day electrolysis plant will produce hydrogen from on-site solar power and recycled water from the city's wastewater treatment plant.[136] The plant will supply liquid hydrogen to their fuel cell forklift fleet customers and sell the surplus to the transportation market. Plug Power indicates that, due to zero carbon intensity associated with hydrogen production and the ability to earn LCFS credits, they will be able to offer hydrogen at a price competitive with diesel.

H. Fleet considerations for ZEV Deployment

The transition to ZEVs requires entities to consider a number of factors in order to accommodate the unique needs of each fleet, including upfront costs, availability, and operating characteristics, which are discussed in this section. This section also describes electricity rate structures in consideration of the influence electricity costs have on battery-electric recharging costs as well as provides a greater discussion on weight and payload capacities of ZEVs within each vehicle weight class category. Staff acknowledges these significant factors and illustrates solutions that are additionally contained within the section, along with supplemental discussion on the flexibility that the ZEV phase-in option offers for range and vehicle weight barriers.

1. Upfront Cost of ZEVs

Today and for the foreseeable future, BEVs and FCEVs will cost more upfront than their combustion-powered counterparts. This is due to a combination of higher vehicle prices as well as additional infrastructure costs. While operational savings are expected to offset these upfront costs over the lifetime of most vehicles, the increased capital expenditure associated with ZEVs will have an impact on fleets during this transition.

New vehicle prices for ZEVs are expected to be higher than their combustion counterparts for the near future due to the more costly components needed for their manufacture. BEVs require a battery and FCEVs require hydrogen tanks and fuel cell stacks, both of which increase the vehicle's overall price. However, while these prices are higher today, cost declines are occurring and are expected to continue. The price of batteries and other ZEV components continue to decline due to increased volume and economies of scale. For example, Bloomberg estimates the price of batteries has declined from $1,200/kilowatt-hour

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[135] CAFCP, *California Fuel Cell Partnership Hydrogen Stations map*, 2022 (web link: https://cafcp.org/stationmap, last accessed August 2022).

[136] Plug Power Inc., *Plug Power to Build Largest Green Hydrogen Production Facility on the West Coast*, 2021 (web link: https://www.ir.plugpower.com/press-releases/news-details/2021/Plug-Power-to-Build-Largest-Green-Hydrogen-Production-Facility-on-the-West-Coast-2021-9-20/default.aspx, last accessed August 2022).

(kWh) in 2010 to $132/kWh in 2021, a decrease of nearly 90 percent.[137] In some vocations, there is already evidence of cost parity between diesel and battery-electric vehicles. For example, Thomas-Built Buses recently announced a letter of intent which would deliver battery-electric school buses at cost parity with diesel school buses.[138] Similarly, the Ford F150 Lightning is being offered at a similar price versus an ICE Ford F150 with a similar configuration.[139] However, for vehicles with limited production, ZEV prices continue to be substantially higher than their combustion counterparts and we expect it to take more time before the incremental price for ZEVs to decline. For these reasons, staff foresees that incremental vehicle prices will become less of an issue over time.

Transitioning fleets to ZEVs would also require new infrastructure construction, which adds additional upfront costs. Initially, ZEVs will require the construction of new infrastructure for battery-electric and FCEVs. Many of the State's utilities have set up infrastructure investment programs that can offset the cost of installing infrastructure, as discussed in previous sections. As the ZEV market expands, more publicly accessible recharging and refueling networks will develop, providing fleets more refueling options and fewer concerns about range anxiety.

Financing can also alleviate these issues by spreading these upfront costs overtime. Because ZEVs have lower operating costs than combustion-powered vehicles, a fleet can spread out the higher upfront cost over the initial years of the deployment and then offset those costs with operational savings. This will allow the fleet's cashflow to remain neutral despite the higher cost of deploying ZEVs. To accelerate this process, the State is establishing programs to increase financing availability for ZEV replacements pursuant to Senate Bill 372.[140] In some instances, manufacturers themselves are setting up financing and infrastructure packages that can offer further support to fleets.[141,142] Additionally, new trucks-as-a-service business models are also appearing that allow fleets to operate trucks with minimal or no capital expenditure, resulting in increased flexibility and reduction in the needed commitment of ZEVs.[143] The combination of these programs will ease entry into the ZEV market in the upcoming years, especially for smaller fleets.

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[137] Bloomberg, *Battery Pack Prices Fall to an Average of $132/kWh, But Rising Commodity Prices Start to Bite*, 2021 (web link: https://about.bnef.com/blog/battery-pack-prices-fall-to-an-average-of-132-kwh-but-rising-commodity-prices-start-to-bite/, last accessed August 2022).

[138] Thomas-Built Buses, *Highland Electric Fleets and Thomas Built Buses Sign Agreement to Make Electric School Buses an Affordable Option Today*, 2022 (web link: https://thomasbuiltbuses.com/resources/news/highland-electric-fleets-and-thomas-built-2022-03-17/, last accessed August 2022).

[139] Inside EVs, *Ford F-150 Lightning Is Priced Much Like Gas F-150, But How?, 2021*. (web link: https://insideevs.com/news/520495/ford-f150-lightning-pricing-interview/, last accessed August 2022).

[140] SB 372 (Leyva, Stats. 2021 ch. 369). Health and Safety Code sections 44274.10 to 44274.15.

[141] Charged, *Volvo Trucks' Next-Gen VNR Electric Offers Enhanced Range and Additional Configurations*, 2022 (web link: https://chargedevs.com/newswire/volvo-trucks-next-gen-vnr-electric-offers-enhanced-range-and-additional-configurations/, last accessed August 2022).

[142] PACCAR, *PACCAR Extends Zero Emissions Leadership with Schneider Electric and Faith Technologies to Provide Comprehensive Battery Charging Solutions*, 2020 (web link: https://www.paccar.com/news/current-news/2020/paccar-extends-zero-emissions-leadership-with-schneider-electric-and-faith-technologies-to-provide-comprehensive-battery-charging-solutions/, last accessed August 2022).

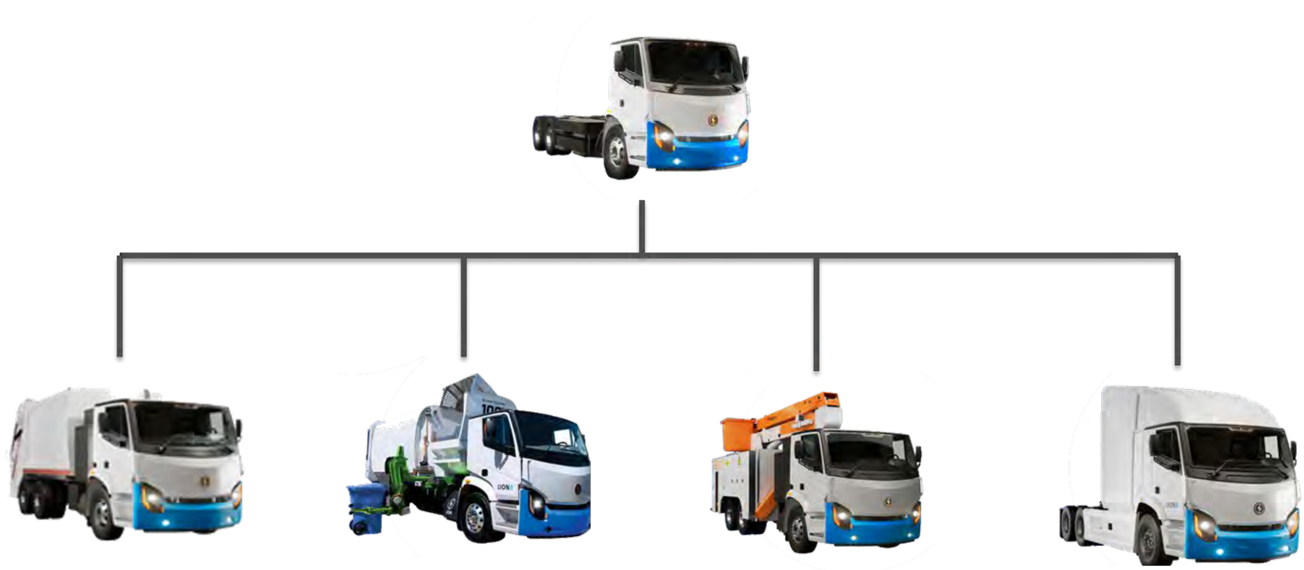
[143] WattEV, *WattEV Orders 50 Volvo VNR Electric Trucks*, 2022 (web link: https://www.wattev.com/post/wattev-orders-50-volvo-vnr-electric-trucks, last accessed August 2022).

2. Vehicle Availability from a Fleet Perspective

In consideration of highly varying fleet demands, truck manufacturers work closely with their customers to provide a vehicle model capable of meeting fleets' needs. As a result, vehicles in Class 4 and above are typically manufactured in stages, beginning with a common cab-and-chassis configuration that is then upfitted with a unique body based on a fleet's unique specifications. This process can take up to a year or more depending on the complexity of the manufacturing process. This timeline may be amplified for ZEVs.

Additional complexity may be introduced when a fleet owner or operator considers key operational needs of their potential ZEV fleet including, but not limited to, charging or fueling location (on site or otherwise), charging or fueling time (overnight or periodically throughout the day), and projected energy expenditure. Considering these factors, a manufacturer may work with fleets through dealerships to "spec out" vehicles in order to identify the ideal base configuration that best suits the needs of the fleet. This procedure requires fleets to work closely with manufacturers so that they can be apprised of what ZEVs are available for purchase as well as production lead times. Similar to the process for conventional vehicles, the body manufacturer or a post-purchase upfitter will then place the appropriate body type on the vehicle after a base cab-and-chassis is chosen. Figure 44 illustrates an example of how different bodies can be fitted on the same base cab-and-chassis, resulting in a diverse range of configurations that are able to fulfill an assortment of job functions.

Figure 44: Example of Multiple Bodies Fitted to Base Cab-and-Chassis



There are currently 158 models of ZEVs where manufacturers are accepting orders or pre-orders in every vehicle weight class category in the United States that exist in a wide variety of configurations. Manufacturers continue to make announcements for new product offerings and as technology advancements are made, staff anticipates a greater expansion in available

ZEV configurations and capabilities. A list of current internationally available ZEVs may be found on CALSTART's Zero-Emission Technology Inventory website. [144]

3. Zero-Emission Vehicle Operational Characteristics and Considerations

ZE technologies possess some operating characteristics that differ from ICE vehicles. Fleet owners or operators will need to consider which ZE technologies are best suited to meet their operational needs as well as how these vehicles will be fueled or charged.

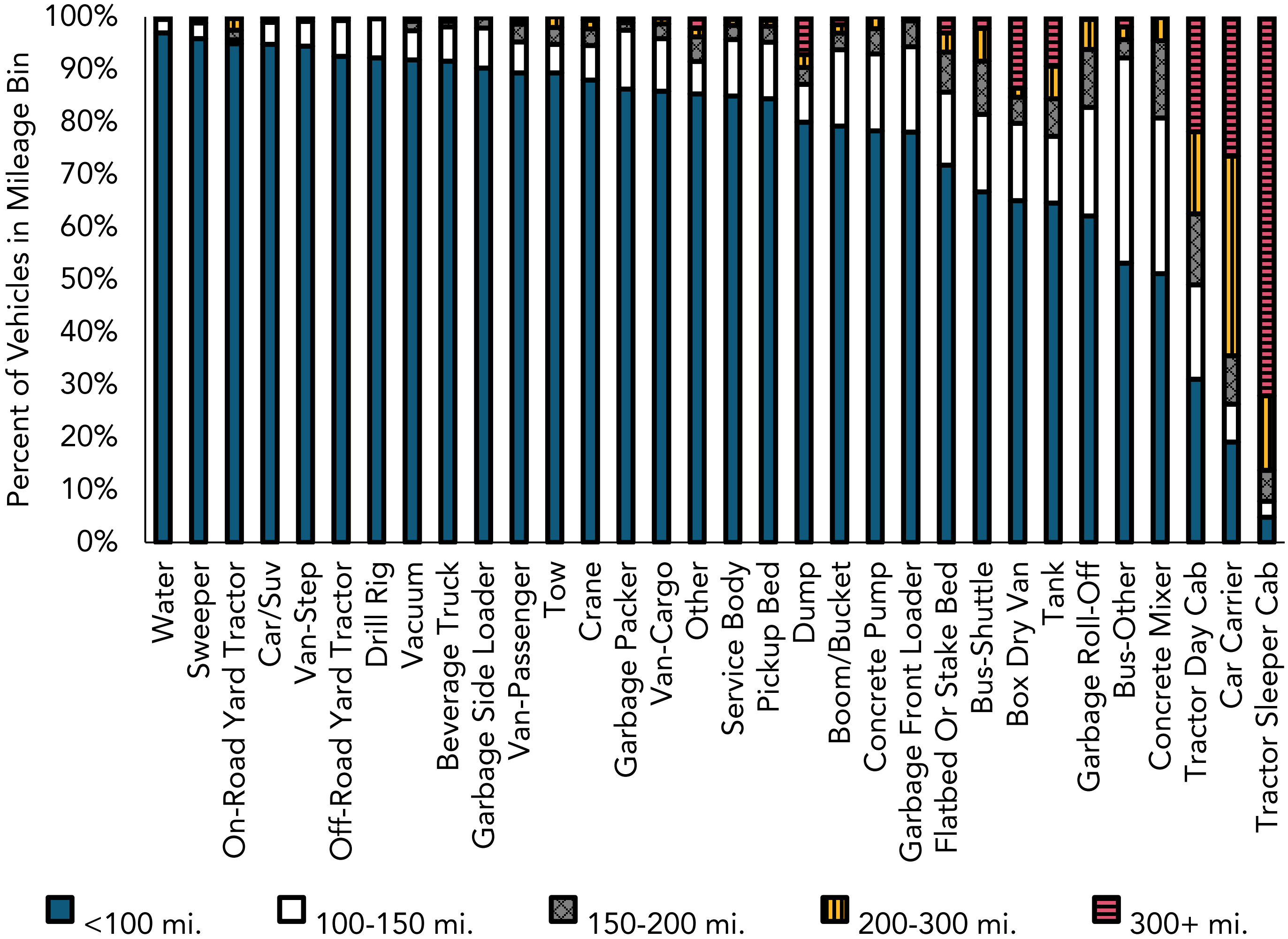
Fleets must consider daily operating characteristics as they transition to a ZEV fleet. BEVs are already commercially available but have greater range limitations than ICE vehicles and require access to charging. FCEVs do not have the same range limitations as BEVs but there are fewer FCEVs available today and fueling infrastructure is still under development.

The LER data indicates that most vehicles operate less than 100 miles per day. Class 3-8 BEVs that are already commercially available have a nominal daily range of 100 miles. Although range application in a real-world setting is affected by factors such as heating and air conditioning, suitability is expected to improve with manufacturers currently demonstrating models with range capabilities of over 200 miles per charge.[145,146,147]

Figure 45 illustrates the estimated average daily mileage for a number of vehicle types that were surveyed in the LER. This figure demonstrates that, within the sample population, the majority of these vehicles operate for less than 100 miles per day. This is largely consistent with prior data collected from the Vehicle Inventory and Use Survey and indicates that truck electrification is achievable based on ZE trucks available today. [148]

[144] CALSTART, *Zero-Emission Technology Inventory*, 2021 (web link: https://globaldrivetozero.org/tools/zero-emission-technology-inventory/, last accessed August 2022).
[145] Volvo Trucks, *The Volvo VNR Electric*, 2022. (weblink: https://www.volvotrucks.us/trucks/vnr-electric/, last accessed August 2022).
[146] Ford, *2022 Ford F-150 Lightning*, 2022. (web link: https://www.ford.com/trucks/f150/f150-lightning-electric-truck/, last accessed August 2022).
[147] Freightliner, *eCascadia*. (web link: https://freightliner.com/trucks/ecascadia/specifications/, last accessed August 2022).
[148] United States Census Bureau, *2002 Vehicle Inventory and Use Survey*, 2002 (web link: https://www2.census.gov/library/publications/economic-census/2002/vehicle-inventory-and-use-survey/ec02tv-us.pdf, last accessed August 2022).

Figure 45: Chart of the Estimated Average Daily Mileages for Select Vehicle Categories in Large Entity Reporting



For some applications that require high idling or the use of PTO, daily operational mileage may not be the best measure of a truck's duty cycle and other factors may affect a fleet's ability to electrify. Other measurement methods such as hour of operation would be appropriate in these applications.

Future expansion of the medium- and heavy-duty ZEV market must take into account applications that suit current and future ZEV technology. The most suitable market segments for electrification are ones where weight or space utilization are not overly constrained with relatively short, predictable routes operated from a centralized location. Appendix E of the ACT ISOR identified that just over 70 percent of Class 4-7 vehicles are good fits for electrification today while roughly 30 percent of Class 2b-3 and Class 8 vehicles are currently best suited for electrification. Further advances in technology will increase this portion of the medium- and heavy-duty truck population that is suitable for electrification.[149]

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[149] California Air Resources Board, *Advanced Clean Trucks Regulation – Appendix E: Zero Emission Truck Market Assessment*, 2019 (web link: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2019/act2019/appe.pdf, last accessed August 2022).

4. Electricity Rate Structures

The cost of electricity influences ZE refueling costs for BEVs. Electricity is needed to recharge batteries and to create renewable or electrolytic hydrogen necessary for fuel cell operation. Electricity is provided to customers in California primarily by 6 IOUs, and 46 POUs. These utilities strive to set rates low that balance policy goals and equity concerns. The CPUC governs rates for the IOUs whereas the local utility board oversees rates for POUs. The 3 largest IOUs (PG&E, SCE, and SDG&E) provide over 75 percent of the state's electricity.

Rates have a direct impact on BEV and FCEV operating costs. Rate barriers vary by sector but revolve around similar themes comprising intermittent or inflexible use leading to charging peaks and higher rates. These barriers may inhibit fleets' abilities to electrify by increasing costs beyond conventional fuels. Monthly utility bills vary by utility, customer type, and rate schedule, but generally consist of three charge components that include:

a. Fixed: The fixed charge is a flat dollar ($) amount per billing cycle. The fixed charge is included for all customer classes and is a standard method of cost recovery for utilities located in the United States.
b. Volumetric: The volumetric component is based on the volume of energy consumed in the month and is measured in kWh. This component is subdivided into two factors, which include the total amount of energy used in the billing cycle and when the energy was used (time-of-use). The volumetric charge components are determined by multiplying the energy usage (kWh) by the dollar per kWh ($/kWh) of energy consumed resulting in a dollar amount.
c. Demand: Demand charges assess the costs associated with being able to transmit power to a customer at a specific maximum level. This is priced in dollars per kW of peak power required. Non-coincident and coincident prices are contained within the demand charge and are based on the maximum energy usage in the United States standard interval period of 15 minutes. Non-coincident demand charge uses the peak 15-minute interval during the billing cycle, whereas coincident demand charge uses the peak from the peak (or semi-peak) time of use period. The complexity of calculating demand charges makes it difficult for heavy-duty vehicles and freight equipment to budget their electricity fueling costs.

Since the 1980's, California utilities have offered time of use pricing plans for commercial rates that vary according to the time of day, season, and day type (weekday or weekend). Higher rates are charged during the peak demand and lower rates during off-peak times. Most rates include three different time of use windows that, in addition to the peak and off-peak windows, includes a super off-peak within the 24-hour clock with different price schedules for weekends and holidays. Generally, pricing includes a winter and a summer season schedule. Recently, a new rate with increased granularity has been offered to commercial customers with four windows and three seasons, including a new schedule for the spring months when renewable generation is the highest.

Early demonstration projects found that, in some situations, demand charges could account for half of electricity fueling costs. While the cost for EV operation was still lower than the diesel equivalent, fleets learned that demand charges could be a significant barrier. Generally, demand charges are highest when EVSE utilization rates are low and become a smaller bill component as fleets utilization rates increase with more adoption. In response to early challenges, CPUC and IOUs have instituted new rates that eliminate demand charges through a combination of demand charge holidays and subscription rates. For PG&E, it is the BEV1 and BEV2 Rate; SDG&E EV-HP; SCE TOU-EV-7, TOU-EV-8 and TOU-EV-9. Some fleets, however, may decide to stay on existing commercial rates instead of switching to new EV rates.

Many IOUs and POUs now offer electricity cost calculators for fleets to estimate their fueling costs. Many niche businesses have arisen to provide sophisticated software to manage charging for fleets that will optimize electricity fueling costs with technology to dampen the peaks to reduce demand charges.

AB 841 authorizes IOUs to pay for more EV charging infrastructure costs on the utility side of the meter, among other infrastructure installation costs. The law helped to resolve the need for the utility to recover costs of providing the infrastructure directly from customers pursuing the TE project. The law is being implemented into utility rules as well. For example, SCE's Rule 29 lays out the new policies on cost borne by the utility versus the customer for system upgrades. Some studies indicate that large-scale TE will lead to a decline in electricity costs due to higher utilization of generation assets, reducing electricity costs for all ratepayers.[150,151]

Fleets that work with utilities in the planning stage of ZEV infrastructure deployment to estimate their electricity demands and estimate such demands in light of existing local distribution capacity would be ideally situated in identifying how charging strategies and rate structures can be utilized to minimize their electrical rate costs. There are a number of free rate calculator tools to model fleet make and charging needs.

From the fleet perspective, implementing a smart charging strategy is an effective way to avoid charging the BEVs at peak or mid-peak hours and instead charge vehicles during off-peak hours as much as possible to manage electricity bills more effectively, resulting in a lower total operating cost of BEVs. As fleets electrify, smart charging should be considered and incorporated from the beginning to maintain low operational costs and support both grid flexibility and sustainability. Fleet operators can kickstart this process by engaging with manufacturers and exploring EV fleet service providers who may offer fleets a one-stop shop for navigating the electrification process, such as implementing managed charging systems and facilitating relationships with charger manufacturers, software vendors, and utilities.

5. Weight and Payload Capacity

Government Code section 11343.3 requires CARB to account for "vehicle weight impacts and the ability of vehicle manufacturers or vehicle operators to comply with laws limiting the weight of vehicles." The proposed ACF regulation seeks to accelerate ZEV adoption in the medium- and heavy-duty truck sector using battery or fuel cell technology. However, a concern among fleet owners and operators is that the heavier ZE trucks, when compared to

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[150] E3, *EVGrid: Electric Vehicle Grid Impacts Model,* 2019 (web link: https://www.ethree.com/tools/electric-vehicle-grid-impacts-model-2/, last accessed August 2022).

[151] M.J. Bradley and Associates, *MJB&A Analyzes State-Wide Costs and Benefits of Plug-in Vehicles in Five Northeast and Mid-Atlantic States*, 2017. (web link: *https://www.mjbradley.com/reports/mjba-analyzes-state-wide-costs-and-benefits-plug-vehicles-five-northeast-and-mid-atlantic*, last accessed August 2022).

their diesel counterparts, will result in reductions in cargo capacity in weight limited applications. However, as described in this section, most medium- and heavy-duty vehicles travel relatively short distances and don't need the largest available battery for battery electric vehicles ,and fuel cell vehicles may have advantages in certain applications where long distance travel is needed. Weight is not a major concern for ZEVs that are below Class 7 because most lighter vehicle operate less than 150 miles per day and don't need large batteries, and they can be upsized to the next higher weight class if a high mileage is needed. For Class 7 and 8 tractors, weight is potentially an issue for about 10 percent of tractor trailers that operate at their weight limits. Some of the weight concerns are partly addressed by Assembly Bill 2061[152] that allows for an additional 2,000 lbs. for alternative fueled vehicles, and as technology improves weight concerns are expected to diminish for the few trucks that are weight limited.

Battery electric vehicle weight depends on the size of the battery needed for the application. Lithium-ion batteries are the most commonly used rechargeable battery because they have one of the highest energy densities of any current battery technology. Battery systems have significantly improved over the past decade because of increases in energy density at the cell, module, and system levels.[153] Energy density has increased by more than 30 percent from the period of 2011 to 2018 across different lithium-ion chemistries and designs.[154] New chemistries that offer higher theoretical energy density limits are being researched, developed, and tested. In the near term, technologies that will outperform current lithium-ion batteries involve new cathode, anode, and electrolyte materials that increase the amount of energy stored. These include lithium-sulfur chemistries and solid-state batteries which are anticipated to be introduced into the marketplace by 2025.[155]

Recently, BEVs have employed weight saving measures such as lighter materials through the replacement of vehicle components that offer weight savings and offset the differential between ICEVs and BEVs operating at maximum payload capacities. As a result, battery energy density improvements and lightweighting are creating weight parity for many truck applications across Class 3-8 vehicles, particularly for operations that have daily ranges of 150 miles or less, or for operations that are not weight sensitive.

Hydrogen has relatively high energy density and is suited for longer range applications. Hydrogen's greater energy density allows FCEVs to have lower vehicle weights when compared to BEVs with substantially more than 150-mile range.[156] It should also be noted that weight saving advancements combined with AB 2061, that allows for an additional 2,000

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[152] AB 2061 (Frazier, Stats. 2018 ch. 580). Amendments to Business and Professions Code section 12725, and Vehicle Code section 35551.

[153] World Electric Vehicle Journal, *From Cell to Battery System in BEVs: Analysis of System Packing Efficiency and Cell Types*, 2020 (web link: https://www.mdpi.com/2032-6653/11/4/77, last accessed August 2022)

[154] European Commission, *Circular Economy Perspectives for the Management of Batteries used in Electric Vehicles*, 2019 (web link: https://publications.jrc.ec.europa.eu/repository/handle/JRC117790, last accessed August 2022).

[155] European Commission, *Circular Economy Perspectives for the Management of Batteries used in Electric Vehicles*, 2019 (web link: https://publications.jrc.ec.europa.eu/repository/handle/JRC117790, last accessed August 2022).

[156] US Department of Energy, *Fuel Cell and Battery Electric Vehicles Compared*, 2014 (web link: *https://www.energy.gov/sites/default/files/2014/03/f9/thomas_fcev_vs_battery_evs.pdf*, last accessed August 2022).

pounds, may result in class 8 BEVs and FCEVs having equal cargo payloads to ICE vehicles in the near future. [157]

a) Class 7-8 Tractors

Progress in increasing battery energy densities has greatly improved the performance and decreased the weight of batteries over the past decade. However, battery technology still requires further maturing to meet the range and weight requirements of long-haul operations, particularly those operations that regularly reach the maximum GVWR limit of 80,000 lbs. While the current state of battery technology is capable of meeting most fleet applications, such as those with stable routes, short haul, and return-to-base operations, the technology has also progressed enough to meet uses cases involving drayage and regional operations. And for operations that are not weight sensitive, as technology continues to improve BEVs with a range up to 300 miles are not expected to compromise payload capacity in the near future.[158]

The sensitivity to weight is dependent on the market segment (e.g., bulk haulers, refrigerated haulers, dry van general freight operation). For example, bulk haulers (petroleum products, chemicals, aggregates) are the most weight-sensitive market segment, but only account for 2 percent of the total trucks on the road. Refrigerated haulers represent about 10 percent of the trucks on the road, but only is weight-sensitive on a small portion (10 percent) of their trips. The majority of tractors (i.e., dry van general freight operation), about 88 percent, never travel at maximum weight because their trailers will reach the volumetric capacity "cube out" before reaching weight capacity "gross out," or because their routes and cargo patterns are not conducive to traveling with a full trailer.[159] This information is supported by data provided by U.S. EPA, which estimates that the typical average freight weight of a Class 8 tractor is 38,000 lbs. and the average total weight of a Class 8 tractor with trailer and freight is about 67,300 lbs.[160] Similarly, data from the North American Council for Freight Efficiency (NACFE) show that 50 percent or more of the loads of Class 7-8 vehicles across three operational segments (i.e., city, regional, and long-haul tractors), were below a freight weight of 39,500 lbs. This data also shows that the 90th percentile of Class 8 trucks have a GVWR less than 55,000 lbs. and the 95th percentile have a GVWR below 65,000 lbs.[161]

Class 7 and 8 FCEV and BEV tractor weight parity and performance parity may arrive much sooner than previously anticipated. According to the 2020 Tesla Impact Report, Tesla claims

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[157] California Legislature, *Assembly Bill No. 2061*, 2022 (web link: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=202120220AB2061, last accessed August 2022).

[158] Lawrence Berkeley National Laboratory, *Why Regional and Long-Haul Trucks are Primed for Electrification Now*, 2021 (web link: https://eta-publications.lbl.gov/sites/default/files/updated_5_final_ehdv_report_033121.pdf, last accessed August 2022).

[159] NACFE, *Confidence Report: Lightweighting,* 2021 (web link: https://nacfe.org/wp-content/uploads/2021/02/Lightweighting-Confidence-Report-Feb2021.pdf, last accessed August 2022).

[160] U.S. EPA, *Greenhouse Gas Emissions Model (GEM) User Guide*, 2011 (web link: https://nepis.epa.gov/Exe/ZyPDF.cgi/P100BOPV.PDF?Dockey=P100BOPV.PDF, last accessed August 2022).

[161] NACFE, *Guidance Report: Electric Trucks-Where They Make Sense*, 2018 (web link: https://nacfe.org/downloads/full-report-electric-trucks/, last accessed August 2022).

that their semi-truck is capable of a 500-mile range and can handle the equivalent payload of a diesel truck, after considering the increased weight allowances for ZE technology.[162]

b) Class 3-8 Vocational Trucks

Payload capacity and range concerns are much less of a factor for Class 3-8 vocational trucks using existing battery technology. This is because typical payloads in many applications are well below the truck's maximum GVWR. For most operations in the medium-duty truck sector, freight tends to "cube out" before weight overload becomes a constraint. According to NACFE, vehicle weight for Class 3-6 medium-duty EV applications do not present a significant risk for fleet operators because they have sufficient freight weight margins or have alternate choices in vehicle designs and GVWR ratings.[163] In addition, most Class 3-8 vocational trucks have operations characterized by stable routes and home base locations that work well with the current state of battery technology. Data from NACFE shows that 75 percent of Class 3-8 vehicles are operated on shift schedules where they are parked for more than 6 hours per day. This data also suggests that 98 percent of Class 3-6 trucks travel between 50 and 150 miles a day.[164] The NACFE daily mileage data corresponds well with data collected through the LER requirement of the ACT regulation. The LER daily mileage data for Class 3-8 vocational trucks shows that 90 percent of these trucks travel less than 150 miles a day and 78 percent travel less than 100 miles per day.[165] As a result, existing data shows that BEVs with daily ranges up to 150 miles match well with expected Class 3-8 vocational duty cycles without compromising payload.

Similar to the availability of EV tractors described above, there are multiple EV medium-duty and heavy-duty non-tractors capable of a 100 to 200-mile range on a single charge available through HVIP.[166] These ZEVs include truck types such as straight trucks, flat beds, utility trucks, pickup trucks, step vans, refuse trucks, and many more. Most of the Class 3-8 vocational ZE trucks available through HVIP meet the range and weight requirements for a majority of the market segments, but for weight-sensitive vocations, there are several solutions available to address this issue.

c) Solutions for Weight Sensitive Operations

For operations that require larger battery capacities to meet longer ranges, or for vocations that are weight-sensitive, such as medium-duty beverage delivery and linen services, owners of Class 3-7 trucks considering the purchase of ZEVs using current battery technology have the option to move up a vehicle weight class if necessary. For Class 6 vehicles moving up a

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[162] Tesla, *2020 Impact Report*, 2020 (web link: https://www.tesla.com/ns_videos/2020-tesla-impact-report.pdf, last accessed August 2022).
[163] NACFE, *Guidance Report: Medium-Duty Electric Trucks Cost of Ownership*, 2018 (web link: https://nacfe.org/wp-content/uploads/2018/10/medium-duty-electric-trucks-cost-of-ownership.pdf, last accessed August 2022).
[164] NACFE, *Guidance Report: Electric Trucks-Where They Make Sense*, 2018 (web link: https://nacfe.org/downloads/full-report-electric-trucks/, last accessed August 2022).
[165] California Air Resources Board, *LER statewide aggregated data*, 2022 (web link: https://ww2.arb.ca.gov/sites/default/files/2022-02/Large_Entity_Reporting_Aggregated_Data_ADA.pdf, last accessed August 2022).
[166] California HVIP, *HVIP Eligible Vehicles*, 2022 (web link: https://californiahvip.org/vehiclecatalog/, last accessed August 2022).

weight class to Class 7, drivers are required to have either a Commercial Class A or Class B driver's license to operate the higher GVWR trucks, which may be a consideration for some fleets. In addition to moving up a vehicle weight class, reducing the vehicle's curb weight through light-weighting is an option for both medium- and heavy-duty vehicles to accommodate a larger battery pack. Lightweighting replaces heavier vehicle components with lighter weight materials, such as converting steel frames, roof hoods, side compartments, floor pans, and doors to aluminum or a lighter composite material. Also, tractors can use light-weighted trailers to provide additional and significant weight savings. Another promising option for reducing a vehicle's weight is the introduction of advanced system components. For example, Meritor is developing a fully scalable electric powertrain for Class 5-8 trucks that eliminates the need for conventional driveshafts and can provide weight savings of up to 800 lbs.[167] The flexibility in the proposed ACF regulation gives fleet owners additional time for long-haul applications and options to deploy ZEVs where most suited before needing to upgrade vehicles with more challenging applications.

d) Flexibility of the Zero-Emission Vehicle Phase-in Schedule

The proposed ACF regulation is structured in a way that provides flexibility for fleet owners to meet the ZEV phase-in requirements based on a fleet's mix of vehicle types and extends the compliance timeframe for high mileage vehicles. The ZEV phase-in schedule allows fleet owners/operators to be able to identify the trucks that are best suited for the technology available at that time. For example, the first ZEV phase-in requirements (10 percent of fleet in 2025) are in line with the current state of technology of vehicles that typically have daily ranges of 50 to 150 miles without compromising payload capacity. These vehicles include box trucks and vans which generally have stable routes and return-to-base operations, such as last mile delivery. Other vehicle types such as day cab tractors, work trucks are phased in starting 2027. The specialty truck and sleeper cab tractor phase-in requirement start in 2030, and by this time, ZEV technology is expected to have advanced to the point that range and vehicle weight are no longer barriers.

II. The Problem that the Proposed ACF regulation is Intended to Address

Transitioning to ZE technology for every on- and off-road mobile sector is essential for meeting near- and long-term emissions reductions goals mandated by statutes and policies established by various Governor-issued Executive Orders and Board directives. ZEVs are needed to reduce emissions of criteria pollutants and greenhouse gases, and especially the emissions of such pollutants that disparately impact disadvantaged communities. Diesel trucks emit a disproportionate amount of air pollution including PM, NOx (a precursor to smog), GHGs, and toxic air pollutants. Additionally, diesel vehicles often operate in clusters centered around distribution warehouses, railyards, and ports which further exacerbates the poor air quality in these overburdened communities. The sections below on the need to address State policy can be used to quickly reference the 18 statutes, Board resolutions, strategies and plans, Executive Orders, and a Memorandum of Understanding used to

[167] HDT Trucking Info, *Meritor to Begin Commercial Electric Powertrain Production*, 2021 (web link: https://www.truckinginfo.com/10136025/meritor-to-begin-commercial-electric-powertrain-production, last accessed August 2022).

support the proposed ACF regulation. The sections that follow on the need to reduce exposure and risk, as well as need to reduce NOx, PM and GHG emissions put the State policy framework into context. Finally, the section on need to reduce emissions generated from internal combustion engines provides an overview of CARB's ongoing efforts to reduce emissions generated from internal combustion engines and the fuels used to power them, the role of biofuels in the on-road medium- and heavy-duty transportation sector, and finally how ZEVs are the solution moving forward.

In January 2021, the ACT regulation was adopted by CARB as a key part of the holistic approach to accelerate a large-scale ZEV transition of medium- and heavy-duty trucks. Alone, the ACT regulation is insufficient for achieving the significant emissions reductions that are needed on the time scale required, especially given the long lifetimes of these vehicles. The proposed ACF regulation would build on the ACT regulation. The initial focus is on drayage trucks, which have the largest impact in overburdened communities, and high priority and federal fleets, as well as State and local government fleets, whose vehicles are most suitable for electrification. CARB staff is confident that the proposed ACF regulation targets fleets best suited for electrification while allowing flexibility over a longer time horizon for the more challenging use cases to transition to ZEVs.

A. Need to Address State Policy

CARB staff reviewed and considered air quality attainment goals established by the federal government, the laws passed by the California State Legislature, the SIP, and the Executive Orders issued by Governors of California to develop the regulation. The following is a chronological summary of key supporting and existing policies used to guide the development of the proposed ACF regulation:

1. Assembly Bill 32

In 2006, California's Governor signed Assembly Bill 32, (AB 32) the California Global Warming Solutions Act of 2006[168] to address global climate change. AB 32 directed CARB to develop a scoping plan identifying integrated and cost-effective regional, national, and international GHG reductions programs. CARB adopted the AB 32 Scoping Plan in 2008, with subsequent updates in 2013 and 2017, and is currently undertaking the public process to update it for 2022. California's 2017 Climate Change Scoping Plan outlines the State's strategy to achieve its 2030 GHG targets.

2. Executive Order B-16-2012

In March 2012, Governor Brown issued Executive Order B-16-2012 directing California agencies to establish benchmarks for key milestones to help support and facilitate the ZEV market in California.[169] One of those milestones includes deploying over 1.5 million light-, medium-, and heavy-duty ZEVs and PHEVs on the road by 2025. As a result of this Order, multiple State agencies, including CARB, worked to develop and release the 2013 ZEV

[168] AB 32 (Núñez, Stats. 2006, ch. 488); Health & Saf. Code sections 38500 et seq.
[169] Office of Governor Edmund G. (Jerry) Brown Jr., *Executive Order B-16-2012*, 2012 (web link: https://www.ca.gov/archive/gov39/2012/03/23/news17472/index.html, last accessed August 2022).

Action Plan.[170] The 2013 ZEV Action Plan identified over 100 strategies to meet the milestones of the Executive Order and included 4 broad goals to advance the overall light-, medium-, and heavy-duty ZEV market. These 4 goals are:

- Complete needed ZEV infrastructure and planning;
- Expand consumer awareness and demand of ZEVs;
- Transform fleets; and
- Grow jobs and investment in the private sector.

3. Senate Bill 605 and Senate Bill 1383

Senate Bill 605 required CARB to develop a plan to reduce emissions of short-lived climate pollutants (SLCP), and Senate Bill 1383 required the Board to approve and begin implementing the plan by January 1, 2018. [171,172] SB 1383 also sets targets for statewide reductions in SLCP emissions of 40 percent below 2013 levels by 2030 for methane and hydrofluorocarbons, and 50 percent below 2013 levels by 2030 for black carbon. Reductions in GHGs from trucks, including SLCPs like black carbon, are needed to achieve the State's multiple GHG emissions reductions targets and related climate goals.

4. Board Resolution 14-2

In April 2015, CARB released the "Sustainable Freight Pathways to Zero and Near-Zero Discussion Document" in response to Board Resolution 14-2, which directed CARB to engage with stakeholders to identify and prioritize actions to move California toward a sustainable freight transport system.[173,174] The Discussion Document set out CARB's vision of a clean freight system and listed immediate and potential near-term CARB actions that staff would develop for future Board consideration. The CARB measures identified in the Discussion Document included developing and implementing strategies to accelerate the deployment of heavy-duty zero-emission technologies.

5. Executive Order B-32-15

In July 2015, Governor Brown signed Executive Order B-32-15 directing the California State Transportation Agency, California Environmental Protection Agency (CalEPA), and the Natural Resources Agency to lead other relevant State departments in developing an integrated action plan by July 2016 that "establishes clear targets to improve freight

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[170] Governor's Interagency Working Group on Zero-Emission Vehicles, *2013 ZEV Action Plan: A roadmap toward 1.5 million zero-emission vehicles on California roadways by 2025*, 2013 (web link: http://opr.ca.gov/docs/Governors_Office_ZEV_Action_Plan_(02-13).pdf, last accessed August 2022).
[171] SB 605 (Lara, Stats. 2014, ch. 523); Health & Saf. Code section 39730.
[172] SB 1383 (Lara, Stats. 2016, ch. 395); Health & Saf. Code sections 39730.5 through 39730.8, and Public Resources Code sections 42652 through 42654.
[173] California Air Resources Board, *Sustainable Freight Pathways to Zero and Near-Zero Emissions Discussion Document*, 2015 (web link: https://ww2.arb.ca.gov/sites/default/files/2020-09/Sustainable%20Freight%20Pathways%20to%20Zero%20and%20Near-Zero%20Emissions%20Discussion%20Document.pdf, last accessed August 2022).
[174] California Air Resources Board, *Board Resolution 14-2*, 2014 (web link: https://www.arb.ca.gov/board/res/2014/res14-2.pdf, last accessed August 2022).

efficiency, transition to ZE technologies, and increase competitiveness of California's freight system."[175] The 2016 California Sustainable Freight Action Plan included recommendations such as strengthening existing freight regulations as a State agency action to advance the objectives of the Executive Order.

6. Senate Bill 350

SB 350, the Clean Energy and Pollution Reduction Act, establishes GHG reductions targets and orders the CPUC to direct the 6 IOUs in the state to "accelerate widespread TE." The resulting programs developed by the electric utilities, for which $740 million has been authorized, promote the deployment of medium- and heavy-duty ZEVs through incentivizing infrastructure upgrade projects that offset most or all the costs for electrical service upgrades.

7. Senate Bill 32

In 2016, Senate Bill 32 was signed into law, which requires CARB to ensure that California's GHG emissions are reduced to at least 40 percent below the 1990 GHG level by 2030.[176]

8. Revised 2016 State Strategies

In March 2017, CARB adopted the Revised Proposed 2016 State Strategies document as part of the SIP which identified several sectors that are key to launching ZE technologies in the on-road, heavy-duty sector: transit buses, delivery trucks, and airport shuttles.[177] The proposed ACF regulation continues implementation of these strategies to increase heavy-duty ZEV deployments.

9. Senate Bill 1

In April 2017, Senate Bill 1, also known as the Road Repair and Accountability Act of 2017 was signed into law, which provides specified commercial vehicles over 10,000 lbs. GVWR a "useful life" period before such vehicles can be retired, replaced, retrofitted, or repowered through new or amended regulations.[178] The useful life period is specified as the later of

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[175] State of California Executive Order signed by Governor Edmund G. (Jerry) Brown Jr., *Executive Order B-32-15*, 2015 (web link: https://www.ca.gov/archive/gov39/2015/07/17/news19046/index.html, last accessed August 2022).
[176] SB 32 (Pavley, Stats. 2016, ch. 249); Health & Saf. Code section 38566.
[177] California Air Resources Board, *Revised 2016 State Strategy for the State Implementation Plan*, 2016 (web link: https://ww3.arb.ca.gov/planning/sip/2016sip/rev2016statesip.pdf, last accessed August 2022).
[178] SB 1 (Beall, Stats. 2017, ch. 5). Govt. Code: repeal Sections 63048.66, 63048.67, 63048.7, 63048.75, 63048.8, 63048.65, and 63048.85; add new sections 14033, 14110, 14526.7, 14556.41, 14460, 14461, 14526.7, 14556.41, 16321, and 63048.65; amend section 14526.5; Health & Saf. Code add Section 43021; Public Utilities Code: amend Section 99312.1, and add Sections 99312.3, 99312.4, and 99314.9; Revenue & Taxation Code amend Sections 6051.8, 6201.8, 7360, 8352.4, 8352.5, 8352.6, and 60050; to add Sections 7361.2, 7653.2, 60050.2, and 60201.4 to, and to add Chapter 6 (commencing with Section 11050) to Part 5 of Division 2 of, the Revenue and Taxation Code; Streets and Highways Code: amend Sections 2104, 2105, 2106, and 2107, add Sections 2103.1 and 2192.4, add Article 2.5 (commencing with Section 800) to Chapter 4 of Division 1 of, and to add Chapter 2 (commencing with Section 2030) and Chapter 8.5 (commencing with Section 2390) to Division 3 of, the Streets and Highways Code; Vehicle Code: amend Section 4156, add Sections 4000.15 and 9250.6.

either (a) 13 years from the MY that the engine and emissions control systems are first certified or (b) (when the vehicle travels 800,000 VMT or 18 years from the MY that the engine and emissions control systems are first certified for use, whichever is earlier). SB 1 also empowered the California DMV to enforce the Truck and Bus regulation through vehicle registrations.

10. Assembly Bill 617

In July 2017, California's Governor signed AB 617 into law. The bill requires new community-focused and community-driven action to reduce air pollution emissions and exposures and improve public health in communities that experience disproportionate burdens from cumulative exposure to toxic air contaminants and criteria air pollutants. To implement AB 617, CARB established the Community Air Protection Program. The Program's focus is to reduce exposure in communities most impacted by air pollution. CARB, air districts, and communities around the State are working together to develop and implement new strategies to measure air pollution, develop plans for localized emissions and exposure reductions, improve community engagement, and reduce health impacts. In addition to funding incentive projects and technical assistance for organizations participating in the program, a significant implementation activity involves air districts developing Community Emissions Reduction Programs (CERPs) and Community Air Monitoring Plans (CAMPs) for high cumulative exposure communities selected by the Board, in consultation with community steering committees of community stakeholders. All community steering committees for communities selected to date have identified air pollution from heavy-duty diesel vehicles as a concern in their communities and air districts have adopted CERPs identify strategies to respond to these vehicle emissions community concerns.

11. Title VI of U.S. Civil Rights Act of 1964

The U.S. Civil Rights Act of 1964, Title VI,[179] requires entities receiving federal assistance from discriminating on the basis of race, color, or national origin in their programs or activities. Historically, there was a common practice of denying access to federally funded services, programs, and activities based on certain people's race, color, or national origin, which Title VI intended to prevent going forward. As a recipient of funding from U.S. EPA, CARB complies with Title VI. Both discrimination and causing disparate impacts are prohibited by Title VI.

12. Executive Orders B-48-18 and B-55-18

In January 2018, Governor Brown issued Executive Order B-48-18 building on past efforts by increasing California's goal to introduce 5 million light-, medium-, and heavy-duty ZEVs on the road by 2030 and setting a target of 250,000 chargers by 2025.[180] Also in 2018, Governor Brown issued Executive Order B-55-18, which sets a target to achieve carbon neutrality in

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[179] 42 U.S.C. § 2000d et seq.

[180] Office of Governor Edmund G. (Jerry) Brown Jr., *Governor Brown Takes Action to Increase Zero-Emission Vehicles, Fund New Climate Investments*, 2018 (web link: https://www.ca.gov/archive/gov39/2018/01/26/governor-brown-takes-action-to-increase-zero-emission-vehicles-fund-new-climate-investments/index.html, last accessed August 2022).

California no later than 2045 and achieve and maintain net negative emissions thereafter.[181] The proposed ACF regulation directly supports achieving these goals through the required transition to medium- and heavy-duty ZEVs in California in local government, drayage, and high priority and federal transportation sector fleets.

13. Governor Brown's August 2018 Letter to CARB

In August 2018, Governor Brown sent a letter to CARB directing it to pursue conversion of public and non-public fleets to ZEVs in categories including large employers, delivery vehicles, and transportation service fleets.[182] The proposed ACF regulation addresses this direction by requiring medium- and heavy-duty ZEV purchases for State and local government fleets, conversion of the drayage fleet to heavy-duty ZEVs, and upgrading to medium- and heavy-duty ZEVs in high priority and federal fleets.

14. Executive Order N-19-19

In September 2019, Governor Newsom issued Executive Order N-19-19, which requires every aspect of State government to redouble efforts to reduce GHG emissions and mitigate the impacts of climate change while building a sustainable and inclusive economy.[183] The Executive Order specifically calls for CARB to propose new strategies to increase demand in the primary and secondary markets for ZEVs, and to consider strengthening existing regulations or adopting new regulations to achieve necessary GHG reductions in the transportation sector. The proposed ACF regulation would support these goals by achieving GHG emissions reductions from the deployment of medium- and heavy-duty ZEVs. Additionally, ZEVs deployed early in the proposed regulatory timeline would be expected to be resold, thereby supporting a robust secondary market.

15. Board Resolution 20-19

As part of adopting the ACT regulation in June 2020, the Board also approved Resolution 20-19. The resolution required staff to come back to the Board in 2021 with requirements ensuring fleets, businesses, and public entities purchase and operate medium- and heavy-duty ZEVs.[184] The resolution set goals for the fleet requirements to be implemented on a timeline consistent with the ACT regulation and to achieve a smooth transition of California's fleet to ZEVs by 2045 everywhere feasible. The resolution also directs staff to ensure these upcoming regulations emphasize emissions reductions within DACs to the maximum extent

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[181] State of California Executive Order signed by Governor Edmund G. (Jerry) Brown Jr., *Executive Order B-55-18*, 2018 (web link: https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf, last accessed August 2022).
[182] Signed by Edmund G. (Jerry) Brown Jr., *Governor's Letter to Chair Nichols*, 2018 (web link: https://ww2.arb.ca.gov/sites/default/files/2020-06/zero_emission_fleet_letter_080118_ADA.pdf, last accessed August 2022).
[183] State of California Executive Order signed by Governor Gavin Newsom, *Executive Order N-19-19*, 2019 (web link: https://catc.ca.gov/-/media/ctc-media/documents/ctc-codes/execorder-n-19-19-a11y.pdf, last accessed August 2022).
[184] California Air Resources Board, *Resolution 20-19*, 2020 (web link: https://ww3.arb.ca.gov/regact/2019/act2019/finalres20-19.pdf, last accessed August 2022).

feasible. The resolution set the following clear goals for transitioning sectors of California's transportation industry to medium- and heavy-duty ZEVs where feasible:

- 100 percent ZE drayage, last mile delivery, and government fleets by 2035;
- 100 percent ZE refuse trucks and local buses by 2040;
- 100 percent ZE-capable vehicles in utility fleets by 2040; and
- 100 percent ZE everywhere else, where feasible, by 2045.

Staff's proposed ACF regulation largely meets the overall goals laid out by the Board with implementation starting in 2024 to align with ACT as originally planned. It would achieve 100 percent ZE drayage trucks by 2035 and most regulated delivery vehicles by 2035 as well, although the proposed ACF regulation will be brought to the Board in 2022. This proposed ACF regulation is a part of a comprehensive strategy to transition all trucks to ZE where feasible.

16. Memorandum of Understanding to Accelerate Zero-Emission Vehicle Market

After the ACT regulation was adopted by the Board, 16 states, the District of Columbia, and Province of Quebec signed a Memorandum of Understanding to work collaboratively to advance and accelerate the market for electric medium- and heavy-duty vehicles.[185] The states agreed to work together to set and meet medium- and heavy-duty ZEV sales targets and develop action plans that accelerate vehicle electrification. As of January 2022, 5 states have adopted the ACT regulation, with more expected in this year.[186]

17. Executive Order N-79-20

In September 2020, Governor Newsom signed Executive Order N-79-20, which establishes a goal that 100 percent of California sales of new passenger car and trucks be ZE by 2035.[187] In addition, the Governor's Order set a goal to transition all drayage trucks to ZEVs by 2035, all off-road equipment to ZE where feasible by 2035, and the remainder of medium- and heavy-duty vehicles to ZEVs where feasible by 2045. Under the Order, CARB is tasked to work with our State agency partners to develop regulations to achieve these goals considering technological feasibility and cost-effectiveness, which the proposed ACF regulation seeks to fulfill.

18. Revised 2020 Mobile Source Strategy

The 2020 Mobile Source Strategy was heard by the Board on October 28, 2021, and will be forwarded to the appropriate policy and fiscal committees of the Legislature as required by

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[185] California Air Resources Board, *Press Release 20-18 15 states and the District of Columbia join forces to accelerate bus and truck electrification*, 2020 (web link: https://ww2.arb.ca.gov/news/15-states-and-district-columbia-join-forces-accelerate-bus-and-truck-electrification, last accessed August 2022).
[186] Washington, Oregon, New York, New Jersey, and Massachusetts have all adopted the ACT regulation.
[187] State of California Executive Order signed by Governor Gavin Newsom, *Executive Order N-79-20*, 2020 (web link: https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-Climate.pdf, last accessed August 2022).

Senate Bill 44.[188,189] The strategy document looks at existing and emerging technologies to reduce emissions from California's transportation sector, including cars, trucks, trains, ships, and other on-road and off-road sources. These strategies illustrate the technology mixes needed for the State to meet its various clean air goals, including attaining the NAAQS, community risk reductions, and ambitious mid- and long-term climate change targets. To meet these goals, the Mobile Source Strategy found it is necessary for California's transportation sector to rapidly increase use of ZE technologies everywhere feasible.

19. Draft 2022 State Strategy for the State Implementation Plan

In January 2022, CARB released the Draft 2022 SIP Strategy for public comment.[190] The Draft 2022 State SIP Strategy focuses on emission reductions needed to meet the health-based 70 parts per billion (ppb) federal ozone standard. It will be considered by the Board in Fall 2022. Given that the document indicates California will be short of needed tons of emissions reductions needed for attainment, there is a need to push for more ZEV deployments beyond the proposed ACF regulation in future measures.

The 2022 SIP Strategy builds on the 2020 Mobile Source Strategy, and ACF as well as a proposed commitment to accelerate the number of medium- and heavy-duty ZEV beyond the ACT and proposed ACF regulation by upgrading remaining ICE vehicles to new or used ZEVs. The 2022 SIP Strategy and the upcoming legislatively mandated SB 1 report will further evaluate the potential advantages associated with additional authorities in accelerating this transition.

B. Need to Reduce Exposure and Risk in Impacted Communities

Many of the communities located near facilities where trucks operate bear a disproportionate health burden due to their proximity to emissions from the combustion engines that power trucks. There are several occurrences across the state where communities contain "groups" or "clusters" of facilities where trucks operate. In many cases, these facilities are in or near communities classified as disadvantaged by the CalEPA by using the California Communities Environmental Health Screening Tool to rank California communities based on environmental pollution burden and socio-economic indicators.[191] Exposure to diesel PM is a main contributor to these metrics for many communities ranked in the top 10th percentile statewide. Under AB 617, all community steering committees for communities selected to date have identified air pollution from heavy-duty diesel vehicles as a concern in their communities, including communities in the Bay Area, South Coast, San Joaquin Valley and San Diego air district regions. listing emissions from ports and/or railyards as a top

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[188] SB 44 (Skinner, Stats. 2019, ch. 297) (weblink: *https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201920200SB44*, last accessed August 2022).

[189] California Air Resources Board, 2020 Mobile Source Strategy, April 23, 2021. (web link: https://ww2.arb.ca.gov/sites/default/files/2021-12/2020_Mobile_Source_Strategy.pdf, last accessed August 2022).

[190] California Air Resources Board, *Draft 2022 State Strategy for the State Implementation Plan*, 2022 (web link: https://ww2.arb.ca.gov/sites/default/files/2022-01/Draft_2022_State_SIP_Strategy.pdf, last accessed August 2022).

[191] Office of Environmental Health Hazard Assessment, *CalEnviroScreen 4.0*, 2021 (web link: https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30, last accessed August 2022).

community concern. Adopted air district Community Emissions Reduction Program (CERPs) identify strategies to respond to these community concerns.

The proposed ACF regulation would assist California by simultaneously contributing to achieve the state's criteria pollutant and GHG reduction goals and cleaner technology targets. The California 2016 Mobile Source Strategy states that mobile sources and the fossil fuels that power them are the largest contributors to the formation of ozone, GHG emissions, PM 2.5 and toxic diesel PM.[192] In California, the transportation sector alone accounts for 41 percent of total GHG emissions (50 percent when upstream emissions from fuel is included) and is a major contributor to NOx and PM emissions.[193] The proposed ACF regulation is needed to accelerate the transition to ZE in the medium- and heavy-duty vehicle sector and to eliminate tailpipe emissions that disparately impact the DACs located in areas that are especially impacted by truck operations. Aligning with the Governor's Executive Order N-79-20, the deployment of ZEVs meets goals identified in Resolution 20-19, which calls for fleet requirements to be implemented on a timeline consistent with the ACT regulation and to achieve a smooth transition of California's fleet to ZEVs by 2045 everywhere feasible.

C. Need to Reduce NOx and Particulate Matter Emissions

Progress has been achieved in reducing PM2.5 and NOx emissions from mobile sources statewide through implementation of CARB's existing programs. These programs are expected to continue to provide further emissions reductions, helping the State to meet air quality standards. However, challenges remain in meeting the ambient air quality standards for ozone and PM2.5. California continues to experience some of the worst air quality in the nation. The South Coast and San Joaquin Valley Air Basins are designated as extreme non-attainment with the ozone NAAQS areas while 7 other areas are in serious or severe non-attainment with the ozone NAAQS. The near-term targets for these areas are a 2023 deadline for attainment of the 80 parts per billion (ppb) 8-hour ozone standard, 2024 for the 35 microgram per cubic meter ($\mu g/m^3$) 24-hour PM2.5 standard, and 2025 for the 12 $\mu g/m^3$ annual PM2.5 standard. There are also attainment years of 2031 and 2037 for the more recent 8-hour ozone standards of 75 ppb and 70 ppb, respectively. NOx is a precursor to both ozone and secondary PM2.5 formation. Consequently, reductions in NOx emissions provide benefits to help meet both the ozone and the PM2.5 standards. Additional PM2.5 and NOx reductions from all freight sources, including trucks, are essential to meeting these air quality standards as described in the recent Draft 2022 SIP Strategy.[194]

[192] California Air Resources Board, *2016 Mobile Source Strategy*, 2016 (web link: https://ww3.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf, last accessed August 2022).
[193] California Air Resources Board, *California Greenhouse Gas Emission Inventory*, 2022 (web link: https://www.arb.ca.gov/cc/inventory/data/data.htm, last accessed August 2022).
[194] California Air Resources Board, *2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy)*, 2022 (web link: https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy, last accessed August 2022).

D. Need to Reduce Greenhouse Gas Emissions

To date, California has made significant progress towards meeting the goals of SB 32. SB 32 requires California to reduce GHG emissions to at least 40 percent below 1990 levels by 2030. Significant progress has been made, however more needs to be done.

SLCPs such as black carbon, methane, nitrous oxide, and other compounds are emitted from transportation sources, including from burning fuels such as diesel or natural gas. These are powerful climate forcers that remain in the atmosphere for a much shorter period than longer-lived climate pollutants, such as CO_2, but are more potent when measured in terms of Global Warming Potential, which can be tens, hundreds, or even thousands of times greater than CO_2.

1. Low Carbon Fuels

The use of low carbon fuels contributes towards the reduction of GHG emission from the transportation sector. The LCFS program is based on the principle that each fuel has "life-cycle" GHG emissions that include CO_2, CH_4, N_2O, and other GHG contributors. This life cycle assessment examines the GHG emissions associated with the production, transportation, and use of a given fuel. The life cycle assessment includes direct emissions associated with producing, transporting, and using the fuels, as well as significant indirect effects on GHG emissions, such as changes in land use for some biofuels. The LCFS standards are expressed in terms of the "carbon intensity" of gasoline and diesel fuel and their respective substitutes.

In 2011, CARB's LCFS was implemented, with the carbon intensity set to just below the 2010 benchmark value calculated for fuels produced from California refineries. In 2018, the Board amended the LCFS program to harmonize with SB 32 by adjusting the annually declining carbon intensity benchmarks and extending them to 2030, and by adding new crediting opportunities to promote ZEV adoption. The 2018 LCFS amendments also consider the fuel use, or the energy efficiency ratio (EER) of the fuel-vehicle system. EER shows that BEVs are four to five times more efficient than comparable internal combustion powered technologies.[195] Electricity and hydrogen are currently the primary fuels for ZEVs, and both fuels must be produced using low carbon technology and feedstocks to minimize upstream emissions as the LCFS calculates life-cycle carbon intensity of fuel-vehicle systems. The 2018 LCFS amendments also added ZEV infrastructure crediting provision designed to support the deployment of light-duty public ZEV infrastructure. The ZEV infrastructure provision covers light-duty public hydrogen refueling infrastructure and direct current fast charging infrastructure. In addition to generating LCFS credit for dispensed fuel, the eligible hydrogen station, or direct current fast charger can generate infrastructure credits (also referred to as "capacity credits") based on the capacity of the station or charger minus the quantity of dispensed fuel.[196] LCFS Infrastructure Capacity Credits provide a revenue stream for fueling

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[195] California Air Resources Board, *LCFS Guidance 20-04 Requesting EER-Adjusted Carbon Intensity Using a Tier 2 Pathway Application Energy Efficiency Ratio*, 2020 (web link: https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/guidance/lcfsguidance_20-04.pdf, last accessed August 2022).

[196] California Air Resources Board, *LCFS ZEV Infrastructure Crediting*, 2022 (web link: https://ww2.arb.ca.gov/resources/documents/lcfs-zev-infrastructure-crediting, last accessed August 2022).

stations until ZEVs become more commonplace. Medium-duty ZEVs may be able to take advantage of these hydrogen fueling stations.

a) Renewable Natural Gas

The use of RNG as a transportation fuel has the potential to reduce GHG emissions. RNG made from organic waste counts avoided methane emissions from landfills and has a lower carbon intensity score than natural gas from fossil sources. California has the potential to produce approximately 90.6 billion cubic feet per year of RNG from dairy, landfill, municipal solid waste, and wastewater treatment facility sources[197] which represents only 4 to 5 percent of California's total annual consumption[198]. Currently, about half of the refuse trucks that operate in California are fueled by natural gas and the other half are fueled by diesel.[199] The number of CNG vehicles projected for 2024 is one percent of California's statewide fleet affected by the proposed ACF regulation.

SB 1383 established organic-waste diversion targets to achieve a 50 percent reduction of landfilled organic waste by 2020, and a 75 percent reduction by 2025 when compared to 2014-levels.[200] CalRecycle's SLCP regulation is expected to result in organics recycling infrastructure development and expanded markets for the products generated by organics recycling facilities to assist in meeting the targets set by SB 1383.[201]

Refuse companies fear if the State electrifies all sectors of the transportation sector too quickly, then the State's organic waste product procurement goals will conflict with the State's vehicle electrification policies, and they want CARB to create a long-term strategy that accounts for the SB 1383 induced circular economy. The wastewater industry comments suggest they will accept large amounts of municipal organic waste to co-digest at wastewater treatment plants, and they intend to invest in CNG vehicles and fueling infrastructure to make use of this bio-CNG. Both waste and wastewater industries have claimed new source review requirements are limiting RNG combustion at new onsite electricity generating units.

However, the limited availability of California made RNG can be directed towards harder to decarbonize sectors than transportation, or as a feedstock for energy and materials. In fact, CPUC's decision implementing Senate Bill 1440 directs RNG away from the transportation sector and creates RNG procurement targets for the IOUs.[202] SB 1440 also prohibits IOUs from procuring bio-CNG from facilities that do not commit to exclusively purchase and/or lease either NZE or ZE Class 8 trucks. Furthermore, SB 1440 states that, "It is the intent of

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[197] STEPS Program UC Davis, *Jaffee et al. "The Feasibility of Renewable Natural Gas as a Large-Scale, Low Carbon Substitute Contract No. 13-307*, 2016 (web link: https://ww2.arb.ca.gov/sites/default/files/classic/research/apr/past/13-307.pdf, last accessed August 2022).
[198] US EIA website on data for natural gas consumption by end use. (web link: *https://www.eia.gov/dnav/ng/ng_cons_sum_dcu_SCA_a.htm*, last accessed August 2022).
[199] CARB, *EMFAC*, 2021 (web link: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-modeling-tools-emfac-software-and, last accessed August 2022).
[200] California Legislative Information, *SB-1383 Short-lived climate pollutants: methane emissions: dairy and livestock: organic waste: landfills*, 2016 (web link: https://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160SB1383, last accessed August 2022).
[201] CalRecycle, *California's Short-Lived Climate Pollutant Reduction Strategy*, 2016 (web link: https://calrecycle.ca.gov/organics/slcp/, last accessed August 2022).
[202] SB 1440 (Hueso, Stats. 2018 ch. 739). Pub. Utilities Code sections 650 and 651.

the Commission that NZE Class 8 trucks will be allowed only as long as ZE vehicles are not commercially available."[203] CPUC's definition of NZE in this context is not the same as used by CARB in this regulation and as defined in title 13, California Code of Regulations, section 1963(c)(16). CPUC considers NZE vehicles for the purposes of SB 1440, as those that meet CARB's ultra-low or optional low NOx standard and that only combust bio-CNG rather than fossil gas. CPUC's decision implementing SB 1440 will be re-evaluated in 2025 as a Renewable Gas Standard. The 2025 review will consider adopting a Renewable Gas Standard for IOUs, as well as when to require a jurisdiction's prospective purchases and/or leases of Class 8 trucks to be exclusively ZE in order to enter into RNG procurement contracts with IOUs.

The proposed ACF regulation does not conflict with the organic waste product procurement targets established by enacting SB 1383. Recovered organic waste product procurement target for jurisdictions does not require jurisdictions to purchase RNG for use directly as a transportation fuel. Moving forward, CPUC's Renewable Gas Standard may be a viable alternative to CARB's LCFS for RNG purchased by utilities and used in the residential sector.

b) Scoping Plan 2022 Update

CARB's AB 32 Scoping Plan (2022 Update) systematically evaluates and identifies feasible clean energy and technology options that will not just bring near-term air quality benefits, but also deliver on longer-term climate goals. The proposed ACF regulation takes a long view as well, by recognizing that bridging technology like NZEV as defined in title 13, CCR section 1963(c)(16), will need to play a larger role than CNG vehicles in transforming the transportation sector to ZE. Importantly, given the pace at which we must transition away from fossil fuels, we absolutely must identify and address market and implementation barriers to be successful. Given that ICE vehicles from legacy fleets will likely remain on the road for some time, even after all new vehicle sales have transitioned to ZEV technology, low carbon liquid fuels may continue to be used during this period of transition especially for more challenging use cases, and sectors such as aviation, locomotives, and marine applications. RNG or bio-CNG, currently displaces fossil fuels in transportation and will largely be needed for hard-to-decarbonize sectors but will likely continue to play a targeted role in some fleets while the transportation sector transitions to ZEVs.

E. Need to Reduce Emissions Beyond Combustion

Over the past 50 years combustion engines have gone through many upgrades as innovative vehicle emission control strategies have been adopted.[204] The primary policies implemented to address truck exhaust emission emissions have been adopting increasingly stringent engine emissions standards along with a variety of in-use fleet measures, and fuel standards. However, for California to achieve federally mandated ozone NAAQS and provide clean air for all Californians, more must be done. ZEVs have no tailpipe emissions, and have lower PM

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[203] California Public Utilities Commission, *Decision Implementing Senate Bill 1440 Biomethane Procurement Program*, 2022 (web link: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M454/K335/454335009.PDF, last accessed August 2022).

[204] California Air Resources Board, *History of CARB*, 2022 (web link: https://ww2.arb.ca.gov/about/history, last accessed August 2022).

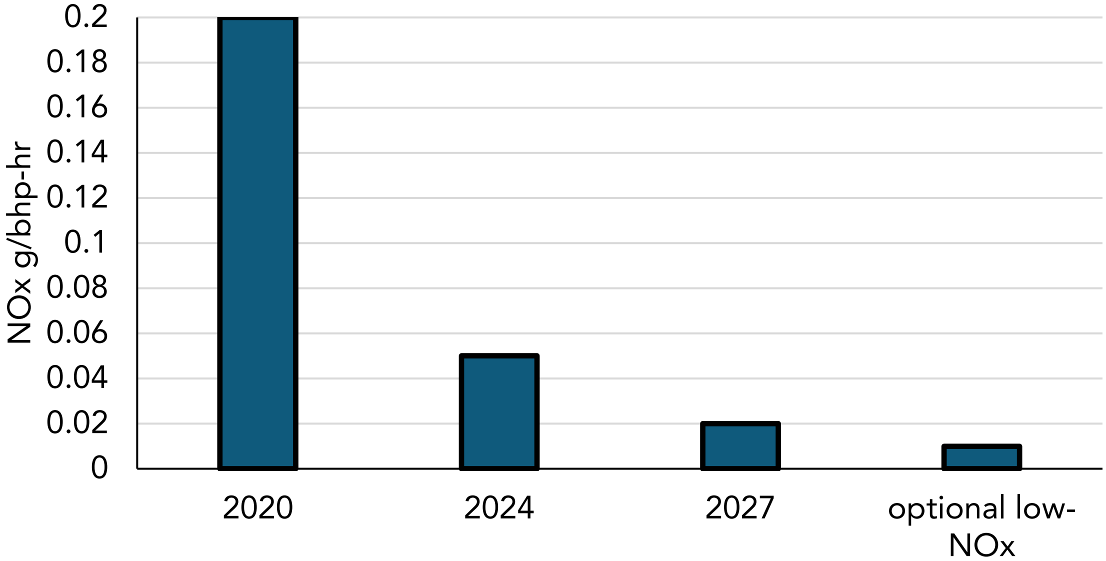
emissions from reduced brake wear than even the cleanest ICE vehicles. The following is a summary of some of California's more significant emission control measures and their impact on emissions reductions from combustion engines.

CARB first began regulating heavy-duty engine exhaust emission standards for 1969 MY vehicles. Since the 1970s, California's regulations to control heavy-duty engine pollutant emissions have become more rigorous, continuing in the 1990s through 2010, with increasingly stringent emissions standards and test procedures for CO, HC, NOx and PM emissions. In 2004, a combined standard for smog-forming emissions for HC and NOx was implemented to further reduce the combined emissions by 40 percent. In 2007, NOx and non-methane hydrocarbon (NMHC) standards of 0.20 and 0.14 grams per brake horsepower-hour (g/bhp-hr), respectively, were phased in, reaching full compliance in 2010. An approximate reduction of 90 percent in NMHC and NOx emissions was achieved in 2010. Overall, heavy-duty engine emissions have been significantly reduced compared to uncontrolled levels.

California is already experiencing a significant decline in NOx emissions reductions from 2010 or newer MY diesel trucks. California's Truck and Bus regulation is now in its last replacement phase with a final deadline of January 1, 2023, for truck owners to upgrade to 2010 or newer MY engines.[205] By 2031, CARB's Heavy-Duty Omnibus regulation will dramatically reduce NOx emissions by another 90 percent from truck exhaust through a comprehensive suite of emissions-related requirements for 2024 and subsequent MY California-certified heavy-duty engines.[206] Figure 46 shows the steep decline in NOx emissions from now (2010 MY engines are labeled as "2020"), through full implementation of the Heavy-Duty Omnibus regulation engine certification standards for NOx (labeled as "2024" and "2027").[207] HD Omnibus certified engines will not only need to meet the 0.05 g/bhp-hr (2024) and 0.02 g/bhp-hr (2027) NOx standards, but they will also be subject to an in-use limit of 0.1 g/bhp-hr (2024), 0.04 g/bhp-hr (2027), and 0.03 g/bhp-hr (2030) NOx emissions standards.

[205] California Air Resources Board, *Truck and Bus Regulation*, 2022 (web link: https://ww2.arb.ca.gov/our-work/programs/truck-and-bus-regulation, last accessed August 2022).
[206] California Air Resources Board, *Heavy-Duty Omnibus Regulation*, 2022 (web link: https://ww2.arb.ca.gov/rulemaking/2020/hdomnibuslownox, last accessed August 2022).
[207] California Air Resources Board, *Facts about the Low NOx Heavy-Duty Omnibus Regulation*, 2022 (web link: https://ww2.arb.ca.gov/sites/default/files/classic/msprog/hdlownox/files/HD_NOx_Omnibus_Fact_Sheet.pdf, last accessed August 2022).

Figure 46: Bar Chart Showing Heavy-Duty Omnibus Regulation Engine Certification Standards for NOx in 2024 and 2027 When Compared to the Current (2020) Standard



Inspection and maintenance programs for light to medium-duty vehicles started in 1988 with on-board computers, check engine lights and smog checks. Finally, starting in 2023, a similar program being proposed would be phased in for the heavy-duty sector. In 2037, the proposed HD I/M program is projected to cut statewide NOx emissions by 81.3 tpd and PM emissions by 0.7 tpd.[208]

CARB and the U.S. EPA also establish fuel certification standards which help lower exhaust emissions from combustion vehicles. Starting in 1975 lead was reduced in gasoline to enable the use of the catalytic converter. Then diesel fuel standards were established to reduce tailpipe NOx and PM, and to enable the use of PM filters and other exhaust emissions control technology. Adopted in 1988, California diesel fuel regulations set limits on aromatic hydrocarbon and sulfur content. These regulations, in effect since 1993, reduce emissions from diesel engines and equipment: 7 percent NOx, 25 percent PM, 80 percent sulfur oxides, as well as several toxic substances, such as benzene and polynuclear aromatic hydrocarbons. Volatile organic compound emission and evaporative emission controls for motor vehicle fuels and dispensers started in 1990's which helped improve air quality even more. The California Reformulated Gasoline program was implemented in 1991, which eliminated lead from gasoline and set regulations for deposit control additives and Reid vapor pressure.

The proposed ACF regulation would ensure California's fleets lead the shift towards a ZE pathway, meeting the State's goals and leading the nation in a widespread move towards carbon neutrality. A suite of new regulations, including CARB's Heavy-Duty Omnibus regulation and the proposed HD I/M program, will work to ensure that ICE vehicles operate as intended in the real world. Those regulations work in harmony with the ACT regulation

[208] California Air Resources Board, *Heavy-Duty Inspection and Maintenance Program*, 2022 (web link: https://ww2.arb.ca.gov/our-work/programs/heavy-duty-inspection-and-maintenance-program, last accessed August 2022).

and this proposed ACF regulation as the medium- and heavy-duty on-road transportation sector transitions to ZE everywhere feasible.

1. Compressed Natural Gas Vehicles

CNG vehicles operate at a 15 to 20 percent lower fuel economy than their diesel counterparts and after factoring in upstream methane emissions, natural gas trucks are more harmful to the climate than diesel trucks. [209,210] Recent studies demonstrate real-world emissions from CNG vehicles do not perform as laboratory certification standards suggest. Additionally, the potential to create low carbon fuels from California's organic waste products is limited and these fuels need to be directed towards harder to decarbonize sectors than transportation. Finally, CPUC's decisions implementing SB 1440[211] and SB 1477[212] send a clear signal that state policies supporting natural gas and distribution infrastructure must also align with key strategies to reach carbon neutrality by 2045.

One key strategy to meet California's climate neutrality target identified in the Scoping Plan Update (2022) is electrification in almost all sectors.[213] As discussed in the previous section on Renewable Natural Gas, SB 1440 directs RNG towards harder to decarbonize sectors than transportation by requiring IOUs to procure SB 1383 generated RNG. This decision goes further by requiring IOUs to procure RNG only from organic waste diversion facilities that commit to exclusively purchase or lease ZE Class 8 trucks.[214] Recently, CPUC aimed to phase out gas usage in the building sector by eliminating gas line extension allowances, ten-year refundable payment option, and fifty percent discount payment option under gas line extension rules as part of SB 1477 (Phase III). CPUC states that ending subsidies to extend gas lines "will send a price signal that building new gas infrastructure is more expensive, thus making dual fuel new construction less desirable and financially riskier". They further claim that ending gas line extension subsides beyond existing use areas will prevent stranded assets given the decade or longer lifetime of residential gas appliances.[215] Expanding CNG fueling infrastructure for CNG vehicles after the ZEV requirements take effect would have a similar risk of being stranded assets. The number of Class 2b-8 CNG vehicles projected for 2025 is relatively small at approximately one percent of California's statewide heavy-duty vehicles. Staff have also analyzed scenarios which evaluate the cost and emissions impact of

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[209] CEC Energy Almanac, *Transportation Natural Gas in California*, 2016 (web link: https://ww2.energy.ca.gov/almanac/transportation_data/cng-lng.html, last accessed August 2022).

[210] International Council on Clean Transportation, *A comparison of NOx emissions from heavy-duty diesel, natural gas, and electric vehicles*, 2021 (web link: https://theicct.org/sites/default/files/publications/low-nox-hdvs-compared-sept21.pdf, last accessed August 2022).

[211] SB 1440 (Hueso, Stats. 2018 ch. 739). Pub. Utilities Code sections 650 and 651.

[212] SB 1477 (Stern, Stats. 2018, ch. 378). (web link: *https://legiscan.com/CA/text/SB1477/id/1819922*).

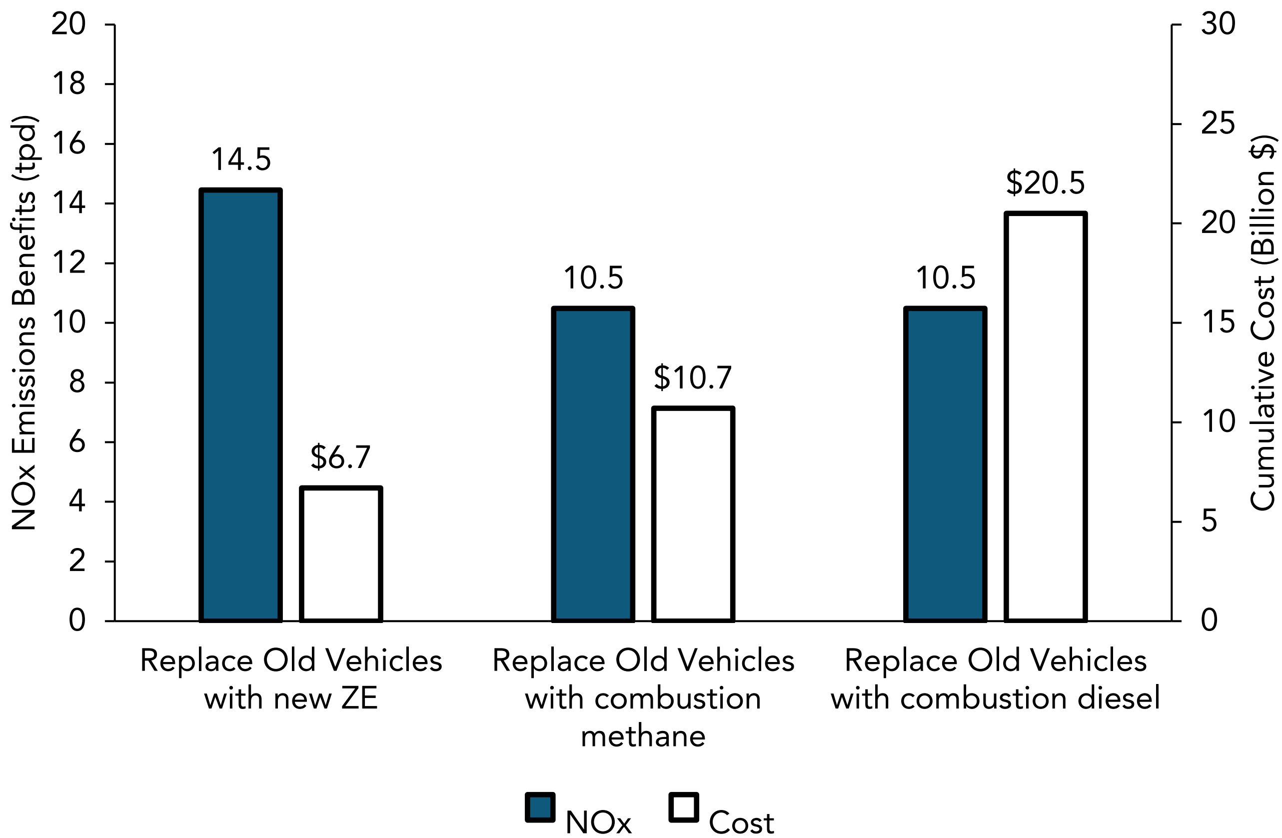
[213] California Air Resources Board, *California's 2017 Climate Change Scoping Plan*, 2017 (web link: https://ww2.arb.ca.gov/sites/default/files/classic//cc/scopingplan/scoping_plan_2017.pdf, last accessed August 2022).

[214] California Public Utilities Commission, *Decision Implementing Senate Bill 1440 Biomethane Procurement Program*, 2022 (web link: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M454/K335/454335009.PDF, last accessed August 2022

[215] California Public Utilities Commission Rulemaking 19-01-011, Phase III decision eliminating gas line extension allowances, ten-year refundable payment option, and fifty percent discount payment option under gas line extension rules. (web link: *https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M496/K415/496415627.PDF*)

transitioning older heavy-duty vehicles to new diesel, natural gas, and battery-electric vehicles.[216,217] Staff found that when comparing these different options, ZEVs offer the lowest cost and the greatest NOx emission benefits versus both combustion fuels as shown in Figure 47. This comparison illustrates how moving forward with a ZEV focused policy offers the greatest benefits to California for both health and economic reasons.

Figure 47: Statewide NOx Reductions and Cumulative Cost of Replacing Old Vehicles with ZEVs, Natural Gas, and Diesel



Furthermore, if California is to meet its health-based ambient air quality standards, we need to reduce levels of NOx emissions from on-road heavy-duty trucks by 85 percent. This will help achieve the 2008 75 ppb ozone standard required by 2031 in the South Coast region. Heavy-duty trucks and buses powered by CNG have been the "clean air" solution to help solve California's ozone problems for decades. Unfortunately, vehicles certified to the optional low NOx standard do not perform as expected within real-world applications as was

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216 California Air Resources Board, *Technical Analysis of End of Useful Life Scenarios – Statewide*, 2022 (web link: https://ww2.arb.ca.gov/resources/documents/technical-analysis-end-useful-life-scenarios-statewide, last accessed August 2022).

217 California Air Resources Board, *Technical Analysis of End of Useful Life Scenarios – South Coast*, 2022 (web link: https://ww2.arb.ca.gov/resources/documents/technical-analysis-end-useful-life-scenarios-south-coast, last accessed August 2022).

demonstrated by a recent study conducted by South Coast Air Quality Management District, CEC, CARB, and SoCalGas.[218]

This study measured emissions from 30 0.2-certified and fifteen 0.02-certified natural gas engines during controlled laboratory tests on a chassis dynamometer, and in real world applications using an on-board vehicle emissions testing device, or Portable Emissions Measuring System. This study measured the in-use emissions of 0.02-certified engines at much higher levels than certified under regular daily driving conditions in real-world applications.[219] Almost all the 0.02-certified engines produced NOx emissions greater than this certification standard, with an average NOx emission of 0.07 g/bhp-hr and some NOx emissions as much as three times higher. In addition, HD Omnibus requires more stringent test procedures such as the three-bin moving average window and the Low-load Cycle to limit emission rates during in-use operation.[220] Data on 15 tested vehicles suggest that optional low NOx engines are no cleaner than engines that will need to be certified under HD Omnibus. HD Omnibus has expanded warranty and On-Board Diagnostics requirements aimed at ensuring real-world emissions performance.

Even though the HD Omnibus has an optional pathway for even lower NOx engines, these optional low NOx engines have not been certified or tested in the real world and have some potential for a higher level of emissions while in use, especially after the end of the regulatory engine useful life period. Early conclusions point to real-world operational characteristics, such as idle time and duty cycles, as well as emission control systems deteriorating as a result of natural degradation or mal-maintenance as vehicles age and accumulate mileage, all of which can lead to real-world ICE vehicle emissions that are often much higher than their certification standard. In contrast, ZEVs have zero tailpipe emissions to guarantee that air quality benefits can be achieved throughout engine lifetimes regardless of operation and duty cycles.

The 2022 State Implementation Strategy (draft) air quality modeling indicates NOx emissions will need to decline by approximately 126 tpd from 2037 levels to provide for attainment in the remaining portions of the South Coast region that do not yet meet the preliminary 70 ppb ozone standard. Measures including the proposed ACF regulation and other policies described further in Next Steps will provide an estimated 73 tpd of NOx emission reductions in 2037 for the South Coast.[221]

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[218] Contractor's report will be made available during the 15-day changes since the estimated release date is just beyond the September 2, 2022 release of this ISOR. For background, the 200 vehicle in-use study is an extramural contract funded through the California Energy Commission and Southern California Gas Company ($2.5 million) with minor funding provided by the South Coast Air Quality Management District ($0.6 million) and California Air Resources Board ($0.25 million).
[219] California Air Resources Board, *In-Use Emission Performance of Heavy-Duty Natural Gas Vehicles Lessons Learned from 200 Vehicle Project,* 2021 (web link: https://ww2.arb.ca.gov/sites/default/files/2021-04/Natural_Gas_HD_Engines_Fact_Sheet.pdf, last accessed August 2022).
[220] California Air Resources Board (CARB), *Title 13 Final Regulation Order*, 2020 (web link: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2020/hdomnibuslownox/froa-1.pdf, last accessed August 2022).
[221] California Air Resources Board, *2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy)*, 2022 (web link: https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy, last accessed August 2022).

By definition, ZEVs produce no exhaust emissions of criteria pollutants or greenhouse gases under any possible operational mode. BEVs and FCEVs are the most common examples of ZEVs and both technologies utilize batteries to store energy and to power electric motors. These EVs have instant torque response, low noise, regenerative braking from energy recovered by the motor that greatly reduces brake wear and associated emissions, and generally have a simplified mechanical drivetrain, often without a transmission. Electric motors produce maximum torque and smooth acceleration from a full stop, which can be especially useful when hauling heavy loads. Additionally, some vehicles can even serve as an energy source for off-board equipment such as power tools or lights, providing several kilowatts of electricity through multiple electrical outlets.[222] Heavy-duty EVs in on-road applications across multiple vocations, weight classes, and drive cycles are more efficient than similar combustion-powered vehicles, with an efficiency ratio of 3.5 for highway speed duty cycles to greater than 7 for slow speed duty cycles when compared to similar combustion vehicles.[223]

City driving conditions have more frequent stops, which maximize the benefits of regenerative braking. Our expectation that the early battery-electric truck and bus market is more likely to be supported by centrally operated and maintained fleets that are expected to primarily be charged in the yard. Shorter range applications present less operational risk, have lower upfront cost with smaller battery packs and have a better near-term potential for a payback period more attractive for fleets. The ZEV market is expected to continue to expand to all types of vehicle operations as more ZEVs are deployed and publicly accessible infrastructure is built out.

III. The Specific Purpose and Rationale of Each Adoption, Amendment, or Repeal

California Government Code section 11346.2(b)(1) requires a description of the specific purpose for each proposed adoption, or amendment, the problem the agency intends to address with the proposed ACF regulation, and the rationale for determining that each proposed adoption and amendment is reasonably necessary to both carry out the purposes of CARB staff's proposed ACF regulation and to address the problems for which it is proposed.

The overarching purpose of the proposed ACF regulation is to reduce harmful emissions from motor vehicles. The problems these emissions cause are described above in Chapter II. Appendix H: Purpose and Rationale Description, presents the summary of each proposed amendment and describes its purpose and rationale for its role reducing emissions from motor vehicles.

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[222] U.S. Department of Energy, *All-Electric Vehicles*, 2022 (web link: https://afdc.energy.gov/vehicles/electric_basics_ev.html, last accessed August 2022).
[223] California Air Resources Board, *Advanced Clean Trucks Regulation – Appendix G: Battery Electric Truck and Bus Energy Efficiency Compared to Conventional Diesel Vehicles*, 2019 (web link: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2019/act2019/appg.pdf, last accessed August 2022).

IV. Benefits Anticipated from the Regulatory Action, Including the Benefits or Goals Provided in the Authorizing Statute

A. Health Benefits

Diesel-powered mobile sources emit a complex mixture of air pollutants, including diesel PM, volatile organic compounds, and NOx which can lead to the formation of ozone and the secondary formation of PM.

The proposed ACF regulation would reduce NOx and PM2.5 emissions, resulting in health benefits for individuals in California. The value of health benefits calculated for this regulation is due to fewer instances of premature mortality and fewer hospital and ER visits. The evaluation method used in this analysis is the same as the one used for CARB's LCFS 2018 Amendments, Heavy-Duty Vehicle Inspection Program, and Periodic Smoke Inspection Program.

1. Non-Cancer Health Impacts and Valuation

The proposed ACF regulation's reduction of NOx and PM2.5 emissions would result in health benefits for individuals in California. CARB analyzed the value associated with four health outcomes in the Legal Baseline, Modified Baseline, proposed ACF regulation, and alternatives: cardiopulmonary mortality, hospitalizations for cardiovascular illness, hospitalizations for respiratory illness, and ER visits for asthma. These health outcomes and others have been identified by U.S. EPA as having a causal or likely causal relationship with exposure to PM2.5 based on a substantial body of scientific evidence.[224] U.S. EPA has determined that both long-term and short-term exposure to PM2.5 plays a causal role in premature mortality, meaning that a substantial body of scientific evidence shows a relationship between PM2.5 exposure and increased risk of death. This relationship persists when other risk factors such as smoking rates, poverty, and other factors are taken into account. U.S. EPA has also determined a causal relationship between non-mortality cardiovascular effects and short- and long-term exposure to PM2.5, and a likely causal relationship between non-mortality respiratory effects (including worsening asthma) and short- and long-term PM2.5 exposure. These outcomes lead to hospitalizations and ER visits and are included in this analysis.

CARB staff evaluated a limited number of statewide non-cancer health impacts associated with exposure to PM2.5 and NOx emissions from medium- and heavy-duty vehicles. NOx includes nitrogen dioxide, a potent lung irritant when inhaled, which can aggravate lung diseases such as asthma.[225] However, the most serious quantifiable impacts of NOx emissions occur through the conversion of NOx to fine particles of ammonium nitrate aerosols through chemical processes in the atmosphere. PM2.5 formed in this manner is termed secondary PM2.5. Both directly emitted PM2.5 and secondary PM2.5 from medium- and heavy-duty

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[224] U.S. EPA, *Integrated Science Assessment for Particulate Matter (Issue EPA/600/R-19/188)*, 2019 (web link: https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=347534, last accessed August 2022).

[225] United States Environmental Protection Agency, *Integrated Science Assessment for Oxides of Nitrogen – Health Criteria, EPA/600/R-15/068*, 2016 (web link: http://ofmpub.epa.gov/eims/eimscomm.getfile?p_download_id=526855, last accessed August 2022).

vehicles are associated with adverse health outcomes, such as cardiopulmonary mortality, hospitalizations for cardiovascular illness and respiratory illness, and ER visits for asthma. As a result, reductions in PM2.5 and NOx emissions are associated with reductions in these health outcomes.

2. Reduction in Potential Cancer Risk

Diesel PM is a toxic air contaminant composed of over 40 known cancer-causing substances and PM. Examples of these carcinogenic chemicals include: polycyclic aromatic hydrocarbons, benzene, formaldehyde, acetaldehyde, acrolein, and 1,3-butadiene. CARB listed diesel PM as a toxic air contaminant in 1998, due largely to its association with lung cancer. In 2012, additional studies on the cancer-causing potential of diesel exhaust, published since CARB's listing, led the International Agency for Research on Cancer, a division of the World Health Organization, to classify diesel engine exhaust as "carcinogenic to humans."[226] In California, about 70 percent of known cancer risks from toxic air contaminants are from diesel engine emissions.

Diesel PM is composed primarily of PM2.5. Due to its small size, inhaled PM2.5 can reach the lower respiratory tract and potentially pass into the bloodstream to affect other organs. In this way, PM2.5 air pollution contributes not only to increased cancer risk, but also to respiratory and cardiovascular diseases and even premature death; other adverse health outcomes from PM2.5 also include asthma, chronic heart disease, and heart attack.

Because the proposed ACF regulation is expected to result in the reduction of both NOx and PM2.5, it is expected that there would be a resulting reduction in incidences of cancer, though this was not quantified for the proposed ACF regulation.

3. Incidence-per-Ton Methodology

CARB uses the incidence-per-ton (IPT) methodology to quantify the health benefits of emissions reductions in cases where dispersion modeling results are not available. A description of this method is included on CARB's webpage.[227] CARB's IPT methodology is based on a methodology developed by U.S. EPA.[228,229,230]

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[226] World Health Organization, International Agency for Research on Cancer, *IARC: Diesel Engine Exhaust Carcinogenic*, 2012 (web link: https://www.iarc.who.int/news-events/iarc-diesel-engine-exhaust-carcinogenic/, last accessed August 2022).

[227] California Air Resources Board, *CARB's Methodology for Estimating the Health Effects of Air Pollution* (web link: https://ww2.arb.ca.gov/resources/documents/carbs-methodology-estimating-health-effects-air-pollution, last accessed August 2022).

[228] Fann N, Fulcher CM, Hubbell BJ., *The influence of location, source, and emission type in estimates of the human health benefits of reducing a ton of air pollution*, Air Quality, Atmosphere & Health, 2:169-176, 2009 (web link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2770129/, last accessed August 2022).

[229] Fann N, Baker KR, Fulcher CM., *Characterizing the PM2.5-related health benefits of emission reductions for 17 industrial, area and mobile emission sectors across the U.S.*, Environ Int.; 49:141-51, 2012 (web link: https://www.sciencedirect.com/science/article/pii/S0160412012001985, last accessed August 2022).

[230] Fann N, Baker K, Chan E, Eyth A, Macpherson A, Miller E, Snyder J., *Assessing Human Health PM2.5 and Ozone Impacts from U.S. Oil and Natural Gas Sector Emissions in 2025, Environ. Sci. Technol. 52 (15), pp 8095–8103*, 2018 (web link: https://pubs.acs.org/doi/abs/10.1021/acs.est.8b02050, last accessed August 2022).

Under the IPT methodology, changes in health outcomes are approximately proportional to changes in emissions. IPT factors are derived by calculating the number of health outcomes associated with exposure to PM2.5 for a baseline scenario using measured ambient concentrations and dividing by the emissions of PM2.5 or a precursor. The calculation is performed separately for each air basin using the following equation:

$$\text{IPT} = \frac{\text{number of health outcomes in air basin}}{\text{annual emissions in air basin}}$$

Multiplying the emissions reductions from the proposed ACF regulation in an air basin by the IPT factor then yields an estimate of the reduction in health outcomes achieved by the proposed ACF regulation. For future years, the number of outcomes is adjusted to account for population growth. CARB's current IPT factors are based on a 2014-2016 baseline scenario, which represents the most recent data available at the time the current IPT factors were computed. IPT factors are computed for the two types of PM2.5: primary PM2.5 and secondary PM2.5 of ammonium nitrate aerosol formed from precursors.

4. Reduction in Adverse Health Impacts

CARB staff evaluated the reduction in adverse health impacts including cardiopulmonary mortality, hospitalizations for cardiovascular and respiratory illness, and ER visits for asthma. Staff estimates that the total number of cases statewide that would be reduced (from 2024 to 2050) from implementation of the proposed ACF regulation are as follows:

1. 5,519 cardiopulmonary deaths reduced (4,316 to 6,744, 95 percent confidence interval (CI));
2. 873 hospital admissions for cardiovascular illness reduced (0 to 1,711, 95 percent CI);
3. 1,042 hospital admissions for respiratory illness reduced (244 to 1,838, 95 percent CI); and
4. 2,537 ER visits for asthma reduced (1,606 to 3,470, 95 percent CI).

Table 19 shows the estimated avoided cardiopulmonary mortality, hospitalizations, and ER visits because of the proposed ACF regulation for 2024 through 2050 by California air basin, relative to the Legal Baseline. As shown, the proposed ACF regulation is estimated to reduce overall emissions of PM2.5 and NOx, and lead to net reduction in adverse health outcomes statewide, relative to the baseline. While this analysis does not further quantify upstream emissions benefits of criteria pollutant reductions, to the degree reduced fuel demand from this rule results in reduced liquid fuel production at California refineries, further benefits would result from criteria pollutant reductions.[231] As noted above, during the COVID-19 pandemic and the stay-at-home orders, there was a drastic reduction in demand for petroleum fuels as residents stayed home. As a result of that reduced demand, several

[231] CARB conducted a similar analysis, incorporated here by reference, in a recent SRIA document for the large fuel demand reductions associated with the proposed Advanced Clean Cars 2 Regulation. *See* California Air Resources Board, *Advanced Clean Cars II SRIA*, 2022 (web link: https://www.dof.ca.gov/forecasting/economics/major_regulations/major_regulations_table/documents/ACCII-SRIA.pdf, last accessed August 2022).

refineries shutdown or announced the repurposing of those facilities to produce low carbon fuels.[232,233] Just as GHG reductions from these sources might be expected to result from corresponding fuel demand reductions from this regulation, criteria and toxic pollution reduction from these sources will also likely occur, further expanding the benefits of these regulations. To be conservative, and in light of the many factors affecting upstream sector behavior, CARB has opted not to include specific reductions here—and even without them very significant health benefits are expected.

It should be noted that the results presented in Table 19 are estimated at a regional scale, at the air basin level. However, it is important to consider that the proposed ACF regulation may decrease the occupational exposure to air pollution of California truck operators and other employees who work around truck traffic. Without the proposed ACF regulation, these individuals are likely at higher risks of developing cardiovascular and respiratory issues as a result of medium- and heavy-duty vehicle PM emissions. Although CARB staff cannot quantify the potential effect on occupational exposure, the proposed ACF regulation is expected to provide large health benefits for these types of workers.

Table 19: Regional and Statewide Avoided Mortality and Morbidity Incidents from 2024 to 2050 under the Proposed ACF regulation

Air Basin	Cardiopulmonary mortality	Hospitalizations for cardiovascular illness	Hospitalizations for respiratory illness	ER visits
Great Basin Valleys	3 (2 - 3) ‡	0 (0 - 1)	0 (0 - 1)	1 (1 - 1)
Lake County	2 (2 - 3)	0 (0 - 0)	0 (0 - 0)	1 (1 - 1)
Lake Tahoe	1 (0 - 1)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Mojave Desert	94 (73 - 115)	14 (0 - 28)	17 (4 - 30)	36 (23 - 49)
Mountain Counties	46 (36 - 57)	4 (0 - 9)	5 (1 - 9)	15 (10 - 21)
North Central Coast	23 (18 - 28)	4 (0 - 8)	5 (1 - 8)	13 (8 - 18)
North Coast	8 (6 - 10)	1 (0 - 2)	1 (0 - 2)	3 (2 - 4)
Northeast Plateau	3 (2 - 3)	0 (0 - 1)	0 (0 - 1)	1 (1 - 2)
Sacramento Valley	243 (190 - 298)	31 (0 - 61)	37 (9 - 66)	90 (57 - 124)
Salton Sea	71 (55 - 87)	11 (0 - 21)	13 (3 - 23)	33 (21 - 45)
San Diego County	226 (177 - 277)	34 (0 - 67)	41 (10 - 72)	89 (56 - 122)

[232] Phillips 66, *Phillips 66 Plans to Transform San Francisco Refinery into World's Largest Renewable Fuels Plant, 2020* (web link: https://investor.phillips66.com/financial-information/news-releases/news-release-details/2020/Phillips-66-Plans-to-Transform-San-Francisco-Refinery-into-Worlds-Largest-Renewable-Fuels-Plant/default.aspx, last accessed August 2022).
[233] BiodieselMagazine.com, *Marathon proceeds with renewables conversion at Martinez refinery,* 2021 (web link: https://biodieselmagazine.com/articles/2517427/marathon-proceeds-with-renewables-conversion-at-martinez-refinery, last accessed August 2022).

Air Basin	Cardiopulmonary mortality	Hospitalizations for cardiovascular illness	Hospitalizations for respiratory illness	ER visits
San Francisco Bay	419 (327 - 513)	68 (0 - 133)	81 (19 - 142)	225 (142 - 308)
San Joaquin Valley	1,111 (870 - 1355)	141 (0 - 277)	169 (40 - 298)	393 (249 - 537)
South Central Coast	63 (49 - 76)	10 (0 - 20)	12 (3 - 21)	27 (17 - 36)
South Coast	3,207 (2,509 – 3,918)	554 (0 – 1,085)	661 (155 – 1,166)	1,610 (1,019 – 2,201)
Statewide*	**5,519 (4,316 – 6,744)**	**873 (0 – 1,711)**	**1,042 (244 – 1,838)**	**2,537 (1,606 – 3,470)**

*Note: Totals may differ due to rounding.

‡ Numbers in parentheses throughout this table represent the 95 percent confidence interval (CI).

5. Uncertainties Associated with the Mortality and Illness Analysis

Although the estimated health outcomes presented in this report are based on a well-established methodology, they are subject to uncertainty. Uncertainty is reflected in the 95 percent CIs included with the central estimates in Table 19. These CIs take into account uncertainties in translating air quality changes into health outcomes.

Other sources of uncertainty include the following:

- The relationship between changes in pollutant concentrations and changes in pollutant or precursor emissions is assumed to be proportional, although this is an approximation.
- Emissions are reported at an air basin resolution, and do not capture local variations.
- Future population estimates are subject to increasing uncertainty as they are projected further into the future.

Baseline incidence rates can also experience year-to-year variations.

6. Monetization of Health Impacts

In accordance with U.S. EPA practice, health outcomes are monetized by multiplying each incident by a standard value derived from economic studies.[234] The value per incident is shown in Table 20. The value for avoided premature mortality is based on willingness to pay, which is a statistical construct based on the aggregated dollar amount that a large group of

[234] U.S. EPA, *Appendix B: Mortality Risk Valuation Estimates, Guidelines for Preparing Economic Analyses (240-R-10-001)*, 2010 (web link: https://www.epa.gov/sites/default/files/2017-09/documents/ee-0568-22.pdf, last accessed August 2022).

people would be willing to pay for a reduction in their individual risks of dying in a year.[235] While the cost-savings associated with premature mortality is important to account for in the analysis, the valuation of avoided premature mortality does not correspond to changes in expenditures, and is not included in the macroeconomic modeling. As avoided hospitalizations and ER visits correspond to reductions in household expenditures on health care, these values are included in the macroeconomic modeling.

Unlike mortality valuation, the cost-savings for avoided hospitalizations and ER visits are based on a combination of typical costs associated with hospitalization and the willingness of surveyed individuals to pay to avoid adverse outcomes that occur when hospitalized. These include hospital charges, post-hospitalization medical care, out-of-pocket expenses, lost earnings for both individuals and family members, lost recreation value, and lost household production (e.g., valuation of time-losses from inability to maintain the household or provide childcare).[236] These monetized benefits from avoided hospitalizations and ER visits are included in macroeconomic modeling.

Table 20: Valuation per Incident for Avoided Health Outcomes (2021$)

Outcome	Value per incident
Avoided Premature Mortality	$10,453,897
Avoided Cardiovascular Hospitalizations	$61,750
Avoided Acute Respiratory Hospitalizations	$53,862
Avoided ER Visits	$884

Statewide valuation of health benefits was calculated by multiplying the value per incident by the statewide total number of incidents for 2024-2050 as shown in Table 21. The total statewide health benefits derived from criteria emissions reductions is estimated to be $57.8 billion, with $57.7 billion resulting from reduced premature cardiopulmonary mortality and $0.1 billion resulting from reduced hospitalizations and ER visits. The spatial distribution of these benefits across the state follows the distribution of the health impacts by air basin as described in Table 21.

[235] U.S. EPA, *An SAB Report on EPA's White Paper Valuing the Benefits of Fatal Cancer Risk Reduction (EPA-SAB-EEAC-00-013)*, 2000 (web link: https://nepis.epa.gov/Exe/ZyPDF.cgi/P100JOK2.PDF?Dockey=P100JOK2.PDF, last accessed August 2022).
[236] Chestnut, L. G., Thayer, M. A., Lazo, J. K. and Van Den Eeden, S. K., *The Economic Value Of Preventing Respiratory And Cardiovascular Hospitalizations, Contemporary Economic Policy, 24: 127– 143*, 2006 (web link: https://onlinelibrary.wiley.com/doi/abs/10.1093/cep/byj007, last accessed August 2022).

Table 21: Statewide Valuation from Avoided Health Outcomes (Million 2021$)

Year	Avoided cardiopulmonary mortality valuation	Avoided hospitalizations for cardiovascular illness valuation	Avoided hospitalizations for respiratory illness valuation	Avoided ER visits valuation	Annual total valuation
2024	8	1	1	4	$83.75
2025	9	1	1	4	$94.20
2026	12	2	2	6	$125.68
2027	20	3	3	10	$209.43
2028	27	4	4	13	$282.73
2029	38	5	6	18	$397.90
2030	55	8	9	26	$575.97
2031	73	11	13	35	$764.54
2032	90	13	16	43	$942.55
2033	106	16	20	50	$1,110.17
2034	129	20	25	61	$1,351.08
2035	156	24	30	73	$1,633.92
2036	179	28	35	84	$1,874.83
2037	203	32	40	95	$2,126.25
2038	229	36	45	107	$2,398.58
2039	254	40	51	118	$2,660.45
2040	275	43	56	127	$2,880.39
2041	301	48	61	139	$3,152.78
2042	328	52	67	151	$3,435.56
2043	336	53	68	154	$3,519.37
2044	344	55	70	157	$3,603.18
2045	357	57	73	162	$3,739.37
2046	370	59	77	168	$3,875.56
2047	383	62	80	174	$4,011.81
2048	397	64	83	180	$4,158.46
2049	412	67	87	186	$4,315.62
2050	426	69	90	192	$4,462.26
Total Benefit	**$57,674.15**	**$53.91**	**$56.07**	**$2.24**	**$57,786.37**

7. Potential Future Evaluation of Additional Health Benefits

While CARB's PM2.5 mortality and illness analysis has been, and continues to be, a useful method for valuing the health benefits of regulations, it only represents a portion of those benefits. The proposed ACF regulation would result in additional health benefits beyond what CARB staff has quantified. CARB's current PM2.5 mortality and illness evaluation focuses on select air pollutants and health outcomes, and therefore captures only a portion of the health benefits of the proposed ACF regulation. For example, while the current analysis considers the impact of NOx on the formation of secondary PM2.5 particles, NOx can also react with other compounds to form ozone, which can cause respiratory problems. The proposed ACF regulation would also result in a decrease of toxic air contaminants emitted from diesel engines, which can cause cancer and other adverse health effects. In addition to the health benefits that are quantified, the proposed ACF regulation would reduce additional cardiovascular and respiratory illnesses, nonfatal and fatal cancers, and lost workdays. Also, in 2021, U.S. EPA issued a Technical Support Document for their Cross-State Air Pollution Rule that provided both health functions and health valuation for lung cancer incidence, Alzheimer's disease, and Parkinson's disease, among other health endpoints related to PM2.5 exposures.[237] Updated health impact functions and valuations for ozone are also provided in the aforementioned Cross-State Air Pollution Rule Technical Support Document provided by U.S. EPA.[238]

Expanding CARB's health evaluation and economic valuation methodology to include any of the above additional inputs and health outcomes would allow the public to reach a better understanding of the benefits from reducing air pollution by moving toward ZE technologies.

As indicated, the scientific literature has demonstrated an array of air pollutant-related health impacts, well beyond what CARB staff have quantified in Table 19. Some of these impacts are summarized in the next section.

8. Adverse Impacts to Human Health from Diesel Emissions

Diesel-powered mobile sources emit a complex mixture of air pollutants, including diesel PM and gases. The gaseous pollutants include volatile organic compounds (VOC) and NOx, which can lead to the formation of ozone and the secondary formation of PM.

a) Air Toxic Impacts

Diesel PM is a toxic air contaminant composed of PM and over 40 known cancer-causing substances, including polycyclic aromatic hydrocarbons, benzene, formaldehyde, acetaldehyde, acrolein, and 1,3-butadiene.[239] CARB listed diesel PM as a toxic air contaminant in 1998, due largely to its association with lung cancer.[240] In 2012, additional studies on the cancer-causing potential of diesel exhaust published since CARB's listing led the International Agency for Research on Cancer (a division of the World Health Organization) to classify diesel engine exhaust as "carcinogenic to humans."[241] In California,

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[237] U.S. EPA., *Technical Support Document (TSD) for the Final Revised Cross-State Air Pollution Rule Update for the 2008 Ozone Season NAAQS: Estimating PM2.5- and Ozone-Attributable Health Benefits (EPA-HQ-OAR-2020-0272)*, 2021 (web link: https://www.epa.gov/sites/default/files/2021-03/documents/estimating_pm2.5-_and_ozone-attributable_health_benefits_tsd_march_2021.pdf, last accessed August 2022).

[238] Ibid.

[239] Ibid.

[240] Ibid.

[241] International Agency for Research on Cancer (a division of the World Health Organization), *Press Release N° 213, IARC: Diesel Engine Exhaust Carcinogenic*, 2012 (web link: https://www.iarc.who.int/wp-content/uploads/2018/07/pr213_E.pdf, last accessed August 2022).

about 70 percent of known cancer risks from toxic air contaminants are from diesel engine emissions.[242,243]

b) Particle Pollution Impacts

Diesel PM is composed primarily of PM2.5.[244] Due to its small size, inhaled PM2.5 can reach the lower respiratory tract and potentially pass into the bloodstream to affect other organs.[245] In this way, PM2.5 contributes not only to increased cancer risk, but also respiratory and cardiovascular diseases and even premature death.[246] Other adverse health outcomes from PM2.5 include asthma, chronic heart disease, and heart attack.[247,248] Moreover, PM2.5 can result in respiratory, cardiac, and mortality effects over short exposure times such as days or weeks.[249] PM2.5 is well known to exacerbate asthma, bronchitis, and heart disease symptoms.[250] Exposures to PM2.5 may also lead to myriad other health outcomes, including metabolic, nervous system, reproductive, and developmental effects.[251] For example, adverse health conditions with possible links to airborne PM2.5 include high blood pressure, insulin resistance, and other risk factors for Type II Diabetes, as well as psychological/cognitive problems.[252] PM2.5 may especially impact women and children via health effects such as pre-term birth, reduced birth weight, and abnormal lung and cardiovascular development.[253]

c) Ozone Pollution Impacts

As a gaseous pollutant from mobile sources, NOx can react with other compounds to form ozone, which is the main component of smog. Based on extensive evidence from scientific studies, U.S. EPA has determined that short-term exposure from ozone is causally linked to

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[242] Environmental Science & Technology*, Ambient and Emission Trends of Toxic Air Contaminants in California*, 2015 (web link: https://pubs.acs.org/doi/full/10.1021/acs.est.5b02766, last accessed August 2022).
[243] California Air Resources Board, *Overview: Diesel Exhaust & Health | California Air Resources Board*, (web link: https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health, last accessed August 2022).
[244] California Air Resources Board, *Inhalable Particulate Matter and Health (PM2.5 and PM10) | California Air Resources Board*, (web link: https://ww2.arb.ca.gov/resources/inhalable-particulate-matter-and-health, last accessed August 2022).
[245] U.S. EPA, *Health and Environmental Effects of Particulate Matter (PM) | Particulate Matter (PM) Pollution | US EPA*, (web link: https://www.epa.gov/pm-pollution/health-and-environmental-effects-particulate-matter-pm, last accessed August 2022).
[246] U.S. EPA, *Integrated Science Assessment for Particulate Matter (EPA/600/R-19/188),* 2019 (web link: https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=347534#tab-3, last accessed August 2022).
[247] World Health Organization, Regional Office for Europe. *Review of Evidence on Health Aspects of Air Pollution-REVIHAAP Project: Technical Report*, 2013 (web link: https://www.euro.who.int/en/health-topics/environment-and-health/air-quality/publications/2013/review-of-evidence-on-health-aspects-of-air-pollution-revihaap-project-final-technical-report, last accessed August 2022).
[248] California Air Resources Board, *Overview: Diesel Exhaust & Health | California Air Resources Board*, (web link: https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health, last accessed August 2022).
[249] U.S. EPA, *Integrated Science Assessment for Particulate Matter (EPA/600/R-19/188),* 2019 (web link: https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=347534#tab-3, last accessed August 2022).
[250] Ibid.
[251] Ibid.
[252] Ibid.
[253] Ibid.

adverse respiratory effects.[254] Ozone can cause irritation and damage to lung tissue, can worsen asthma and chronic illnesses including chronic obstructive pulmonary disease, and can reduce lung function. For instance, a study conducted in the San Joaquin Valley showed that increased ozone pollution led to increased risk for asthma ER visits, especially for children and Black residents.[255] Metabolic functions are also likely to be affected by short-term ozone exposure, such as those leading to increased risk for complications and hospitalizations in diabetic individuals.[256] And, similar to PM2.5, other potential health effects from ozone exposure may include impacts on the cardiovascular, nervous, and reproductive systems, and possibly increased risk of mortality.[257]

9. Health Benefits Conclusion

Mobile sources generate criteria pollutants and toxic air contaminants that are known to cause a range of serious health impacts including premature deaths. As shown in Table 19, CARB estimates that implementation of the proposed ACF regulation would result in substantial health and economic benefits, due to reduced cardiovascular/respiratory hospitalizations, asthma ER visits, and cardiopulmonary deaths. Despite these substantive benefits, CARB's assessment is limited and thus likely an underestimation, because it does not consider the various other health outcomes that could be avoided with cleaner mobile sources. Furthermore, those who live and work around areas with high mobile source activity, especially those living in DACs, are more heavily impacted by these pollutant exposures. For these individuals, actions like the proposed ACF regulation to move to cleaner mobile sources are critically important.

B. Air Quality and Climate Benefits

This section provides background information regarding California's need to reduce ambient ozone levels and GHGs, including black carbon. The proposed ACF regulation is expected to contribute to reduction of pollutants that lead to the formation of ozone and of GHGs including black carbon.

1. Reduced Ambient Ozone Levels

Diesel-powered mobile sources emit a complex mixture of air pollutants, including diesel PM and gases. The gaseous pollutants include volatile organic compounds and NOx. NOx reacts with other chemicals in the air to form both PM and ground level ozone, both of which are identified in the federal Clean Air Act as criteria pollutants, with NAAQS set. Nineteen areas

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[254] U.S. EPA, *Integrated Science Assessment (ISA) for Ozone and Related Photochemical Oxidants*, Issue EPA/600/R-20/012, 2020 (web link: https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=348522, last accessed August 2022).
[255] Gharibi H, Entwistle MR, Ha S, Gonzalez M, Brown P, Schweizer D, Cisneros R., Ozone pollution and asthma emergency department visits in the Central Valley, California, USA, during June to September of 2015: a time-stratified case-crossover analysis, J Asthma, 2019 Oct;56(10):1037-1048. doi: 10.1080/02770903.2018.1523930. Epub 2018 Oct 9. PMID: 30299181.
[256] U.S. EPA, *Integrated Science Assessment (ISA) for Ozone and Related Photochemical Oxidants Issue EPA/600/R-20/012*, 2020 (web link: https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=348522, last accessed August 2022).
[257] Ibid.

in California are in non-attainment for the 70 ppb ozone standard. Controlling ozone precursor emissions, in particular NOx, is key to attaining the federal ozone standards.[258] Most of the NOx emissions from heavy-duty engines come from diesel-cycle engines, especially in the higher weight classes. However, gasoline and natural gas Otto-cycle spark-ignited engines are also used, to a lesser extent, in heavy-duty trucks, primarily in the lower weight classification vehicles. Even low mileage natural gas vehicles certified to the optional 0.02 g/bhp-hr NOx emissions standard pollute in the field more than expected.[259]

Substantial progress has been achieved in reducing NOx emissions in California through implementation of CARB's existing mobile source programs, and it is expected that these programs will continue to provide further reductions through 2031, contributing significantly to meeting air quality standards. However, challenges still remain in meeting the ambient air quality standards for ozone in 2 areas of the state with the most critical air quality challenges: the South Coast and San Joaquin Valley Air Basins.[260,261] The South Coast Air Basin has the highest ozone levels in the nation. Since NOx is also a precursor to secondary PM2.5 formation, reductions in NOx emissions will also provide benefits for meeting the PM2.5 standards. To meet the 2023 and 2031 ambient air quality standards for ozone, the South Coast Air Basin will require an approximate 80 percent NOx reduction by 2031. For most areas in California to attain the 70 ppb ozone standard, any and all potential reductions must be pursued, and the proposed ACF regulation is one of 4 on-road vehicle measures referenced in the Draft 2022 State Strategy for the SIP to support attainment of the 70 ppb ozone standard statewide.[262]

Mobile sources are the largest source category of NOx emissions and medium- and heavy-duty vehicles are the largest source of mobile source NOx emissions as displayed in Figure 48.

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[258] California Air Resources Board, *Draft 2022 State Strategy for the State Implementation Plan*, 2022 (web link: https://ww2.arb.ca.gov/sites/default/files/2022-01/Draft_2022_State_SIP_Strategy.pdf, last accessed August 2022).

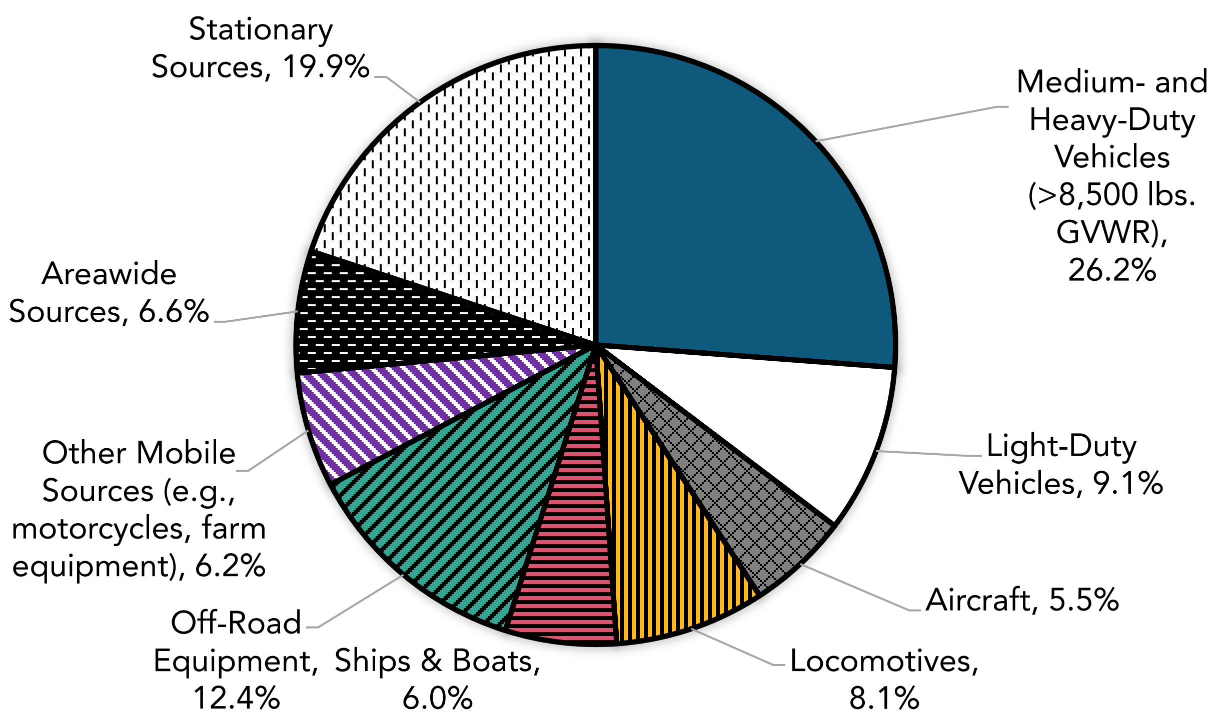
[259] California Air Resources Board, *In-Use Emission Performance of Heavy-Duty Natural Gas Vehicles: Lessons Learned from 200 Vehicle Project*, 2021 (web link: https://ww2.arb.ca.gov/sites/default/files/2021-04/Natural_Gas_HD_Engines_Fact_Sheet.pdf, last accessed August 2022).

[260] California Air Resources Board, *Staff Report: ARB Review of the San Joaquin Valley 2016 Plan for the 2008 8-Hour Ozone Standard*, 2016 (web link: https://www.arb.ca.gov/planning/sip/planarea/2016sjv/staffreport.pdf, last accessed: April 2022).

[261] California Air Resources Board, *State Implementation Plan Attainment Contingency Measures for the San Joaquin Valley 15 ug/m Annual PM2.5 Standard*, 2017 (web link: https://www.arb.ca.gov/planning/sip/sjvpm25/2017contingency/2017_sjv_conting ency_staffreport.pdf, last accessed: April 2022).

[262] California Air Resources Board, *Draft 2022 State Strategy for the State Implementation Plan*, 2022 (web link: https://ww2.arb.ca.gov/sites/default/files/2022-01/Draft_2022_State_SIP_Strategy.pdf, last accessed August 2022).

Figure 48: 2022 NOx Emissions by Source



2. Greenhouse Gases and Black Carbon

The proposed ACF regulation would result in reductions of GHGs, criteria pollutants, and toxic air contaminants, including SLCPs, from on-road medium- and heavy-duty vehicles. SLCPs are powerful climate forcers and harmful air pollutants that have an outsized impact on climate change in the near term, compared to longer-lived GHGs, such as CO_2. These pollutants include the GHGs methane and hydrofluorocarbons, and anthropogenic black carbon. Recent studies have shown that black carbon plays a much larger role in global warming than previously believed. Because SLCP impacts are especially strong over the short-term, acting now to reduce their emissions can have an immediate beneficial impact on climate change and public health.

SLCPs such as black carbon and methane are emitted from transportation sources due to the combustion of diesel and natural gas. Diesel engines emit diesel PM which is typically composed of carbon particles ("soot", also called black carbon) and numerous organic compounds, including over 40 known cancer-causing organic substances such as benzene and formaldehyde.[263] CARB estimates that about 70 percent of the total known cancer risk related to air toxics in California is attributable to diesel PM.[264] Most major sources of diesel emissions, such as ships, trains, and trucks, operate in and around ports, rail yards, and heavily traveled roadways, which are often located near highly populated and DACs. The

[263] California Air Resources Board, *Mobile Source Strategy*, 2020 (web link: https://ww2.arb.ca.gov/sites/default/files/2021-12/2020_Mobile_Source_Strategy.pdf, last accessed August 2022).
[264] California Air Resources Board, *Overview: Diesel Exhaust & Health*, 2020 (web link: https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health, last accessed August 2022).

proposed ACF regulation would reduce a significant amount of diesel emissions from many of these areas.

SB 1383[265] sets targets for statewide reductions in SLCP emissions of 40 percent below 2013 levels by 2030 for methane and hydrofluorocarbons, and 50 percent below 2013 levels by 2030 for anthropogenic black carbon. California's ongoing efforts to improve air quality and address climate change have already led to important reductions in SLCP emissions, and they provide a strong foundation to support further efforts to reduce emissions of these dangerous pollutants. From 2000 to 2020, California has cut black carbon from mobile sources by an estimated 75 percent. [266] CARB's ongoing efforts prevent an estimated 5,000 premature deaths in the state each year and deliver important climate benefits.[267] Reduction in GHGs, including SLCPs like black carbon and methane from ICEs are needed to achieve the State's multiple GHG reduction targets and public health goals. The proposed ACF regulation in combination with other regulations such as ACT and Heavy-Duty Omnibus that target emissions reductions from on-road diesel engines will almost eliminate black carbon emissions from on-road sources within the next ten years.

C. Benefits to Typical Businesses

The 2016 SIP Strategy identifies that "electrification and progress toward ZE is critical to address the remaining (from renewable fuels) localized risk of cancer and other adverse effects from major freight hubs, and (electrification) must play a growing role in reducing GHG emissions and petroleum use."[268] The proposed ACF regulation supports the goals of the SIP and reduces pollutants linked to multiple adverse health effects identified by the California Ambient Air Quality Standards.[269] The proposed ACF regulation also reduces GHG emissions, petroleum use, and provides the certainty needed to establish successful adoption of ZEVs, including medium- and heavy-duty vehicles. Typical businesses that own trucks and buses subject to the proposed ACF regulation may benefit financially through a lower TCO due to ZEV and/or associated infrastructure ownership. Electric utility providers would also benefit from increased electricity deliveries. Natural gas utilities can benefit by participating in the Renewable hydrogen gas market by supplying renewable natural gas to existing hydrogen producers to produce low carbon intensity hydrogen. ZEV manufacturers and component suppliers, EVSE suppliers and installers, and hydrogen fuel station suppliers may also benefit due to higher demand for medium- or heavy-duty ZEVs from the proposed ACF regulation, leading to an increase in related jobs throughout the state.

[265] (Lara, Stats. 2016, Chapter 395)
[266] California Air Resources Board, *Short-Lived Climate Pollutant Reduction Strategy*, 2017 (web link: https://ww2.arb.ca.gov/sites/default/files/2020-07/final_SLCP_strategy.pdf, last accessed August 2022).
[267] California Air Resources Board, *Short-Lived Climate Pollutant Reduction Strategy*, 2017 (web link: https://ww2.arb.ca.gov/sites/default/files/2020-07/final_SLCP_strategy.pdf, last accessed August 2022).
[268] California Air Resources Board, *2016 Mobile Source Strategy*, 2016, (web link: https://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf, last accessed August 2022).
[269] California Air Resources Board, *California Ambient Air Quality Standards*, 2016(web link: https://ww2.arb.ca.gov/resources/california-ambient-air-quality-standards, last accessed August 2022).

1. Truck and Bus Owners

Individual businesses may be able to lower their TCO by taking advantage of the operational cost-savings of ZEVs like battery-electric or hydrogen FCEVs. ZEV owners that also own their charging or hydrogen fueling stations can lower costs further by taking advantage of the LCFS program. Details can be found in the Direct Costs chapter of the ACF Standardized Regulatory Impact Assessment (SRIA) in section 3.1.4.3.

Trucking companies and others that have ZEV fleets might choose to advertise themselves as being environmentally friendly and make partnerships or sign contracts with other companies that want to support the movement toward replacing fossil fuel-burning trucks and buses with those that produce no tailpipe emissions, resulting in better public health. Less vibration in the cab results in a reduced health impact to truck drivers, including a reduction in "driver's fatigue" which can lead to deadly accidents.[270, 271, 272] ZEVs reduce harmful emissions that contribute to air toxics hot spots at places such as truck mechanic shops, loading docks, and inside truck cabs, resulting in better quality air that truck drivers, including owner-operators, breathe.[273]

2. Utility Providers

a) Electric Utility Providers

The proposed ACF regulation would increase the number of medium- and heavy-duty ZEVs deployed which, in turn, would increase the amount of electricity supplied by electric utility providers, either directly or indirectly. In addition, since electric utilities also operate trucks, they would also see potential benefits like other truck owners.

The proposed ACF regulation would also help the state's IOUs meet the goals of SB 350, which includes a requirement that the state's IOUs develop programs "to accelerate widespread TE." PG&E, SCE, and SDG&E have active programs to install low-cost or free EVSE on a customer's site, and they commonly offer a voucher for the charger itself.

All three of these IOUs have established new electricity rates for commercial ZEV deployments to better align with fleet needs and to ensure affordability, which includes a variety of approaches such as demand charge holidays or a subscription-based approach. Research and development of new rate strategies is ongoing. By ensuring that vehicles would be available to make use of these utility investments and rates, the proposed ACF regulation supports the utilities' programs, the goals of SB 350, and an increase in electricity demand. In addition, other electric service providers, such as POUs and community choice aggregators,

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[270] Institute of Transport Economics, *Experiences from Battery-Electric Truck Users in Norway*, 2020 (web link: https://www.mdpi.com/601754, last accessed August 2022).
[271] Bose Corporation, *The impact of different seats and whole-body vibration exposures on truck driver vigilance and discomfort*, 2017 (web link: https://doi.org/10.1080/00140139.2017.1372638, last accessed August 2022).
[272] RAND Corporation, *Evaluating the Impact of Whole-Body Vibration (WBV) on Fatigue and the Implications for Driver Safety*, 2015 (web link: www.rand.org/t/rr1057, last accessed August 2022).
[273] National Library of Medicine, *Potential air toxics hot spots in truck terminals and cabs*, 2012 (web link: https://pubmed.ncbi.nlm.nih.gov/23409510/, last accessed August 2022).

continue to develop and deploy new programs and policies and would similarly benefit from increased electricity deliveries.

b) Natural Gas Utility Providers

The proposed ACF regulation would encourage natural gas utility providers to lower the carbon intensity of the state's natural gas grid by procuring and injecting more RNG from instate sources. Pipeline-accessible low or negative carbon intensity RNG is a valuable resource that can be used by existing hydrogen producers to produce low carbon intensity hydrogen, which has an enhanced LCFS credit value when used for transportation. Stationary fuel cells using RNG or renewable hydrogen to produce electricity can serve as a low or ZE grid resource as is being done by SoCalGas.[274] Finally, natural gas utilities have the opportunity to participate in the renewable hydrogen gas market to a fuller extent. SoCalGas realizes this potential with their proposed Angeles Link project discussed earlier.

3. Other California Businesses

The proposed ACF regulation may result in benefits to ZEV manufacturers and component suppliers, EVSE suppliers and installers, and hydrogen fuel station suppliers. Due to higher demand for medium- or heavy-duty ZEVs from the proposed ACF regulation, production of ZEVs in California would be expected to rise, leading to increases in manufacturing and related jobs throughout the state. The increase in the production and usage of ZEVs would be expected to also benefit various businesses related to the ZEV component supply chain, including those involved with batteries, fuel cells, and electric drivetrains.

The proposed ACF regulation may also benefit EVSE suppliers who would see an increase in charging equipment installation because of increased medium- and heavy-duty ZEV purchases. Most of these installations are expected to be in central depots or yards where trucks are parked overnight. Increased installation of charging infrastructure would benefit the EVSE suppliers, equipment installers, and electricians. EVSE installations would primarily be in California (though, conceivably, some businesses might also choose to operate their ZEVs in other states, resulting in additional EVSE in those states), and some of the EVSE equipment may be manufactured in California. Increased purchase of medium- and heavy-duty ZEVs under the proposed ACF regulation would also benefit various California businesses related to installing hydrogen fueling stations, supplying hydrogen, and providing associated maintenance. The proposed ACF regulation would also increase demand for renewable hydrogen, thereby motivating hydrogen producers to increase instate production of low carbon intensity hydrogen. Low carbon intensity hydrogen, such as that produced via electrolysis from wind and solar resources, will have the ability to earn significant LCFS credits driving the price of hydrogen at the pump towards parity with diesel.

Companies that contract with or use ZEV fleets would be able to tout that they are either moving towards or currently operating with a carbon neutral or carbon optimal supply

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[274] SoCalGas, *SoCalGas Highlights Successful First Year Results for Fuel Cells at Company Facilities*, 2022 (web link: https://newsroom.socalgas.com/stories/socalgas-highlights-successful-first-year-results-for-fuel-cells-at-company-facilities, last accessed August 2022).

chain.[275] Choosing to focus on a more environmentally friendly shipping method and supply chain may help some companies in their move towards carbon neutrality by compensating for other aspects of their businesses from which it is more difficult to reduce GHG emissions.

D. Greenhouse Gases—Social Cost of Carbon

The benefit of GHG emissions reductions can be estimated using the social cost of carbon (SC-CO_2), which provides a dollar valuation of the damages caused by one ton of carbon pollution and represents the monetary benefit today of reducing carbon emissions in the future.

In the analysis of the SC-CO_2 for the proposed ACF regulation, CARB utilizes the current Interagency Working Group (IWG) supported SC-CO_2 values to consider the social costs of actions taken to reduce GHG emissions. This is consistent with the approach presented in the Revised 2017 Climate Change Scoping Plan, is in line with U.S. Government Executive Orders including 13990 and the Office of Management and Budget's Circular A-4 of September 17, 2003 and reflects the best available science in the estimation of the socio-economic impacts of carbon.[276,277]

IWG describes the SC-CO_2 as follows:

> *The SC-CO_2 for a given year is an estimate, in dollars, of the present discounted value of the future damage caused by a 1-metric ton increase in CO_2 emissions into the atmosphere in that year or, equivalently, the benefits of reducing CO_2 emissions by the same amount in that year. The SC-CO_2 is intended to provide a comprehensive measure of the net damages—that is, the monetized value of the net impacts from global climate change that result from an additional ton of CO_2.*
>
> *Those damages include, but are not limited to, changes in net agricultural productivity, energy use, human health, property damage from increased flood risk, as well as nonmarket damages, such as the services that natural ecosystems provide to society. Many of these damages from CO_2 emissions today will affect economic outcomes throughout the next several centuries.*[278]

The SC-CO_2 is year-specific and is highly sensitive to the discount rate used to discount the value of the damages in the future due to CO_2. The SC-CO_2 increases over time as systems become more stressed from the aggregate impacts of climate change and as future emissions cause incrementally larger damages. This discount rate accounts for the preference for current costs and benefits over future costs and benefits, and a higher discount rate decreases the value today of future environmental damages. While the proposed ACF

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[275] University of California at Los Angeles, *Carbon-Optimal and Carbon-Neutral Supply Chains*, 2011 (web link: https://escholarship.org/uc/item/3s01b6pg, last accessed August 2022).
[276] California Air Resources Board, *California's 2017 Climate Change Scoping Plan*, 2017 (web link: https://ww2.arb.ca.gov/sites/default/files/classic//cc/scopingplan/scoping_plan_2017.pdf, last accessed August 2022).
[277] Office of Management and Budgets, *Circular A-4*, 2003 (web link: https://www.transportation.gov/sites/dot.gov/files/docs/OMB%20Circular%20No.%20A-4.pdf, last accessed August 2022).
[278] National Academies of Sciences, *Engineering, Medicine, Valuing Climate Damages: Updating Estimation of Carbon Dioxide*, 2017 (web link: http://www.nap.edu/24651, last accessed August 2022).

regulation cost analysis does not account for any discount rate, this social cost analysis uses the IWG standardized range of discount rates from 2.5 to 5 percent to represent varying valuation of future damages. Table 22 shows the range of SC-CO_2 discount rates developed by the IWG which reflect the societal value of reducing carbon emissions by one metric ton.[279]

Table 22: SC-CO_2 Discount Rates (in 2021$ per Metric Ton of CO_2)

Year	5% Discount Rate	3% Discount Rate	2.5% Discount Rate
2020	$16	$57	$85
2025	$19	$63	$93
2030	$22	$68	$100
2035	$25	$75	$107
2040	$29	$82	$115
2045	$32	$88	$122
2050	$36	$94	$130

The avoided SC-CO_2 from 2024 to 2050 is the sum of the annual tank-to-wheel (TTW) GHG emissions reductions multiplied by the SC-CO_2 in each year. The cumulative TTW GHG emissions reductions along with the estimated benefits from the proposed ACF regulation are shown in Table 23. These benefits range from about $9.4 billion to $36.4 billion through 2050, depending on the chosen discount rate. In Table 23, staff calculated the avoided SC-CO_2 values (Million 2021$) by applying values in Table 22 (Million 2021$ per Metric Ton of CO_2) that were adjusted with a California consumer price index inflation adjustment factor.

Table 23: Avoided SC-CO_2 (Million 2021$)

Year	GHG Emissions Reductions (MMT)	Avoided SC-CO_2 5% Discount Rate	Avoided SC-CO_2 3% Discount Rate	Avoided SC-CO_2 2.5% Discount Rate
2024	0.3	$4.7	$15.8	$23.3
2025	0.5	$8.6	$28.6	$42.2
2026	0.8	$15.8	$51.5	$76.0
2027	1.3	$27.2	$87.6	$129.1
2028	1.8	$37.3	$118.4	$174.4
2029	3.5	$54.2	$169.7	$249.7
2030	4.6	$77.5	$239.6	$352.4

[279] Interagency Working Group on the Social Cost of Carbon, *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 13990*, 2021 (web link: https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf, last accessed August 2022).

Year	GHG Emissions Reductions (MMT)	Avoided SC-CO_2 5% Discount Rate	Avoided SC-CO_2 3% Discount Rate	Avoided SC-CO_2 2.5% Discount Rate
2031	5.5	$102.9	$316.1	$461.8
2032	6.3	$128.5	$392.2	$569.4
2033	7.5	$150.9	$457.8	$660.8
2034	8.8	$183.4	$553.1	$793.6
2035	9.8	$221.1	$663.2	$946.2
2036	10.9	$253.8	$751.8	$1,068.4
2037	12.0	$290.2	$848.8	$1,202.3
2038	13.2	$330.0	$953.8	$1,346.4
2039	13.7	$371.0	$1,060.4	$1,491.9
2040	15.1	$413.4	$1,169.0	$1,639.4
2041	16.6	$473.5	$1,330.9	$1,862.0
2042	18.2	$532.5	$1,488.1	$2,077.0
2043	18.9	$564.4	$1,568.7	$2,184.4
2044	19.6	$597.5	$1,651.6	$2,294.7
2045	20.4	$636.4	$1,750.1	$2,426.3
2046	21.3	$681.0	$1,852.0	$2,566.2
2047	22.2	$727.5	$1,957.4	$2,710.9
2048	23.1	$775.6	$2,065.2	$2,858.8
2049	24.0	$824.4	$2,173.5	$3,007.2
2050	24.8	$873.9	$2,281.8	$3,155.6
Total	**307.2**	**$9,357.3**	**$25,996.4**	**$36,370.5**

It is important to note that the SC-CO_2, while intended to be a comprehensive estimate of the damage caused by carbon globally, does not represent the cumulative cost of climate change and air pollution to society. There are additional costs to society outside of the SC-CO_2, including costs associated with changes in co-pollutants, the social cost of other GHGs including methane and nitrous oxide, and costs that cannot be included due to modeling and data limitations. The Intergovernmental Panel on Climate Change has stated that the IWG SC-CO_2 estimates are likely underestimated due to the omission of significant impacts that cannot be accurately monetized including important physical, ecological, and economic impacts. [280,281]

E. Energy Saving and Reduction of Petroleum Fuel Dependence

Petroleum has historically been the largest major energy source for total annual United States energy consumption. California is the nation's second-largest consumer of refined petroleum products and accounts for about 9 percent of the total consumption in the United States. The transportation sector is the state's largest petroleum user accounting for about 85 percent of the total petroleum consumed.[282] As a result, the transportation sector is the largest source of GHGs in California.

In 2015, Governor Brown issued Executive Order B-30-15 establishing 6 pillars for California's climate change strategy. One of these key pillars was to reduce petroleum consumption of cars and trucks by 50 percent by 2030. California can meet this ambitious goal by building on existing efforts to improve vehicle efficiency, reduce lifecycle fuel emissions, decreasing VMT, and supporting ZEV deployment. Meeting this goal will reduce pollution, strengthen the State's economy, and will put the State on a path to meet its GHG goals. The proposed ACF regulation in combination with the implementation of the ACT Regulation would lead the way in the medium- and heavy-duty vehicle sector to enable fuel switching from petroleum-based fuels used in conventional vehicles toward hydrogen or electricity used in ZEVs.

ZEVs have 2 fundamentally superior technical features (greater upstream energy source flexibility and greater vehicle efficiency) when compared to conventional vehicles.[283] For BEVs, the greater energy source flexibility is the result of the various source types (e.g., natural gas, hydro, solar, nuclear, geothermal, and wind) that can be used to generate electricity. California's total power mix currently consists of 33 percent renewables and the State continues to target a cleaner and more sustainable electricity grid and to promote energy efficient end uses.[284] SB 350 extended California's renewable electricity procurement goal to require 50 percent renewable energy by 2030. [285] This goal was made more stringent by SB 100, which increased the 2030 target to 60 percent renewables and requires California to provide 100 percent of its retail sales of electricity from renewable and zero-carbon resources by 2045. [286] SB 350 also requires California to double statewide energy efficiency savings in electricity end uses by 2030.

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[280] Intergovernmental Panel on Climate Change, *IPCC webpage*, 2022 (web link: https://www.ipcc.ch/, last accessed August 2022).
[281] Environmental Protection Agency, *Social Cost of Carbon Fact Sheet*, 2016 (web link: https://www.epa.gov/sites/default/files/2016-12/documents/social_cost_of_carbon_fact_sheet.pdf, last accessed August 2022).
[282] U.S. Energy Information Administration, *California State Energy Profile*, 2022 (web link: *https://www.eia.gov/state/print.php?sid=CA*, last accessed August 2022).
[283] ICCT, *Transition to a Global Zero-Emission Vehicle Fleet: A Collaborative Agenda for Governments*, 2015 (web link: https://theicct.org/sites/default/files/publications/ICCT_GlobalZEVAlliance_201509.pdf, last accessed August 2022).
[284] California Energy Commission, *2021 Total System Electric Generation*, 2021 (weblink: https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2021-total-system-electric-generation, last accessed August 2022).
[285] SB 350 (De León, Stats. 2015, ch. 547).
[286] SB 100 (De León, Stats. 2018 ch. 312).

Like electricity, hydrogen fuel provides energy source flexibility because it can be produced from several different sources such as natural gas, solar, biomass, wind, and grid electricity. Senate Bill 1505, establishes a statutory minimum of 33.3 percent renewable content for hydrogen fuel.[287] In fact, hydrogen renewable content estimates of 90 percent in 2020 and 92 percent in 2021 were achieved according to reporting from hydrogen station operators and through the LCFS program reporting.[288] CARB anticipates that the hydrogen network will maintain a minimum of 40 percent renewable content through 2027.[289] The increasing application of renewable energy sources to generate electricity and produce hydrogen is a primary catalyst for reducing California's consumption of petroleum fuel.

Another technical advantage of ZEVs in comparison to conventional petroleum-based vehicles is the greater vehicle efficiency. This is because EVs can convert over 77 percent of the electrical energy from the grid to power at the wheels whereas conventional gasoline vehicles only convert about 12 to 30 percent of the energy stored in gasoline to power at the wheels.[290] Similarly, hydrogen fuel cell vehicles have 2 to 3 times the efficiency of conventional vehicles because of the electric motor's efficient conversion of energy.[291] For conventional petroleum-fueled vehicles, the lesser vehicle efficiency is due to the inherently greater thermodynamic energy losses, fuel pumping losses, transmission losses, friction losses, and accessory loads.[292] Conversely, electric-drive vehicles have highly efficient electric powertrains which avoids most of these losses. Due to ZEVs' higher efficiencies and lower energy consumption, ZEVs reduce dependence on petroleum and reduce emissions substantially because ZEVs have no tailpipe emissions. The superior fuel efficiency and greater upstream energy source flexibility of ZEVs will help pave a low carbon future for California's transportation sector.

F. Benefits in Disadvantaged Communities and Job Creation

The proposed ACF regulation would reduce NOx and PM2.5 emissions, resulting in health benefits for Californians, and especially for Californians residing and working in disadvantaged and low-income communities. Many communities located near distribution centers, seaports, railyards, warehouses, and major roadways, bear a disproportionate health burden due to their proximity to harmful emissions from the diesel engines that power medium- and heavy-duty vehicles. ZEV deployment throughout these locations would benefit

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[287] SB 1505 (Lowenthal, Stats. 2006, ch.877). Health and Saf. Code sections 43868 and 43869.

[288] California Air Resources Board, *2021 Annual Evaluation of Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development*, 2021 (web link: https://ww2.arb.ca.gov/sites/default/files/2021-09/2021_AB-8_FINAL.pdf, last accessed August 2022).

[289] California Air Resources Board, *2021 Annual Evaluation of Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development*, 2021 (web link: https://ww2.arb.ca.gov/sites/default/files/2021-09/2021_AB-8_FINAL.pdf, last accessed August 2022).

[290] Department of Energy, *All-Electric Vehicles*, (web link: https://www.fueleconomy.gov/feg/evtech.shtml, last accessed August 2022).

[291] U.S. Department of Energy Hydrogen Program, *Hydrogen Fuel Cells*, (web link: https://www.californiahydrogen.org/wp-content/uploads/files/doe_fuelcell_factsheet.pdf?msclkid=3dc431a0b5fb11ecbaf6a8ab4b1ad0b4, last accessed August 2022).

[292] ICCT, *Transition to a Global Zero-Emission Vehicle Fleet: A Collaborative Agenda for Governments*, 2015 (web link: *https://theicct.org/sites/default/files/publications/ICCT_GlobalZEVAlliance_201509.pdf*, last accessed August 2022).

low-income and DACs. Beginning as early as 2024, the proposed ACF regulation includes ZEV phase-in requirements for trucks that travel in and out of ports and railyards. A majority of these drayage hubs are located in or within less than one mile of a community classified as disadvantaged by CalEPA.[293,294] By 2035, trucks entering the ports and railyards would need to be ZE which would greatly benefit air quality in neighborhoods surrounding these locations. Figure 49 shows the location of the major seaports and intermodal railyards and their proximity to DACs.

In addition to drayage applications, ZEV deployment would occur in other freight sectors and services where medium- and heavy-duty vehicles are deployed. Distribution centers, warehouses, and major roadways are commonly located around more densely populated urban areas, including in low-income and DACs. ZEV adoption would not only maximize NOx and PM reductions in these locations, but also help to achieve the State's GHG emissions reductions goals. Reducing GHG emissions will help stabilize the climate, which benefits all communities, including low-income and DACs.

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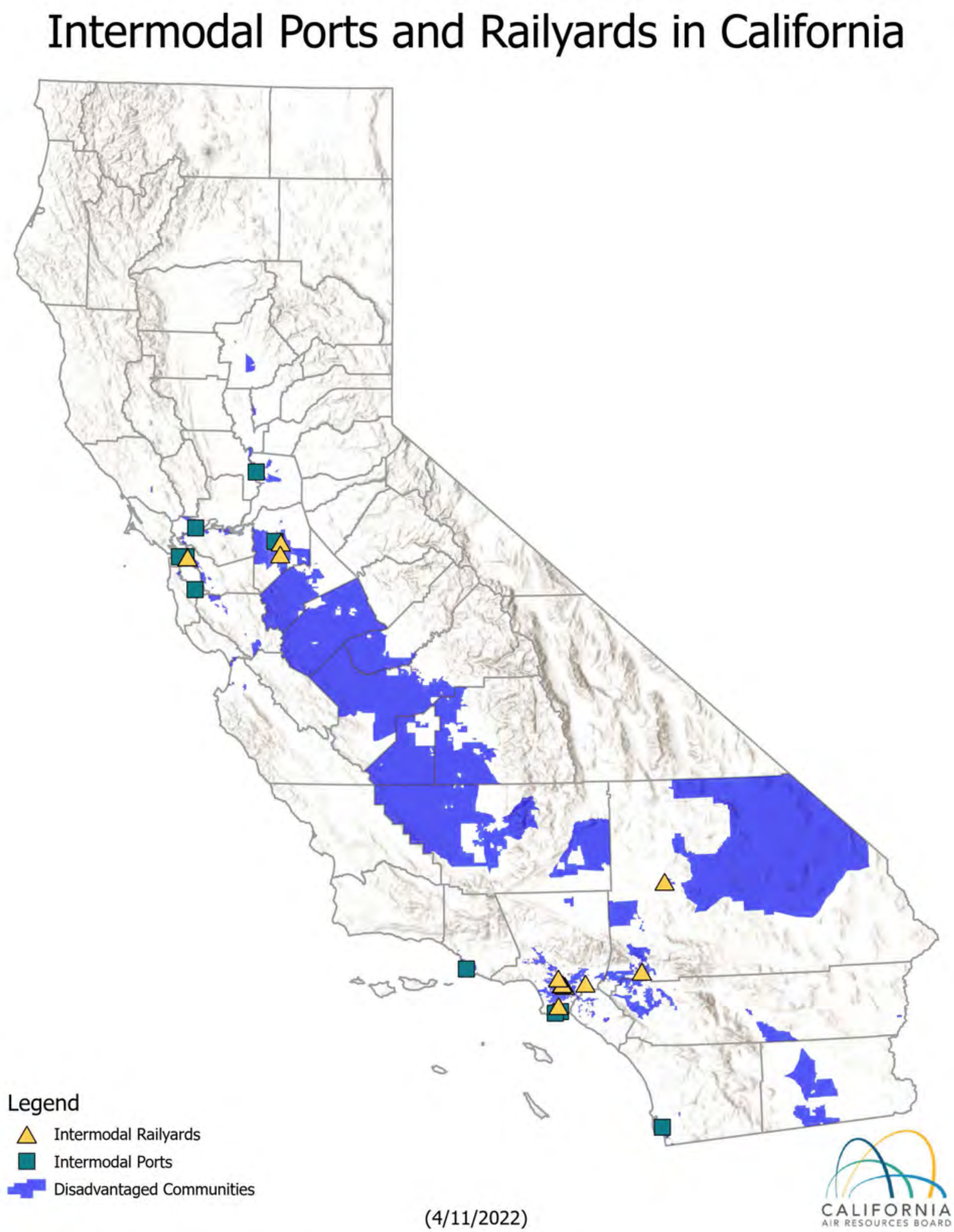
[293] Health and Safety Code section 39711 tasks CalEPA with identifying DACs based on "geographic, socioeconomic, public health, and environmental hazard criteria." CalEPA uses CalEnviroScreen to score California communities based on environmental pollution burden and socio-economic indicators. Its updated DAC Designations, released May 3, 2022, include the twenty-five percent highest-scoring census tracts. CalEPA, *California Climate Investments to Benefit Disadvantaged Communities*, 2022 (web link: https://calepa.ca.gov/envjustice/ghginvest/, last accessed August 2022).
[294] Office of Environmental Health Hazard Assessment, *CalEnviroScreen 4.0*, 2022 (web link: https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-40, last accessed August 2022).

Figure 49: Intermodal Ports and Railyards and Disadvantaged Communities in California



As summarized above, AB 617 requires CARB to address community-scale air pollution through new community-focused and community-driven actions to reduce emissions and exposure to air pollution and improve public health in disadvantaged communities affected by a high cumulative exposure burden.[295,296] As of January 2022, 17 communities have been selected by the CARB Board based on their high cumulative exposure burden, among other relevant factors. Once selected, the regional air district for the community works with a Community Steering Committee to develop and implement a Community Emissions Reduction Program (CERP) and/or a Community Air Monitoring Plan (CAMP). The CERPs identify each community's air pollution concerns and a suite of strategies to reduce emissions from the identified sources. These strategies can include identifying new or amended air district regulations, incentive grant funding, and exposure reduction resources and tools. All AB 617 community steering committees to date have identified air pollution from heavy-duty diesel vehicle as a concern in their communities and would directly benefit from the proposed ACF regulation. Additionally, many of the AB 617 communities including those in the Bay Area, South Coast, San Joaquin Valley and San Diego air district regions have listed emissions from ports and/or railyards as a top community concern. Drayage trucks traveling to and from these locations that would be subject to the proposed ACF regulation requirements for drayage trucks.

There are currently 18 ZEV OEMs located in the state and California is currently ranked first in the United States for ZEV manufacturing jobs.[297,298] The proposed ACF regulation is expected to drive demand even higher for ZEVs and this increase may result in higher employment opportunities in California's ZEV manufacturing sector, including employment in DACs. Examples include Motiv Power and Phoenix Motorcars, two small business ZEV manufacturers located in DACs. The increase in demand for ZEVs may also benefit job creation in various businesses throughout the ZEV supply chain, including those involved in battery, fuel cell, cold plate, and solar photovoltaic technology throughout the California.

The CEC is predicting the need for 157,000 chargers by 2030 and 200 hydrogen refueling stations in California by 2030 which will result in many job opportunities beyond the ZEV manufacturing sector.[299] For example, PG&E is actively engaged in projects to expand EV charging infrastructure through a $236 million program, which has been expanded to medium- and heavy-duty fleets. The goal of the program is to install or rebate make-ready infrastructure at 700 sites by 2024 to support the adoption of 6,500 medium- and heavy-duty ZEVs. PG&E is also committing to ensure that at least 25 percent of the infrastructure portion of the budget is invested in DACs.[300] There are also plans to increase the number of hydrogen stations throughout the state. There are also plans to increase the number of hydrogen stations throughout the state. There are now 56 hydrogen retail stations open to the public in California today, with a majority located in larger cities and metropolitan

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[295] AB 617 (Garcia, Stats. 2017 Ch. 136).

[296] California Air Resources Board, *Community Air Protection Program,* 2022 (web link: https://ww2.arb.ca.gov/capp, last accessed August 2022).

[297] California Air Resources Board, *Zero Emission Vehicle Manufacturing in California*, 2021 (web link: https://ww2.arb.ca.gov/sites/default/files/2021-08/MapofZeroEmissionOEMs.pdf, last accessed August 2022).

[298] EV Hub, *Where are the EV jobs?,* 2022 (web link: https://www.atlasevhub.com/weekly_digest/where-are-the-ev-jobs/, last accessed August 2022).

[299] GO-Biz, *California Zero-Emission Vehicle Market Development Strategy*, 2021 (web link: https://static.business.ca.gov/wp-content/uploads/2021/02/ZEV_Strategy_Feb2021.pdf, last accessed August 2022).

[300] PG&E, *Clean Transportation*, 2022 (web link: https://www.pgecorp.com/corp_responsibility/reports/2021/pr05_clean_transportation.html, last accessed August 2022).

areas.[301,302] The State of California is working to build 200 hydrogen refueling in the next 5 years and 13 of these new stations will also offer fueling for commercial vehicles.

Strategic planning is happening now, and opportunities are mounting for design, engineering, construction, project management firms, EVSE suppliers and installers, and hydrogen fuel station suppliers to design new and expanded infrastructure throughout California. The increase in electric charging and fueling infrastructure will also benefit electricians and other maintenance professions. Many installations will take place in California and some infrastructure equipment may be manufactured in California as well. One manufacturer, ESL Power Systems, has primary operations based in California.[303] The need for infrastructure installations will be most necessary in central depots or yards, along major transportation corridors and near ports and railyards, which are often located near DACs and other communities that bear the disproportionate burden of harmful diesel emissions.

California will also see job creation in third-party support companies and agencies who may see new opportunities for business throughout the ZEV transition. Software companies, marketing and advertising firms, roadside assistance companies, financial institutions, insurance agencies, and recyclers may all see periods of workforce growth.

These opportunities for job creation will be supplemented through the Inclusive, Diverse, Equitable, Accessible, and Local (IDEAL) ZEV Workforce Pilot. CEC’s Clean Transportation Program and CARB recently allocated over $6 million in grant funds for projects that provide workforce training and development that support ZEVs, ZEV infrastructure, and ZEV-related commercial technologies in California. The projects that are rewarded will focus on supporting training in ZEV industries with an emphasis on making workforce opportunities available to DACs.[304]

G. Other Societal Benefits

ZEVs offer a number of other benefits to truck operators when compared to gasoline and diesel vehicles. ZEVs are quiet and have a smoother ride than ICE vehicles, creating a better driving experience for operators. Reduced noise at the worksite creates a safer working environment, provides additional benefits to the community in which the vehicle is operating, and do not conflict with noise ordinances which means they may be able to make more deliveries at night, therefore reducing daytime traffic congestion.

California has approved changes to grid connection rules that will open the door for the interconnection of EVs with two-way charging capabilities to the grid.[305] This vehicle-to-grid concept will allow ZEVs to turn into ‘virtual power plants’, where ZEVs would store and

[301] California Air Resources Board and California Energy Commission Joint Agency Staff Report on AB 8: 2021 Annual Assessment of Time and Cost Needed to Attain 100 Hydrogen Refueling Stations in California, December 2021. (weblink: *https://www.energy.ca.gov/sites/default/files/2021-12/CEC-600-2021-040.pdf*).

[302] California Fuel Cell Partnership Station Map website: https://cafcp.org/stationmap.

[303] ESL Power Systems, Inc., *Homepage*, 2022 (web link: https://eslpwr.com/, last accessed August 2022).

[304] California Energy Commission, *IDEAL Workforce Pilot*, 2021 (web link: https://www.energy.ca.gov/solicitations/2021-10/gfo-21-602-ideal-zev-workforce-pilot, last accessed August 2022).

[305] California Public Utilities Commission, *Rule 21 Interconnection*, 2021 (web link: https://www.cpuc.ca.gov/Rule21/, last accessed August 2022).

dispatch electrical energy stored in networked vehicle batteries which together act as one collective battery for 'peak shaving' (sending power back to the grid when electricity demand is high) and 'valley filling' (charging at night when demand is low).[306] This will also help during a power outage or emergency, as ZEVs could also work as mobile power stations. For example, the F-150 Lightning and its Intelligent Backup Power, can automatically kick in to power a house if the electricity goes out. Once power is restored, the truck automatically reverts to charging its battery. Based on an average 30 kWh of use per day, a fully charged F-150 Lightning with extended-range battery provides full-home power for up to 3 days.[307] These vehicles also have the ability to be used as a portable workstation that also powers worksite tools and appliances.

Over time, advanced transportation systems and technologies have the potential to become a transformative element in the development of a cleaner, safer, and more efficient transportation system.

V. Air Quality

This chapter includes an analysis of air quality data and emissions reductions relevant to the proposed ACF regulation. This analysis may provide support for air quality discussions in chapters II, III, and IV and will provide more detailed information in support of the air quality summaries in chapters VI and VII.

A. Baseline Information

The economic and emissions impacts of the proposed ACF regulation are evaluated against the business as usual (BAU) scenario each year for the analysis period from 2024 to 2050. The BAU case for the economic and emissions analysis for the proposed ACF regulation is also referred to as the "Legal Baseline" and uses the same vehicle inventory for all analyses. The Legal Baseline reflects the implementation of all existing State and federal laws and regulations on the vehicles the proposed ACF regulation would affect. The HD I/M regulation was heard by the Board in December 2021 but was not included in the Legal Baseline because it was not approved by Office of Administrative Law (OAL) at the time this analysis was prepared.

A second baseline analysis was also prepared to show how the analysis differs if the HD I/M regulation is approved. This analysis is in the Modified Baseline Analysis Appendix of the ACF significant regulatory impact analysis (SRIA) and presents a scenario that anticipates the HD I/M regulation being finalized prior to implementation of the proposed ACF regulation. Only NOx and PM exhaust emissions are affected under the Modified Baseline because HD I/M is expected to have minimal impact on PM brake wear and GHG emissions.

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[306] ScienceDirect, *Vehicle to Grid*, 2019 (web link: https://www.sciencedirect.com/topics/engineering/vehicle-to-grid, last accessed August 2022).
[307] Ford, *F-150 Lightning ™ General Product Frequently Asked Questions*, 2022 (web link: https://www.ford.com/support/how-tos/owner-resources/f-150-lightning/f-150-lightning-product-frequently-asked-questions/#11, last accessed August 2022).

Staff used CARB's EMFAC to assess the Legal Baseline vehicle inventory, including vehicle sales and population growth assumptions, for Class 2b and larger vehicles for all fuel types.[308] EMFAC includes the effects of CARB's ASB, ICT, Truck and Bus, Heavy-Duty Omnibus, and ACT regulations, and LCFS program compliance. It is important to note that the benefits of low carbon fuels, such as RNG and renewable diesel (RD), that are part of LCFS are already included in the Legal Baseline and in all scenarios. Therefore, the economic and environmental impacts attributable to the proposed ACF regulation are solely attributable to new actions beyond those already expected. This means only ZEV deployments required by the proposed ACF regulation that exceed the ZEV sales already expected from the ACT regulation would result in new emissions benefits and costs. When compared to the Legal Baseline, the proposed ACF regulation would increase the expected number of medium- and heavy-duty ZEVs (beyond existing regulations) from about 320,000 to about 510,000 by 2035 and from about 780,000 to about 1,230,000 ZEVs by 2045. This increase in ZEVs is expected to be mainly from Class 4-8 vehicles up to 2040, then across all Class 2b-8 vehicles afterwards. The proposed ACF regulation's ZEV requirements on light-duty delivery vehicles is not expected to increase ZEVs deployed in California as the required ZEV purchases by light-duty delivery fleets does not exceed the number of ZEVs light-duty manufacturers are required to sell into California due to the Advanced Clean Car regulation. Based on recent announcements and market developments, a portion of the ZEV sales expected in the Legal Baseline for Class 2b-3 will include vehicles, such as pickup trucks sold to individuals and small businesses, that are not in the scope of the proposed ACF regulation.[309] Further discussion of vehicle population estimates is in Chapter 3 "Direct Costs," Section 3.1.1 "Vehicle Population" of the ACF SRIA. For the costs and emissions analysis, if the estimated ZEV sale can be attributed to the ACT regulation in the Legal Baseline, it will not be counted toward the proposed ACF regulation.

Staff anticipates significant sales of medium- and heavy-duty ZEVs based on the number of pre-orders which have already been placed by customers. As shown in Table 24, these near-term commercial ZEV pre-orders number over 748,000 in the United States, indicating a clear demand for the vehicles such that individuals and entities that are not subject to the proposed ACF regulation are expected to purchase them voluntarily.[310] Some of these early model sales are expected to be counted towards compliance with the ACT regulation so would not be attributed to the proposed ACF regulation. Fleets subject to the proposed ACF regulation would be expected to purchase ZEVs and some have announced pre-orders of ZEVs.

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[308] California Air Resources Board, *EMFAC 2021 Database*, 2021 (web link: https://arb.ca.gov/emfac/, last accessed August 2022).

[309] M.J. Bradley & Associates, *Electric Vehicle Market Status Update*, 2021 (web link: https://www.mjbradley.com/sites/default/files/EDF_EV_Market_Report_January_2021_Update_0.pdf, last accessed August 2022).

[310] Electrek Co, *Tesla Cybertruck pre-orders rise to over 650,000, says new report*, 2020 (web link: https://electrek.co/2020/06/22/tesla-cybertruck-pre-orders-rose-over-650000-report/, last accessed August 2022).

Table 24: Existing Medium- and Heavy-Duty Orders in North America as of November 2021

Manufacturer	Order Status
Tesla	At least 252,000 on order (250,000 Cybertruck) [311,312]
Ford	At least 160,000 on order[313]
Rivian	At least 130,000 on order[314,315]
Lordstown	At least 100,000 on order[316]
Nikola	At least 16,500 on order[317,318]
Workhorse	At least 7,900 on order[319]
Arrival	At least 10,000 on order[320]
GMC	At least 65,000 on order[321]
Bollinger	At least 6,000 on order[322]

[311] Trucks.com, *Everything We Know About the Tesla Semi Truck*, 2019 (web link: https://www.trucks.com/2019/09/05/everything-we-know-about-the-tesla-semi-truck/, last accessed August 2022).

[312] CNBC, *Elon Musk suggests Tesla has received 250,000 pre-orders for its Cybertruck*, 2020 (web link: https://www.cnbc.com/2019/11/27/elon-musk-suggests-tesla-received-250000-pre-orders-for-cybertruck.html, last accessed August 2022).

[313] Elektrek, *Ford F-150 Lightning reservations surpass 160,000 during pre-production*, 2021 (web link: https://electrek.co/2021/11/03/ford-f-150-lightning-reservations-surpass160000-during-pre-production/, last accessed August 2022).

[314] The Verge, *Amazon will order 100,000 electric delivery vans from EV startup Rivian, Jeff Bezos says*, 2019 (web link: https://www.theverge.com/2019/9/19/20873947/amazon-electric-delivery-van-rivian-jeff-bezos-order, last accessed August 2022).

[315] Inside EVs, *Reservation Numbers Reveal Rivian R1T Has 30,000 Buyers Waiting*, 2020 (web link: https://insideevs.com/news/437341/rivian-r1t-30-thousand-reservations/, last accessed August 2022).

[316] Elektrek, *Lordstown claims more than 100,000 pre-orders for its electric pickup truck*, 2021 (web link: https://electrek.co/2021/01/11/lordstown-over-100000-pre-orders-electric-pickup-truck/, last accessed August 2022).

[317] Bloomberg, *Nikola Founder Builds $7.4 Billion Fortune Off Free Truck Orders*, 2020 (web link: https://www.bloomberg.com/news/articles/2020-06-12/nikola-founder-builds-7-4-billion-fortune-off-free-truck-orders, last accessed August 2022).

[318] Nikola, *Nikola Receives Landmark Order of 2500 Battery Electric Waste Trucks from Republic Services*, 2020 (web link: https://nikolamotor.com/press_releases/nikola-receives-landmark-order-of-2500-battery-electric-waste-trucks-from-republic-services-91, last accessed August 2022).

[319] M.J. & Bradley, *EV Market Update January 2021*, 2021 (web link: https://www.mjbradley.com/sites/default/files/EDF_EV_Market_Report_January_2021_Update_0.pdf, last accessed August 2022).

[320] Arrival, *UPS invests in Arrival and Orders 10,000 Generation 2 Electric Vehicles*, 2020 (web link: https://arrival.com/news/ups-invests-in-arrival-and-orders-10000-generation-2-electric-vehicles, last accessed August 2022).

[321] CNBC, *GM looks to increase electric Hummer production as reservations top 65,000, exceeding expectations*, 2022 (web link: https://www.cnbc.com/2022/03/29/gm-looks-to-increase-hummer-ev-production-as-reservations-top-65000.html, last accessed August 2022).

[322] Biznes Alert, *Electric car for tough guys*, 2017 (web link: https://translate.google.com/translate?sl=auto&tl=en&u=https://biznesalert.pl/bollinger-b1-samochod-elektryczny/, last accessed August 2022).

Manufacturer	Order Status
Lion	At least 300 delivered, 150 on order[323,324]
Motiv	At least 128 on order[325]
BYD	At least 100 delivered, 325 on order[326,327,328]
Lightning eMotors	At least 100 on order[329]
GreenPower	At least 100 on order[330]
Phoenix	At least 56 on order[331]
Volvo	At least 15 on order[332]
Oshkosh	10,019 on order[333]

B. Emissions Inventory Methods

Staff used the EMFAC2021 model to assess the emissions reductions that would be associated with the proposed ACF regulation. EMFAC is California's official on-road (e.g., cars, trucks, and buses) mobile source inventory model that CARB uses for various clean air planning, policy development, and regulatory efforts. EMFAC2021 incorporates CARB's current understanding of statewide and regional vehicle activity and emissions and reflects the Legal Baseline of adopted medium- and heavy-duty vehicle regulations including the ACT, ICT, ASB, and Heavy-Duty Omnibus regulations. An alternative baseline is also presented in the "Baseline Information" section above to show how emissions compare if the HD I/M regulation recently adopted by the Board is approved and finalized by OAL.

[323] Inside EVs. *Canadian National Railway Orders Lion Electric Trucks*, 2020 (web link: https://insideevs.com/news/442185/canadian-national-railway-orders-lion-electric-trucks, last accessed August 2022).
[324] Inside EVs. *Lion Electric Scores Largest Truck Order to Date*, 2021 (web link: https://insideevs.com/news/497182/lion-electric-largest-truck-order/, last accessed August 2022).
[325] Inside EVs, *Bimbo Orders More EV Trucks from Motiv After Successful Pilot*, 2020 (web link: https://insideevs.com/news/453800/bimbo-orders-more-ev-trucks-motiv/, last accessed August 2022).
[326] BYD, *BYD Delivers 100th Battery Electric Truck in the United States,* 2020 (web link: https://en.byd.com/news/byd-delivers-100th-battery-electric-truck-in-the-united-states/, last accessed August 2022).
[327] BYD, *Anheuser Busch Names BYD Sustainable Suppler of the Year*, 2020 (web link: https://en.byd.com/news-posts/anheuser-busch-names-byd-sustainable-supplier-of-the-year, last accessed August 2022).
[328] Maersk, *Maersk to deploy 300 electric trucks in partnership with Einride*, 2022 (web link: https://www.maersk.com/news/articles/2022/03/24/maersk-to-deploy-300-electric-trucks-in-partnership-with-einride, last accessed August 2022).
[329] Lightning eMotors, *Lightning eMotors Reports Financial Results for Second Quarter 2021*, 2021 (web link: *https://lightningemotors.com/20120-2/*, last accessed August 2022).
[330] GreenPower, *GreenPower Receives Order for Additional 100 EV Stars from Green Commuter*, 2020 (web link: https://greenpowermotor.com/10-100-ev-stars-green-commuter/, last accessed August 2022).
[331] Phoenix Motorcars, *Phoenix Motorcars Announces Order for 50 Zero-Emissions Utility Shuttles by LR Group of Companies*, 2016 (web link: https://www.phoenixmotorcars.com/phoenix-motorcars-announces-order-for-50-zero-emissions-utility-shuttles-zeus-by-lr-group-of-companies/, last accessed August 2022).
[332] FleetOwner, *Volvo Trucks Lands Largest VNR Electric Order*, 2021 (web link: https://www.fleetowner.com/running-green/press-release/21161426/volvo-trucks-lands-largest-vnr-electric-order, last accessed August 2022).
[333] USPS, *USPS Places Order for 50,000 Next Generation Delivery Vehicles; 10,019 To Be Electric*, 2022 (web link: https://about.usps.com/newsroom/national-releases/2022/0324-usps-places-order-for-next-gen-delivery-vehicles-to-be-electric.htm, last accessed August 2022).

The proposed ACF regulation would require affected entities to upgrade their fleets to ZEVs, thereby eliminating PM, NOx, and GHG tailpipe emissions resulting from vehicle operations. PM, NOx, and GHG emissions benefits are projected by assuming zero tailpipe emissions for the forecasted number of medium- and heavy-duty ZEVs operating in California with the proposed ACF regulation's requirements in place and assuming no change in total VMT, compared to the Legal Baseline. The PM emissions analysis also includes an estimated 50 percent reduction in PM associated with brake-wear for EVs due to regenerative braking when compared to conventional vehicles.[334] Projections, including inventory assumptions, are further discussed in Chapter 3, Direct Costs, of the proposed ACF regulation's SRIA. Staff used the latest available data on population, activity, and in-use emissions from medium- and heavy-duty truck fleets operating in California to estimate the Legal Baseline emissions.

This assessment is focused on the vehicle emissions, also known as TTW emissions, and does not include upstream emissions associated with producing and delivering the fuel or energy source to the vehicle that are addressed by other measures and policies to reduce those emissions. Similar to the proposed ACC II regulation, the proposed ACF regulation is expected to show a net reduction in upstream emissions from transitioning to medium- and heavy-duty ZEVs when compared to gasoline, diesel, natural gas, and other fossil fuels used in the Legal Baseline.[335] Light-duty BEV have an EER of 3.4 and medium- and heavy-duty vehicles have an EER of 5, therefore we expect even greater magnitude emission reductions from upstream sources by implementing this proposed ACF regulation. Additional efficiencies are gained using BEV since energy used to power them do not need to be transported by truck like other transportation fuels. The scale of emissions from short-term construction of infrastructure is expected to be trivial in the context of the total emissions reductions expected from the regulation in the next two decades. For context, staff reviewed a sample of more than 20 California Environmental Quality Act (CEQA) notices for recent medium- and heavy-duty ZEV infrastructure projects funded by CARB and sister agencies and found, for all the notices reviewed, the projects were identified as not having significant impacts on the environment. These ZEV infrastructure deployments are expected to result in substantial emissions reductions. For instance, the Volvo Low Impact Green Highway Transportation Solutions pilot project description identified the project will deploy 23 Class 8 battery-electric tractors and was expected to result in 3.57 tons of criteria emissions reductions and 3,020 metric tons of GHG reductions.[336]

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[334] National Renewable Energy Laboratory, *BAE/Orion Hybrid Electric Buses at New York City Transit*, 2008 (web link: https://afdc.energy.gov/files/pdfs/42217.pdf, last accessed August 2022).

[335] California Air Resources Board, *https://www.dof.ca.gov/forecasting/economics/major_regulations/major_regulations_table/documents/ACCII-SRIA.pdf*, 2022 (web link: https://www.dof.ca.gov/forecasting/economics/major_regulations/major_regulations_table/documents/ACCII-SRIA.pdf, last accessed August 2022).

[336] California Air Resources Board, *Fiscal Year 2017-18 Zero- and Near Zero-Emission Freight Facilities Project Solicitation - List of Applications Received and Project Summaries*, 2018 (web link: https://ww2.arb.ca.gov/our-work/programs/low-carbon-transportation-investments-and-air-quality-improvement-program/low, last accessed August 2022).

C. Emissions Inventory Results

The following section provides a discussion of the projected emissions benefits from the proposed ACF regulation of both criteria pollutants (NOx and PM2.5) and GHGs. The analyses of these statewide tank-to-wheel emissions reductions from the proposed ACF regulation are compared with the Legal Baseline and demonstrate that emissions benefits increase as the ZEV fleet phase-in requirements and the population of medium- and heavy-duty ZEVs increase.

1. Criteria Pollutant Emissions Benefits

Medium- and heavy-duty trucks are the predominant means of distributing freight and services. These trucks can be seen along distribution centers, seaports, railyards, warehouses, and major roadways, which are commonly located around more densely populated urban areas, including in low-income and DACs. Vehicles powered by both diesel and other fuels like natural gas and gasoline contribute to both PM and NOx emissions at varying rates. For example, natural gas trucks use a catalytic reduction system compared to a wall flow filter in a diesel engine, and therefore continue to emit PM and NOx emissions in quantities exceeding zero. ZEV deployment in low-income and DACs will be an important part of the solution, not only for maximizing NOx and PM reductions needed to meet SIP requirements, but also for achieving GHG emissions goals established in many statutes, or complementary to existing statutes including AB 32, SB 32, SB 350, and SB 375.

The projected statewide emissions benefits of the proposed ACF regulation from 2024 through 2050 are identified in Table 25 with respect to NOx, PM2.5, and GHGs. The emissions presented are TTW (i.e., vehicle tank to tailpipe) emissions reductions, although reductions attributable to well to wheel processes are also anticipated; consequently, the following emissions benefits comprise a conservative estimate of the emissions benefit of the proposed ACF regulation. Several critical dates represent important targets for California to meet air quality standards and GHG goals. These include 2031 and 2037 as mid-term attainment deadlines for NAAQS and 2045 and 2050 as longer-term climate goals to achieve carbon neutrality and 80 percent GHG emissions reductions below 1990 levels, respectively.

Table 25: Statewide Tank-to-Wheel NOx, PM2.5, and Greenhouse Gas Benefits of the Proposed ACF regulation Relative to Legal Baseline

Calendar Year	NOx (tpd)	PM2.5 (tpd)	CO_2 (MMT/yr.)
2024	2.39	0.03	0.26
2025	2.69	0.04	0.45
2026	3.69	0.05	0.81
2027	5.96	0.08	1.35
2028	7.78	0.11	1.79
2029	10.91	0.16	2.53
2030	15.24	0.24	3.52
2031	19.99	0.33	4.55
2032	24.42	0.41	5.54
2033	28.23	0.48	6.34
2034	34.05	0.60	7.52

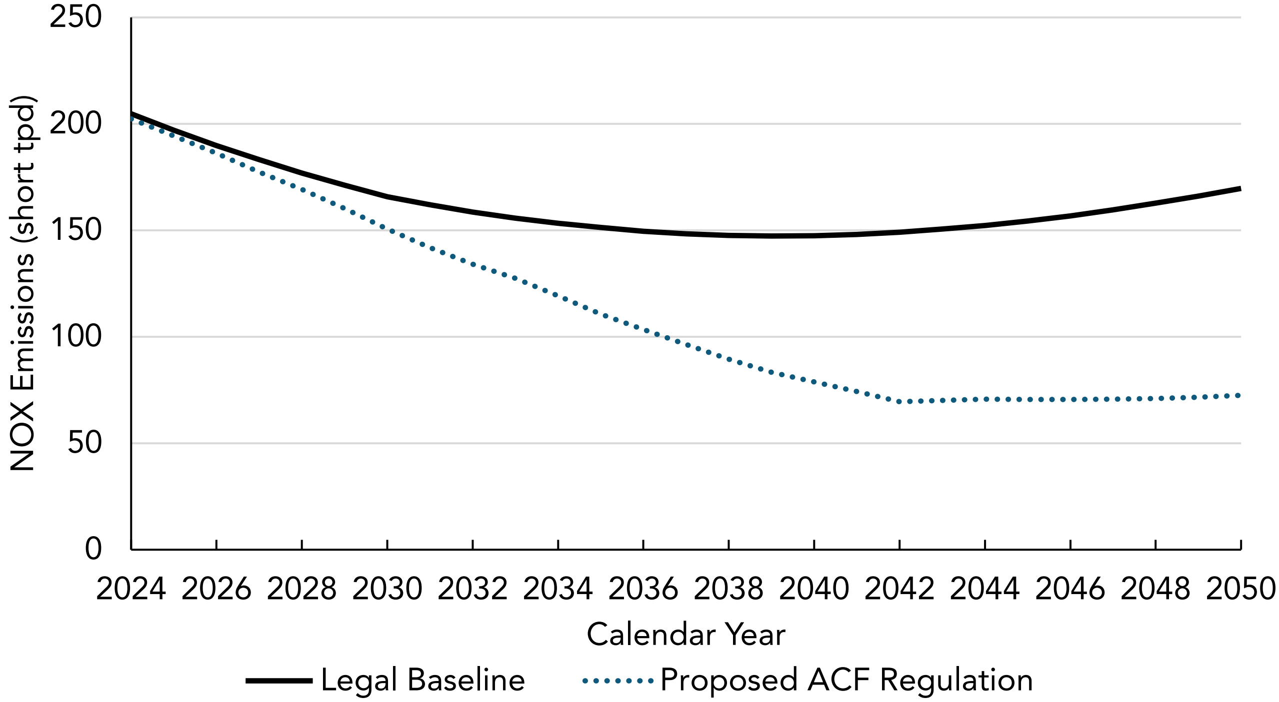
Calendar Year	NOx (tpd)	PM2.5 (tpd)	CO_2 (MMT/yr.)
2035	40.67	0.72	8.84
2036	46.12	0.83	9.84
2037	51.99	0.95	10.91
2038	58.15	1.07	12.04
2039	63.94	1.20	13.16
2040	68.59	1.31	14.26
2041	73.78	1.48	16.00
2042	79.56	1.64	17.63
2043	80.51	1.70	18.32
2044	81.65	1.77	19.02
2045	83.89	1.86	19.89
2046	86.30	1.94	20.76
2047	88.91	2.03	21.65
2048	91.66	2.12	22.55
2049	94.44	2.21	23.42
2050	97.24	2.29	24.27

Emissions benefits increase as the ZEV fleet requirements phase in and the population of medium- and heavy-duty ZEVs increase. The cumulative total emissions reductions from 2024 to 2050 is estimated to result in 418,943 tons reduction in NOx, 8,638 tons reduction in PM2.5 and 307 million metric tons (MMT) reduction of CO_2 TTW emissions, relative to the Legal Baseline.[337]

The statewide NOx and PM2.5 emissions impacts of the proposed ACF regulation are presented in the following two figures and are shown in short tpd. In the Legal Baseline, projected NOx emissions, Figure 50, decrease significantly until 2023 when the Truck and Bus regulation achieves its goal of upgrading most diesel vehicles to 2010 MY and newer engines. Beginning in 2024, the Legal Baseline for NOx emissions continues to decline as cleaner engines and ZEVs are phased in, even as VMT continues to grow, due to the normal replacement of existing vehicles with newer and cleaner ones as well as from existing regulations. However, in later years, the Legal Baseline NOx emissions begin to increase with projected VMT growth.

[337] The total cumulative emissions reductions for PM2.5 and NOx are converted from tons per day into years and assumes 312 operational days per year. Due to rounding errors, the 2024-2050 cumulative totals differ very slightly when compared to the sum values listed.

Figure 50: Projected Statewide NOx Tank-to-Wheel Emissions, Legal Baseline and Proposed ACF regulation

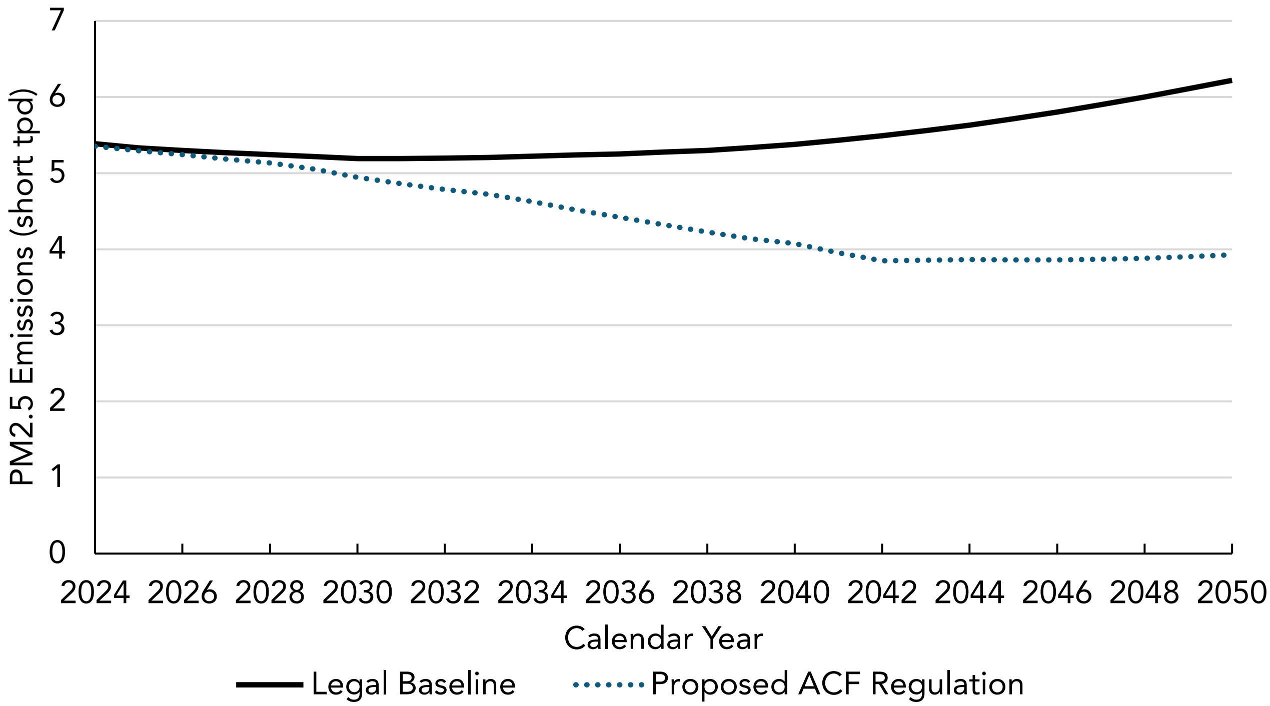


In the Legal Baseline, NOx emissions are expected to decline from 204.7 tpd in 2024 to 169.8 tpd in 2050. With the proposed ACF regulation, NOx emissions decline from 202.3 tpd in 2024 to 72.5 tpd in 2050. Although the regulated fleets will have fully converted to ZEVs by 2042, the new ZEV sales requirement will keep bringing extra emission benefits despite the predicted VMT growth and combustion vehicles emissions deterioration.

Emission and deterioration rates within this analysis followed the same methodology as in EMFAC2021. Staff applied a 50 percent reduction of PM brake wear emissions for ZEVs due to regenerative braking capability.[338] Tire wear emissions for ZEVs were assumed to be the same as ICE vehicles, and thus were not included in either the baseline or the control scenarios. For PM2.5 emissions shown in Figure 51, the Legal Baseline is initially expected to remain relatively flat as most diesel trucks already have PM filters and only limited additional reductions are expected from newer engines. Then PM2.5 emissions are expected to increase as projected VMT grows. With the proposed ACF regulation, PM2.5 emissions are expected to decline rapidly until about 2042 and then slow as more regulated fleets make a full conversion to ZEVs. Under the Legal Baseline, PM2.5 emissions are expected to increase from 5.4 tpd in 2024 to 6.2 tpd in 2050. With the proposed ACF regulation, PM2.5 emissions are expected to decrease from 5.4 tpd in 2024 to 3.9 tpd in 2050. Remaining emissions are largely due to vehicles not covered by the rule and other non-exhaust sources such as brake or tire wear.

[338] National Renewable Energy Laboratory (NREL), *BAE/Orion Hybrid Electric Buses at New York City Transit, A Generational Comparison*, 2008, (web link: https://afdc.energy.gov/files/pdfs/42217.pdf, last accessed August 2022).

Figure 51: Projected Statewide PM2.5 Tank-to-Wheel Emissions, Legal Baseline and Proposed ACF regulation



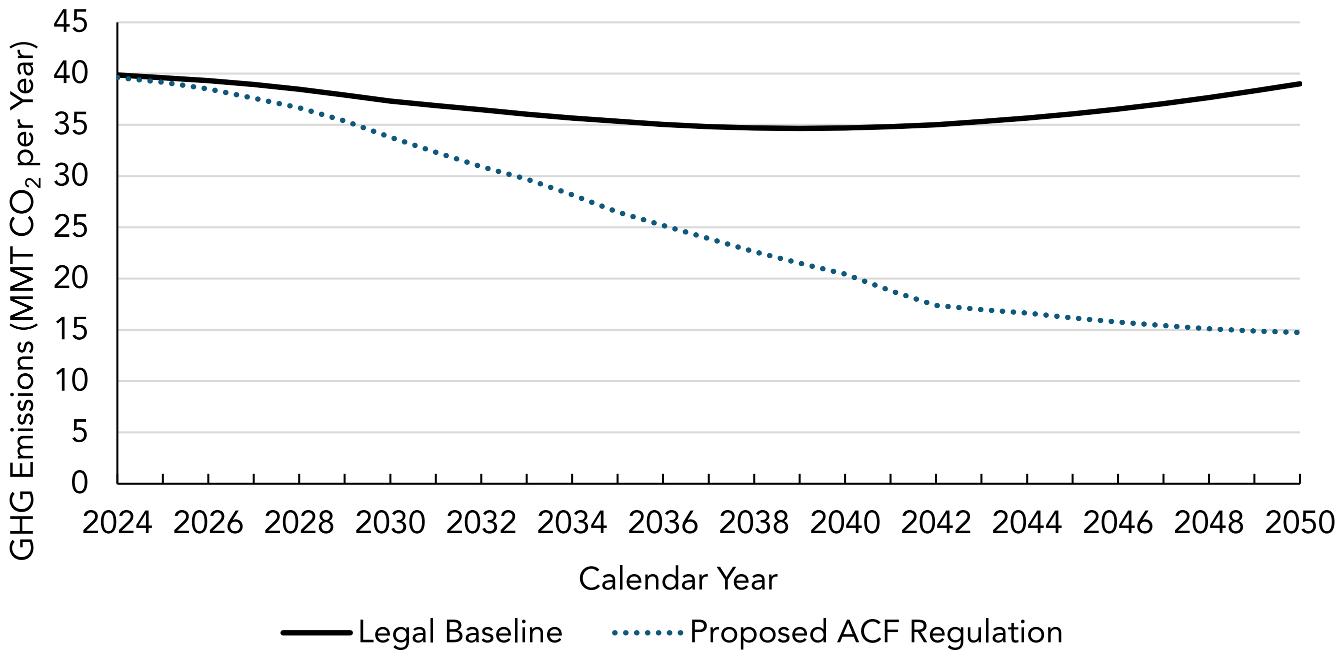
2. Greenhouse Gas Benefits

ZEV adoptions in low-income and DACs will be an important part of the solution for improvement of air quality in these areas that are so heavily impacted by truck traffic, not only for maximizing NOx and PM reductions needed to meet SIP requirements, but also for achieving the State's GHG emissions reductions goals. Reducing GHG emissions will help stabilize the climate, which benefits all communities, including low-income and DACs.

The proposed ACF regulation would be expected to result in significant GHG emissions reductions, due to replacing ICE vehicles with ZEV technologies. ZEVs produce no tailpipe emissions and have lower upstream emissions. These emissions reductions contribute to keeping California on the GHG emissions reductions path set in the Climate Change Scoping Plan.

Figure 52 summarizes the estimated TTW GHG emissions from both the proposed ACF regulation and the Legal Baseline, in units of MMT of CO_2 per year. The proposed ACF regulation would be expected to reduce cumulative TTW GHG emissions by an estimated 307 MMT of CO_2 relative to the Legal Baseline from 2024 to 2050.

Figure 52: Projected Statewide Tank-to-Wheel Greenhouse Gas Emissions of the Proposed ACF regulation



In the Legal Baseline, GHG emissions display a gradual overall decline from 2024 to 2039. The decline is the result of engine manufacturers meeting stricter emissions standards resulting in older models being replaced with more efficient models when normal replacements are made, and of the ACT regulation requiring manufacturers to build and sell a percentage of medium- and heavy-duty ZE trucks and buses. However, emissions begin to increase in about 2040, and by 2050, reach about the same annual emissions level as 2024. The GHG emissions increase is primarily due to the projected growth in medium- and heavy-duty truck VMT.

With the proposed ACF regulation, GHG emissions demonstrate a rapid decline from 2024 to 2042, reducing the annual emissions by roughly half of the 2024 estimate. The decrease in GHG emissions in comparison to the Legal Baseline is attributed to an increase in the number of ZEVs and some early retirement of medium- and heavy-duty ICE vehicles that reach the end of their useful life. The benefits are from the fact that ZEVs have no tailpipe emissions. From 2043 to 2050, GHG emissions continue to decline but at a much slower rate than in prior years.

The oil and gas and refining sector account for half of the industrial sector emissions in the State's annual GHG inventory, roughly 10 percent of the state's total GHGs. The electricity sector currently accounts for approximately 14 percent of the state's total GHGs. As the state moves away from fossil fuel combustion technology, there will be less dependence on petroleum, and this could potentially result in a reduction in petroleum industry-related GHG emissions. In addition, during the COVID-19 pandemic and the stay-at-home orders, there was a drastic reduction in demand for petroleum fuels as residents stayed home. As a result of that reduced demand, several refineries shutdown or announced the repurposing of those facilities to produce low carbon fuels. It is reasonable to expect that as fleets turnover and transition away from petroleum fuel and demand is reduced, we may see resulting upstream reductions in petroleum industry activities which could translate into additional GHG reductions.

Moreover, the transition to a cleaner fleet may also see demand increase for electricity. And, while the electricity sector is still a source of GHG emissions, there are multiple efforts to drastically decarbonize the grid even while load grows. The 2017 Scoping Plan Update, SB 350 Integrated Resource Plans, and SB 100 Report lay out the decarbonization targets and goals for 2030 and 2045. The 2017 Scoping Plan estimated a 51 to 72 percent reduction in GHG emissions relative to 1990 levels in the electricity sector while SB 100 requires planning for 100 percent zero-carbon electricity retail sales by 2045. [339] In addition to these sector specific upstream efforts to reduce GHG emissions, the 2022 Scoping Plan is currently evaluating 4 scenarios for achieving carbon neutrality no later than 2045 which either eliminates or drastically reduces the dependence on fossil fuel sourced energy.

VI. Environmental Analysis

CARB is the lead agency for the Proposed Amendments and has prepared an environmental analysis pursuant to its certified regulatory program (Cal. Code Regs., tit. 17, §§ 60000 through 60008) to comply with the requirements of CEQA. CARB's regulatory program, which involves the adoption, approval, amendment, or repeal of standards, rules, regulations, or plans for the protection and enhancement of the State's ambient air quality has been certified by the California Secretary for Natural Resources under Public Resources Code section 21080.5 of CEQA (Cal. Code Regs., tit. 14, § 15251(d)). Public Resources Code section 21080.5 allows public agencies with certified regulatory programs to prepare a "functionally equivalent" or substitute document in lieu of an environmental impact report or negative declaration, once the program has been certified by the Secretary for the Resources Agency as meeting the requirements of CEQA. CARB, as a lead agency, prepares a substitute environmental document (referred to as an "Environmental Analysis" or "EA") as part of the Staff Report to comply with CEQA (Cal. Code Regs., tit. 17, § 60005).

The Draft Environmental Analysis (Draft EA) for the proposed ACF regulation is included in Appendix D. The Draft EA provides a programmatic environmental analysis of an illustrative, reasonably foreseeable compliance scenario that could result from implementation of the proposed ACF regulation. The Draft EA states that implementation of the proposed ACF regulation could result in beneficial impacts to PM, NOx, and GHGs through the shift from operating ICE vehicles to ZEV in California.

For the purpose of determining whether the proposed ACF regulation would have a potential adverse effect on the environment, CARB evaluated the potential physical changes to the environment resulting from reasonably foreseeable compliance responses.

Implementation of the proposed ACF regulation could result in an increase in the manufacturing of ZEVs, which could require the construction and operation of new or expanded manufacturing facilities to meet the heightened demand for ZEVs, along with construction of new hydrogen-fueling stations and installation of EV charging stations to support ZEV operations. Increased deployment of ZEVs would result in a corresponding decrease in deployment of gasoline and diesel-fueled vehicles. Moreover, increased

[339] SB 100 (De León, Stats. 2018 ch. 312).

deployment of ZEVs would reduce demand for gasoline and diesel fuel, resulting in reduced rates of oil and gas extraction and refinement.

Increases in ZEV purchases may expand the production of hydrogen fuel as well as increased demand on the electrical grid requiring new electricity generation. However, California's electric grid has expanded and evolved as consumer demand for electricity services has grown, including with the recent emergence of light-duty plug-in electric vehicles. California's existing grid and approved investments occurring now will allow the state to handle millions of electric vehicles in the near-term, and projections show the broader western grid can handle up to 24 million light-duty, 200,000 medium-duty, and 150,000 heavy-duty ZEVs without requiring any additional power plants.[340] Electrification of California's entire transportation sector will require further investments in transmission and local distribution systems and coordinated grid planning efforts. The CPUC is currently in the process of evaluating and evolving grid capabilities from multiple energy sources, including renewable sources, to meet this challenge.

As a result of new ZEV demand, extraction of raw materials such as lithium and platinum and other metals may occur outside the state. This could result in increased rates of disposal of lithium-ion batteries and hydrogen fuel cells; however, disposal of these batteries would be subject to provision of California law, including, but not limited to, California's Hazardous Waste Control Law (Health and Safety Code, Division 20, Chapter 6.5; Cal. Code Regs., tit. 22, Division 4.5, Chapter 23), which restricts the disposal of used batteries to landfills. It is reasonably foreseeable that lithium-ion batteries would have a useful life at the end of vehicle life and are likely to be repurposed for a second life. To meet an increased demand for refurbishing or reusing batteries and fuel cells, new facilities or modifications to existing facilities could be constructed to accommodate recycling activities.

Implementation of the proposed ACF regulation could also result in fleet turnover. Fleets would be required to purchase and operate ZEVs, which would result in the replacement of older and less efficient fossil fuel ICE vehicles. The replaced vehicles could be sold to non-regulated entities in California or to an out-of-state party for use, junked, or sold to a salvage yard to be dismantled. As described above, disposal of any of these vehicles and the conventional batteries would be subject to comply with the applicable laws and regulations governing solid and hazardous waste.

Many of the impacts recognized as potentially significant in the EA for the proposed ACF regulation could be mitigated or reduced to less-than-significant levels through conditions of approval applied and mitigation measures to project-specific development. However, the authority to apply that mitigation lies with utilities or other agencies approving the development projects, not with CARB. Consequently, if a potentially significant environmental effect cannot be feasibly mitigated with certainty, the EA takes a conservative approach and identifies the impact as significant and unavoidable while disclosing the impact for CEQA compliance purposes. As such, reasonably foreseeable compliance responses associated with the proposed ACF regulation could result in potentially significant and

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[340] Pacific Northwest National Laboratory, *Electric Vehicles at Scale – Phase I Analysis: High EV Adoption Impacts on the Western U.S. Power Grid*, 2020 (web link: https://www.pnnl.gov/sites/default/files/media/file/EV-AT-SCALE_1_IMPACTS_final.pdf, last accessed August 2022).

unavoidable environmental impacts. Table 26 summarizes the potential environmental impacts of the proposed ACF regulation.

Table 26: Summary of Potential Environmental Impacts

Impact Number	Resource Area Impact	Significance
1-1, 1-2	Short-Term Construction-Related and Long-Term Operation-Related Effects to Aesthetics	Potentially Significant and Unavoidable
2-1	Short-Term Construction-Related and Long-Term Operation-Related Effects to Agriculture and Forest Resources	Potentially Significant and Unavoidable
3-1	Short-Term Construction-Related Effects to Air Quality	Potentially Significant and Unavoidable
3-2	Long-Term Operation-Related Effects to Air Quality	Beneficial
4-1, 4-2	Short-Term Construction-Related and Long-Term Operation-Related Effects to Biological Resources	Potentially Significant and Unavoidable
5-1	Short-Term Construction-Related and Long-Term Operation-Related Effects to Cultural Resources	Potentially Significant and Unavoidable
6-1	Short-Term Construction-Related Effects on Energy Demand	Less-than-Significant
6-2	Long-Term Operation-Related Effects on Energy Demand	Beneficial
7-1	Short-Term Construction-Related and Long-Term Operation-Related Effects to Geology, Seismicity, and Soils	Potentially Significant and Unavoidable
8-1	Short-Term Construction-Related Effects to Greenhouse Gas Emissions and Climate Change	Less-than-Significant
8-2	Long-Term Operation-Related Effects to Greenhouse Gas Emissions and Climate Change	Beneficial
9-1, 9-2	Short-Term Construction-Related and Long-Term Operation-Related Effects to Hazards and Hazardous Materials	Potentially Significant and Unavoidable
10-1, 10-2	Short-Term Construction-Related and Long-Term Operation-Related Effects on Hydrology and Water Quality	Potentially Significant and Unavoidable
11-1, 11-2	Short-Term Construction-Related and Long-Term Operation-Related Impacts on Land Use and Planning	No Impact
12-1	Short-Term Construction-Related and Long-Term Operation-Related Effects to Mineral Resources	Less-than-Significant

Impact Number	Resource Area Impact	Significance
13-1, 13-2	Short-Term Construction-Related and Long-Term Operation-Related Effects to Noise	Potentially Significant and Unavoidable
14-1	Short-Term Construction-Related and Long-Term Operation-Related Effects to Population and Housing	Less-than-Significant
15-1	Short-Term Construction-Related and Long-Term Operation-Related Effects to Public Services	Less-than-Significant
16-1	Short-Term Construction-Related and Long-Term Operation-Related Effects to Recreation	Less-than-Significant
17-1	Short-Term Construction-Related and Long-Term Operation-Related Effects to Transportation and Traffic	Potentially Significant and Unavoidable
18-1	Short-Term Construction-Related and Long-Term Operational Impacts on Tribal Cultural Resources	Potentially Significant and Unavoidable
19-1	Long-Term Operational-Related Effects on Utilities and Service Systems	Potentially Significant and Unavoidable
20-1	Short-Term Construction-Related and Long-Term Operation-Related Effects on Wildfire	Less-than-Significant

Staff prepared a Notice of Preparation and made it available for review and comment for 30 days, per the CEQA Guidelines (Cal. Code Regs., tit. 14, § 15082(b)). The comment period for the Notice of Preparation began on February 16, 2021 and ended on March 18, 2021. CARB held public workshops that also served as CEQA scoping meetings to solicit input on the scope and content of the Draft EA on March 2, 2021 and March 4, 2021. Written comments on the Draft EA will be accepted starting September 2, 2022 through October 17, 2022. The Board will consider the Final EA and responses to comments received on the Draft EA before taking action to adopt the proposed ACF regulation. If comments received during the public review period raise significant environmental issues, staff will summarize and respond to the comments. The written responses to environmental comments will be approved prior to final action on the proposed ACF regulation (Cal. Code Regs., tit. 17, § 60004.2(b)). If the proposed ACF regulation is adopted, a Notice of Decision will be posted on CARB's website and filed with the Secretary of the Natural Resources Agency for public inspection (Cal. Code Regs., tit. 17, § 60004.2(d)).

VII. Environmental Justice

State law defines environmental justice as the fair treatment and meaningful involvement of people of all races, cultures, incomes, and national origins with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies (Gov. Code, § 65040.12, subd. (e)(1)). The advancement of state and federal law on environment justice was greatly influenced by the Principles of Environmental Justice.[341] Environmental justice includes, but is not limited to, all of the following:

- The availability of a healthy environment for all people;
- The deterrence, reduction, and elimination of pollution burdens for populations and communities experiencing the adverse effects of that pollution, so that the effects of the pollution are not disproportionately borne by those populations and communities;
- Governmental entities engaging and providing technical assistance to populations and communities most impacted by pollution to promote their meaningful participation in all phases of the environmental and land use decision making process; and
- At a minimum, the meaningful consideration of recommendations from populations and communities most impacted by pollution into environmental and land use decisions (Gov. Code, § 65040.12, subd. (e)(2)).

The Board approved its Environmental Justice Policies and Actions on December 13, 2001, to establish a framework for incorporating environmental justice into CARB's programs consistent with the directives of State law.[342] These policies apply to all communities in California but are intended to address the disproportionate environmental exposure burden borne by low-income communities and communities of color. Environmental justice is one of CARB's core values and is fundamental to achieving its mission.

Low-income and DACs have long faced disproportionate burdens from exposure to air pollution. Research shows large disparities in exposure to pollution between white and non-white populations in California, and between DACs and other communities as well, with Black and Latino populations experiencing significantly greater air pollution impacts than white populations.[343] Harmful diesel pollution from mobile sources shows some of the highest disparities, as indicated by a CARB-funded study which demonstrated that, on average, mobile sources account for over 30 percent of total PM2.5 exposures.[344] Research has shown that mobile sources are the largest sources of pollution exposure disparity for Black populations and DAC residents when compared to the average population in California. Specifically, mobile sources accounted for 45 percent of exposure disparity for the Black population, and 37 percent of exposure disparity for people in DACs.[345]

In recognition that air pollution heavily impacts DACs in California, AB 617 places additional emphasis on protecting such communities by requiring new community-focused and

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[341] Delegates to the First National People of Color Environmental Leadership Summit, *The Principles of Environmental Justice (EJ)*, 1991 (web link: https://www.ejnet.org/ej/principles.html, last accessed August 2022)
[342] California Air Resources Board, *Report: 2001-12-13 Policies and Actions for Environmental Justice (ca.gov),* 2001 (web link: https://www.arb.ca.gov/ch/programs/ej/ejpolicies.pdf?_ga=2.30332095.1878478371.1648486124-354412339.1596474861, last accessed August 2022).
[343] Office of Environmental Health and Hazard Assessment, *Analysis of Race/Ethnicity and CalEnviroscreen 4.0 Scores*, 2021 (web link: https://oehha.ca.gov/media/downloads/calenviroscreen/document/calenviroscreen40raceanalysisf2021.pdf, last updated July 2022).
[344] California Air Resources Board, *A Method to Prioritize Sources for Reducing High PM2.5 Exposures in Environmental Justice Communities in California. CARB Research Contract Number 17RD006*, 2019 (web link: https://ww2.arb.ca.gov/sites/default/files/classic/research/apr/past/17rd006.pdf, last accessed August, 2022).
[345] Ibid.

community-driven action to reduce air pollution and improve public health in areas that experience disproportionate burdens from exposure to air pollutants.[346]

Although CARB's existing regulations and incentive programs have reduced medium- and heavy-duty mobile source emissions, additional reductions are needed to protect the communities around California freight facilities that are still exposed to higher risk from diesel-powered sources. These communities bear a disproportionate health burden due to their close proximity to diesel emissions and the impacts of the resulting elevated air pollution can be measured. For example, while exposure to cancer-causing diesel particles has decreased statewide, exposure to diesel particles in DACs is on average twice than that experienced in non-DACs.[347]

Medium- and heavy-duty mobile source vehicles emit harmful pollutants both while in transit and during stationary operations across California, but frequently congregate at warehouse and distribution centers, seaports, intermodal railyards, and other locations that are commonly located near schools, hospitals, elder care facilities, and residential neighborhoods. All of California's seaports and intermodal railyards are located within approximately one (1) mile of DACs. The accelerated deployment of medium- and heavy-duty ZEVs in low-income and DACs eliminates tailpipe emissions, decreases petroleum use, reduces energy consumption, and helps California achieve its air quality and climate protection goals.

The proposed ACF regulation is consistent with CARB's environmental justice goal of reducing exposure to air pollutants and reducing adverse health impacts from toxic air contaminants in all communities. As discussed in Chapter V, the proposed ACF regulation would achieve additional emissions reductions from medium- and heavy-duty mobile source vehicles by transitioning them toward ZE technologies. The proposed ACF regulation is designed to reduce criteria pollutants, toxic air contaminants, GHG emissions, and the resulting risk from regional air pollution that can be associated with adverse health impacts. The additional reductions and associated improvements to air quality are intended to help protect all Californians and will be of particular benefit in low-income and DACs.

VIII. Economic Impacts Assessment or Standardized Regulatory Impact Assessment

This chapter describes the methodology used to determine the economic impact of the proposed ACF regulation. This includes methodology to determine the affected fleets, estimated number of ZEVs, sources used to determine the costs of various elements in the proposed ACF regulation, the total estimated incremental cost of the proposed ACF regulation versus the baseline, macroeconomic results, and fleet examples. The original SRIA

[346] California Health and Safety Code sections 40920.6, 42 42402, 39607.1, 40920.8, 42411, 42705.5, and 44391.2, Division 26, *Assembly Bill No. 617, Nonvehicular Air Pollution: Criteria Air Pollutants and Toxic Air Contaminants*, 2017 (web link: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201720180AB617, last accessed August 2022).

[347] California Air Resources Board, *Community Air Protection Blueprint*, 2018 (web link: https://ww2.arb.ca.gov/sites/default/files/2018-08/final_draft_community_air_protection_blueprint_august_2018_1.pdf, last accessed August 2022).

document submitted to Department of Finance is in Appendix C-1, and Department of Finance's comments are in Appendix C-2 to this document.

A. Business-as-Usual Baseline

The economic and emissions impacts of the proposed ACF regulation are evaluated against the BAU scenario each year for the analysis period from 2024 to 2050. The BAU case for the economic and emissions analysis for the proposed ACF regulation is also referred to as the "Legal Baseline" and uses the same vehicle inventory for all analyses. The Legal Baseline reflects the implementation of all existing State and federal laws and regulations on the vehicles the proposed ACF regulation would affect.

The HD I/M regulation was heard by the Board in December 2021 but was not included in the Legal Baseline because it was not approved by OAL at the time this analysis was prepared. A second baseline analysis was also done to show how the analysis differs if the HD I/M regulation is approved, titled the "Modified Baseline." This analysis is in the Modified Baseline Analysis Appendix and presents a scenario that anticipates the HD I/M regulation being finalized prior to implementation of the proposed ACF regulation.

Staff used CARB's EMFAC to assess the Legal Baseline vehicle inventory, including vehicle sales and population growth assumptions, for Class 2b and larger vehicles for all fuel types.[348] EMFAC includes the effects of CARB's ASB, ICT, Truck and Bus, Heavy-Duty Omnibus, ACT regulation, and LCFS program compliance. It is important to note that the benefits of low carbon fuels such as RNG and RD that are part of the LCFS are already included in the Legal Baseline and all scenarios. Therefore, the economic and environmental impacts attributable to the proposed ACF regulation are solely attributable to new actions beyond those already expected. This means only ZEV deployments required by the proposed ACF regulation that exceed the ZEV sales already expected from the ACT regulation would result in new emissions benefits and costs. When compared to the Legal Baseline, the proposed ACF regulation would increase the expected number of medium- and heavy-duty ZEVs (beyond existing regulations) from about 320,000 to about 510,000 by 2035, from about 780,000 to about 1,230,000 ZEVs by 2045, and from about 950,000 to about 1,590,000 ZEVs by 2050. This increase in ZEVs is expected to be from Class 4-8 vehicles before 2040 and all Class 2b-8 vehicles afterwards. For the costs and emissions analysis, if the estimated ZEV sale can be attributed to the ACT regulation in the Legal Baseline, it will not be counted toward the proposed ACF regulation.

B. Direct Costs

The proposed ACF regulation would require fleets to replace their gasoline, diesel, natural gas, and other ICE vehicles with medium- and heavy-duty ZEVs. Staff assumes the total statewide costs of the proposed ACF regulation includes the upfront capital costs for the ZEVs and their associated infrastructure, changes to operating expenses, and other cost elements associated with this technology transition. This approach shows the full estimated statewide costs for deploying the number of ZEVs as required by the regulation.

[348] California Air Resources Board, *EMFAC 2021 Database*, 2021 (web link: https://arb.ca.gov/emfac/, last accessed August 2022).

The estimated direct costs from the proposed ACF regulation and the Legal Baseline scenario include upfront capital costs of the vehicles, infrastructure, and ongoing operating costs which include fueling, maintenance, and LCFS revenues where applicable. Compared to gasoline, diesel, or natural gas powered vehicles, ZEVs generally have higher upfront capital costs today but lower operating costs, which results in an overall savings in staff's analysis over the useful life of the vehicles.

Currently, there are a number of rebate and voucher programs in California that offset some or all of the incremental costs for ZEVs and supporting infrastructure; however, none of these incentives are included in the cost analysis due to uncertainty as to which fleets may utilize funding and uncertainty in ongoing funding. Separate from CARB's incentive programs, the LCFS regulation is a market-based regulatory program that allows some fleets that dispense low carbon fuels to generate credits and sell them on the open market to generate revenue. Because of the regulatory certainty associated with the generation and use of credits by entities under the LCFS regulation, staff models credit revenue from the LCFS regulation for those entities that own and operate charging or hydrogen fueling stations. For retail stations, staff assumes a small portion of the LCFS credit value that reflects the difference in light-duty and heavy-duty credit value is passed through to the fleet. Finally, this analysis did not include any of the vehicle and infrastructure incentive and credits newly available under the recently passed Inflation Reduction Act of 2022.[349] The assumptions underlying the direct costs are detailed in the following sections. All costs discussed are in 2021 constant dollars.

1. Changes Since the Release of the Standardized Regulatory Impact Assessment

The proposed ACF regulation has been updated since the release of the SRIA on May 18, 2022.

a) Modifications to the Proposed ACF Regulation

(1) Inclusion of Light-Duty Delivery Vehicles

The scope of the high priority and federal fleet requirements has been expanded to include light-duty delivery vehicles. Staff estimates this modification would regulate an additional 40,000 light-duty vehicles. Because this modification would not increase light-duty ZEV sales beyond the requirements already set by the ACC regulations, this modification is not projected to have any direct costs on the State; instead, this would shift sales from individuals to businesses performing deliveries with light-duty vehicles. The impacts of this change are modeled through shifting costs from individuals to transportation and warehousing businesses in the macroeconomic modeling.

(2) Modifications to High Priority Fleet Requirements

The high priority fleet requirements were changed between the development of the SRIA and Initial Statement of Reasons (ISOR). As modelled in the SRIA, high priority fleets would

[349] Inflation Reduction Act of 2022, H.R. 5376, 117 Cong. (2021-2022).

comply solely though meeting the ZEV milestones. In the proposed ACF regulation, high priority fleets by default must meet the Model Year Schedule. They may opt-in to the ZEV Milestones Option as an alternative compliance pathway.

For the economic analysis, staff assumes a portion of fleets will opt into the ZEV Milestones Option based on the 3 groups of vehicles they have—50 percent of the Group 1 vehicles will opt into the ZEV Milestones Option, 75 percent of the Group 2 vehicles, and 100 percent of the Group 3 vehicles.

(3) Inclusion of Backup Vehicles in High Priority Fleet Modeling

Based on information from the ACT LER data and Truck and Bus regulation reporting, the inventory analysis models a portion of the fleet will use the backup vehicle exemption. Staff models that fleets on the Model Year Schedule will designate ten percent of their vehicles which exceed their useful life as backup vehicles. For the ZEV Milestones Option, staff models that ten percent of tractors and four percent of non-tractors will be designated as backup vehicles regardless of age.

(4) Updated CARB Staffing and Contracting Estimates

Staff have updated the projected staffing and contracting needs since the release of the SRIA. Estimated staff needs have increased from 21.75 positions to 32.5 positions. Contracting needs have increased from $200,000 in upfront costs to $2,000,000 in upfront costs and $400,000 in ongoing costs.

(5) Corrections to Fleet Reporting Costs

In the SRIA, reporting costs were erroneously modelled as continuing to 2050. Per the proposed ACF regulation, fleet reporting is required from 2024 to 2045 and ceases afterwards. The cost analysis has been updated to model fleet reporting costs up to 2045.

2. Vehicle Population

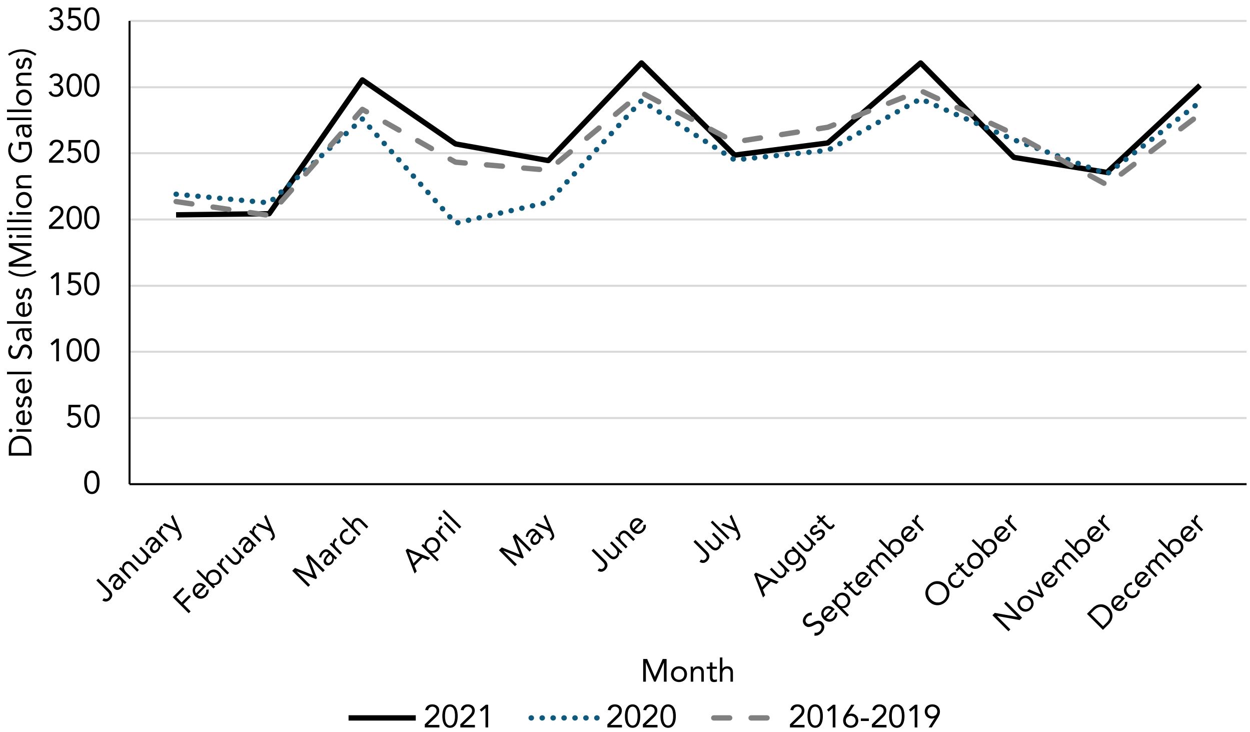
In this analysis, all estimates for annual California population and sales come from CARB's EMFAC 2021 inventory model.[350] The EMFAC model is developed and used by CARB to assess emissions from on-road vehicles including cars, trucks, and buses in California, and to support CARB's regulatory and air quality planning efforts to meet the Federal Highway Administration's transportation planning requirements. U.S. EPA approves EMFAC for use in SIP and transportation conformity analyses. EMFAC accounts for vehicle population growth, mileage accrual rates over time, vehicle fuel usage and associated emissions factors, and vehicle attrition over time.

Staff analyzed the impacts of COVID-19 on the trucking industry during development of EMFAC 2021 and as part of this analysis. Diesel fuel sales are a data surrogate to estimate diesel VMT and illustrate the general trends present in the trucking market. Data from the

[350] California Air Resources Board, *EMFAC 2021 Web Database*, 2021 (web link: https://arb.ca.gov/emfac/emissions-inventory/, last accessed August 2022).

California Department of Tax and Fee Administration is displayed in Figure 53.[351] It shows that diesel fuel sales dropped dramatically in April 2020 and remained depressed through the second quarter of 2020. Afterwards, diesel fuel sales rebounded and returned to normal trends by the end of the year. These trends indicate that diesel fuel sales and truck mileage were not as impacted by the COVID-19 pandemic as other parts of the economy and the general trends forecasted within EMFAC 2021 remains appropriate for the purpose of this analysis.

Figure 53: Diesel Fuel Sales Data for 2021 and 2020 Versus 2016 Through 2016



The proposed ACF regulation affects a subset of the total California Class 2b-8 vehicle population. Staff used data sources including CARB's EMFAC 2021 model, DMV registration data, the CARB Drayage Truck Registry, and financial information from Dun and Bradstreet to determine which vehicles would be subject to the proposed ACF regulation.

State and local government fleet population estimates are derived from DMV information. Vehicles registered in DMV with an exempt plate were assumed to be owned by State and local government fleets. Staff estimates that roughly 128,000 trucks and buses would be subject to the proposed State and local government fleet requirements by 2024.

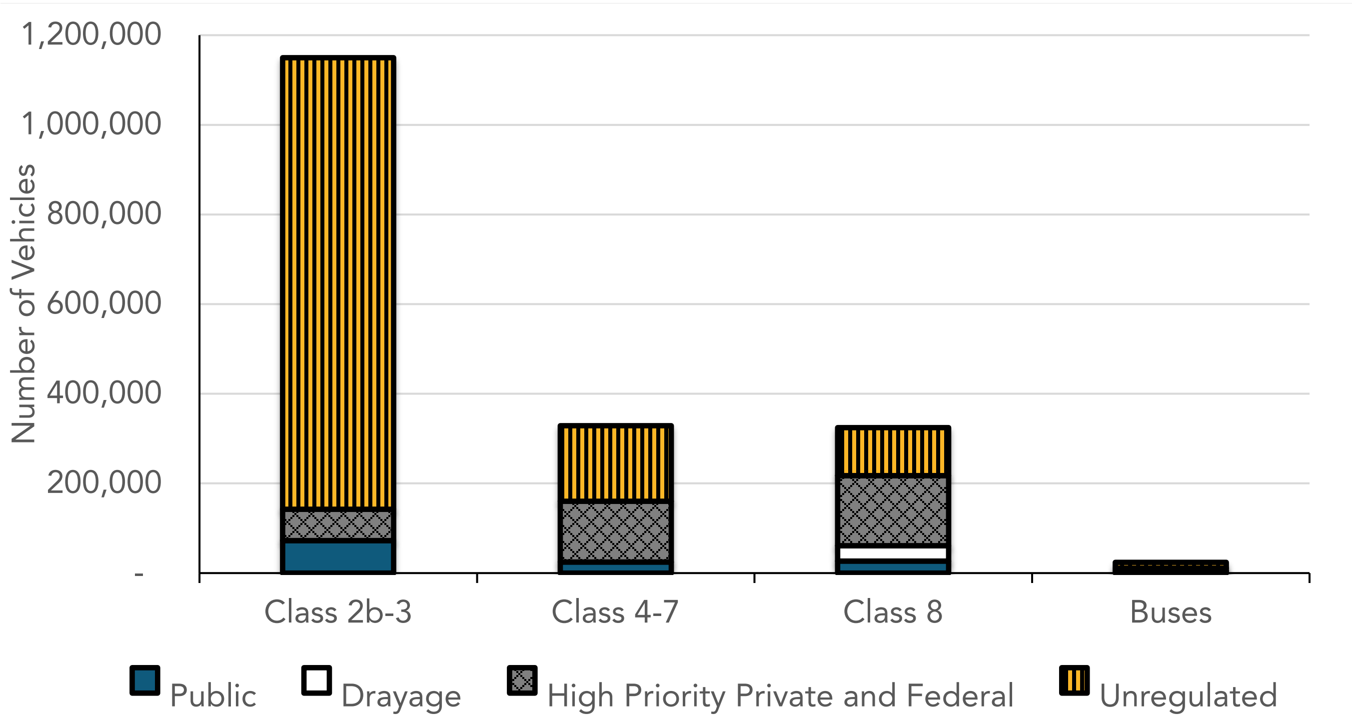
To estimate the number of vehicles subject to the drayage truck requirements, staff used the data from the CARB Drayage Truck Registry and the seaports and railyards to estimate the number of drayage trucks actively operating in California. Staff assumed a truck to be a part of the active fleet if they visited an average of 2 times per week. Staff estimates that

[351] California Department of Tax and Fee Administration, *Taxable Diesel Gallons 10 Year Report*, 2022 (web link: https://www.cdtfa.ca.gov/taxes-and-fees/Diesel-10-Year-Report.xlsx, last accessed August 2022).

approximately 34,000 trucks would be subject to the proposed drayage truck requirements by 2024.

To identify vehicles subject to the high priority and federal fleet requirement, staff first used DMV and International Registration Plan data to identify fleets with 50 or more vehicles. Staff then used Dun and Bradstreet data to determine California locations owned by businesses with greater than $50 million in annual nationwide revenue and, then used this data to match up locations owned by these businesses with vehicles registered at these locations in DMV. The data received from the ACT LER requirement aligns with the results derived from this methodology. Staff estimated the number of vehicles under common ownership and control based on data collected in the ACT one-time LER survey to be an additional 20 percent of the high priority fleet. This data was applied to EMFAC population numbers to create projections for this analysis. Figure 54 summarizes the projected proportion of vehicles subject to the proposed ACF regulation in 4 groups versus the total vehicle population in each group. Generally, vehicles in the Class 2b-3 group include pickup truck and vans that are owned by individuals and small businesses who would not be initially subjected to the proposed ACF regulation. Although the Class 2b-3 category has the highest number of vehicles, the proposed ACF regulation would include the majority of heavier vehicles operating in Classes 4 through 8 in California. Although there are fewer heavier vehicles in Classes 4 through 8, they represent the majority of criteria and GHG emissions due to their higher emission rates and mileages. Buses shown in the figure exclude transit and school buses.

Figure 54: Regulated Vehicles Versus Total Population in 2024



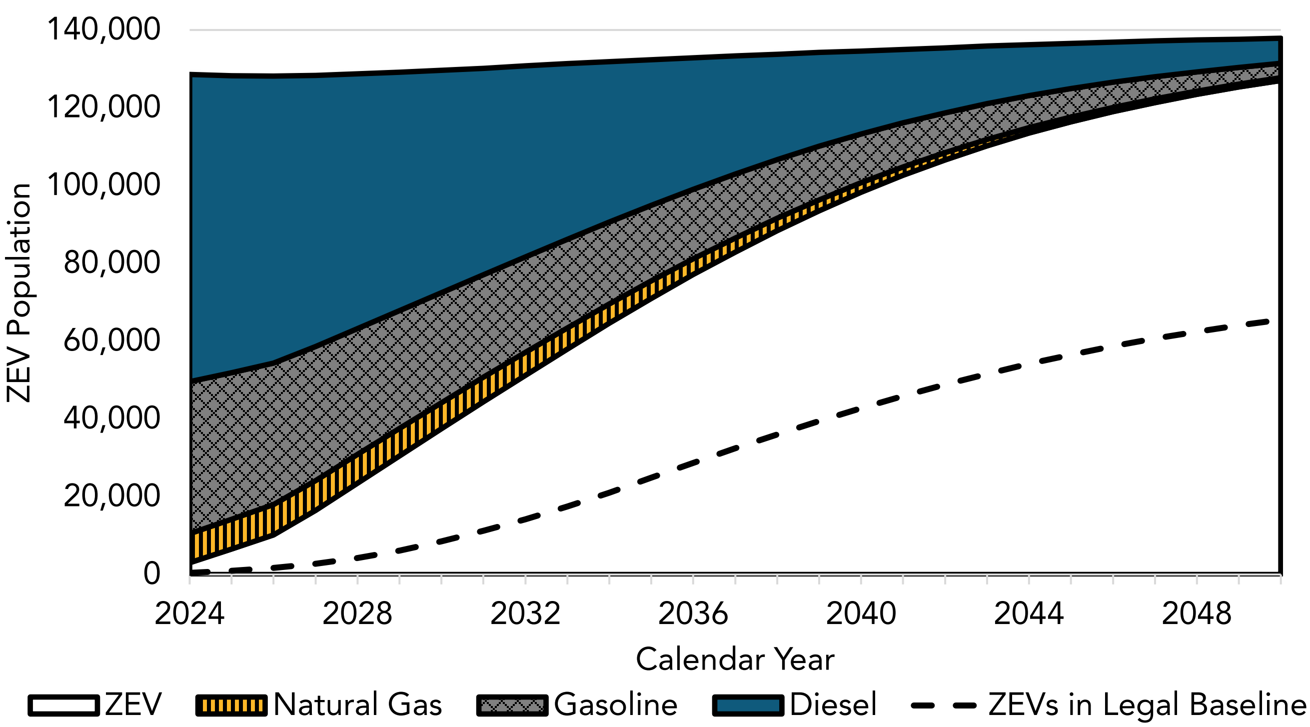
To calculate the State and local government fleet technology mixture over time, the percentage schedules shown below in Table 27 are applied to the projected State and local government fleet sales numbers to calculate the number of medium- and heavy-duty ZEVs purchased per year. Staff estimates that 3 percent of State and local government fleets operate in the designated low-population counties and 97 percent operate elsewhere.

Table 27. State and Local Government Fleets Zero-Emission Vehicle Purchase Schedule

Model Year	Designated Counties	All Other Counties
2024-2026	0	50%
2027+	100%	100%

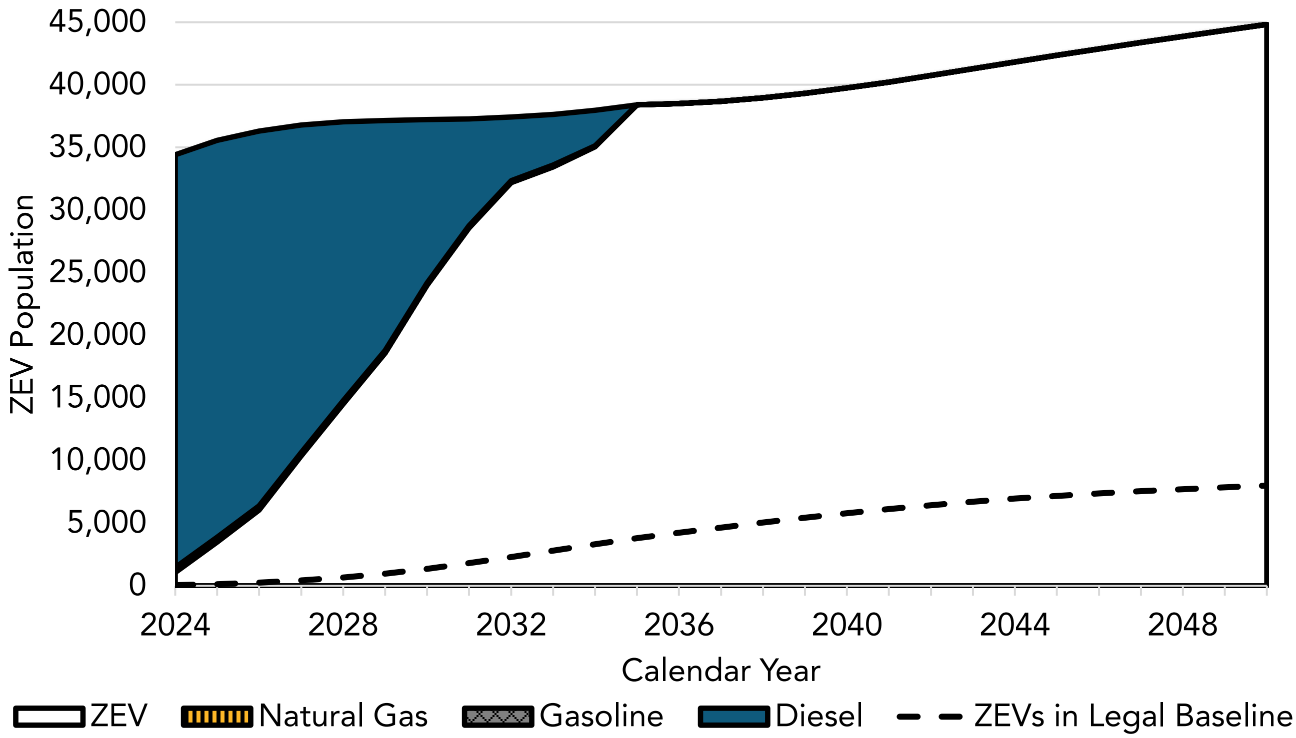
Figure 55 illustrates the projected State and local government fleet population over time by technology type using these inputs versus the medium- and heavy-duty ZEV population in the Legal Baseline scenario.

Figure 55: Projected State and Local Government Fleet Population with the Proposed ACF Regulation



To calculate the drayage truck technology mixture over time, staff assumed all additions to the drayage truck population beginning in 2024 would be ZEVs. Combustion-powered vehicles would leave the drayage truck inventory when they reach 800,000 miles which would typically be when the vehicle is 15-years-old based on mileage data. Figure 56 illustrates the projected drayage fleet population over time by technology type using these inputs versus the medium- and heavy-duty ZEV population in the Legal Baseline scenario. The natural gas population is under 300 vehicles in 2024 and is difficult to see on the figure. This figure includes drayage trucks operating at seaports as well as railyards.

Figure 56: Projected Drayage Truck Population with the Proposed ACF Regulation

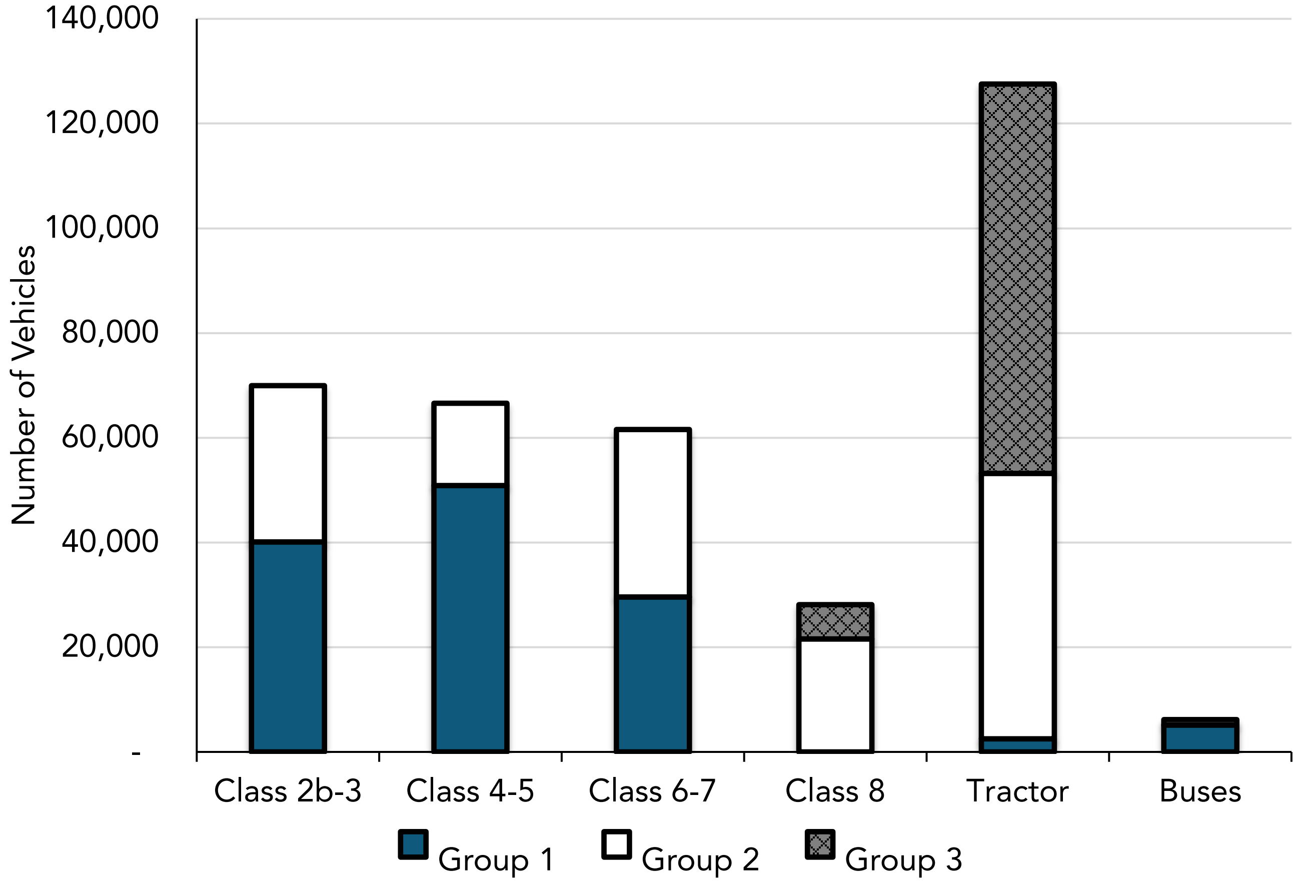


For the high priority and federal fleet requirements, fleets have two pathways to choose from: the Model Year Schedule or the ZEV Milestones Option. Fleets on the Model Year Schedule must purchase only ZEVs beginning January 1, 2024 and must retire vehicles which have exceeded their useful life. Fleets following the ZEV Milestones Option would need to meet the fleet ZEV percentage milestones outlined in Table 28. Work trucks are single-unit trucks except for specialty vehicles and vehicles already included in Group 1. A specialty vehicle is an uncommon Class 8 vocational vehicle that either has a heavy front axle or is designed to perform work while stationary with an auxiliary device which is integral to the vehicle's design e.g., a boom truck or digger derrick. For the emissions and costs analysis, fleet ZEV percentages are interpolated in years between regulatory requirements. Figure 57 illustrates the estimated 2024 population of vehicles in each vehicle category and vehicle group.

Table 28: High Priority and Federal Fleet Percentage Schedule

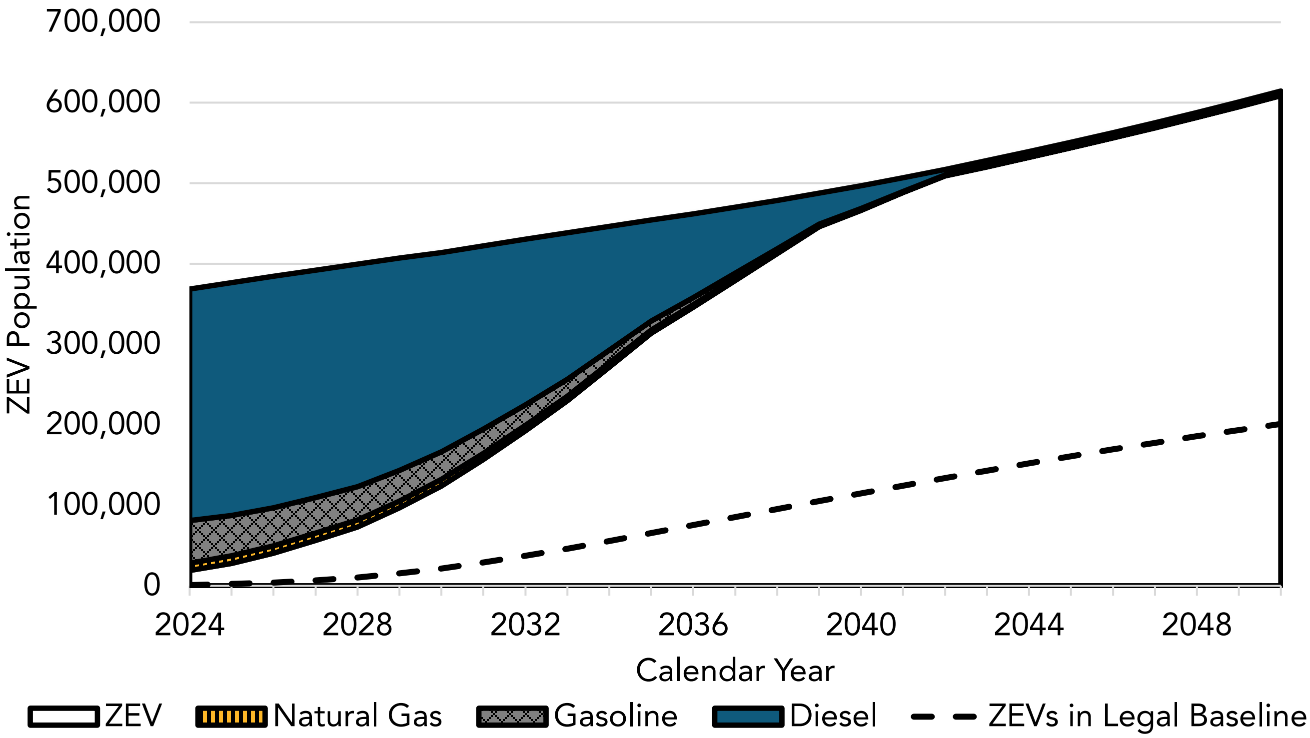
Group	**Vehicle Type**	**10%**	**25%**	**50%**	**75%**	**100%**
1	Box trucks, vans, two-axle buses, yard trucks, light-duty package delivery vehicles	2025	2028	2031	2033	2035
2	Work trucks, day cab tractors, three-axle buses	2027	2030	2033	2036	2039
3	Sleeper cab tractors and specialty vehicles	2030	2033	2036	2039	2042

Figure 57: Estimated Number of Vehicles per Vehicle Category and High Priority and Federal Fleet Grouping in 2024



For this analysis, staff assumes that 50 percent of the Group 1 vehicles will use the ZEV Milestones Option, 75 percent of the Group 2 vehicles, and 100 percent of the Group 3 vehicles. Figure 58 illustrates the projected high priority and federal fleet population over time by technology type using these inputs. Note that because a small portion of the vehicles operated by high priority and federal fleets are assumed to be designated as backup vehicles, some combustion-powered vehicles continue operating after 2042.

Figure 58: High Priority and Federal Fleet Population with the Proposed ACF Regulation



All 2040 MY and newer vehicles are assumed to be ZEVs. Nearly all new vehicles operating within California are originally sold in California; however, staff modelled that more used vehicles originally sold outside California will begin entering the state and will be purchased by regulated fleets. Table 29 shows what portion of vehicles are assumed to be originally sold in California based on their age.[352] This data was gathered using first sold data from California DMV. Instate buses and Class 2b-3 vehicles are assumed to all be sold in California, while out-of-state tractors are assumed to have all been sold outside of California. Most other vehicles newly registered in California are assumed to be purchased in California, but this fraction drops over time showing that more used trucks are being newly registered in California. For example, in 2040, 89.0 percent of 2040 MY Class 8 tractors registered within California are assumed to have been sold in California. By 2045, this fraction drops to 45.87 percent of Class 8 tractors.

Table 29: Percentage of California Registered Vehicles Originally Sold in California

Age	Class 4-6 Vocational	Class 7 Vocational	Class 8 Vocational	Class 7 Tractor	Class 8 Tractor
-1 or 0	90.97%	85.01%	89.78%	84.31%	89.00%
1	88.38%	80.35%	85.80%	82.10%	86.61%
2	85.68%	76.22%	81.86%	76.91%	79.17%
3	83.07%	72.74%	78.34%	69.92%	68.61%

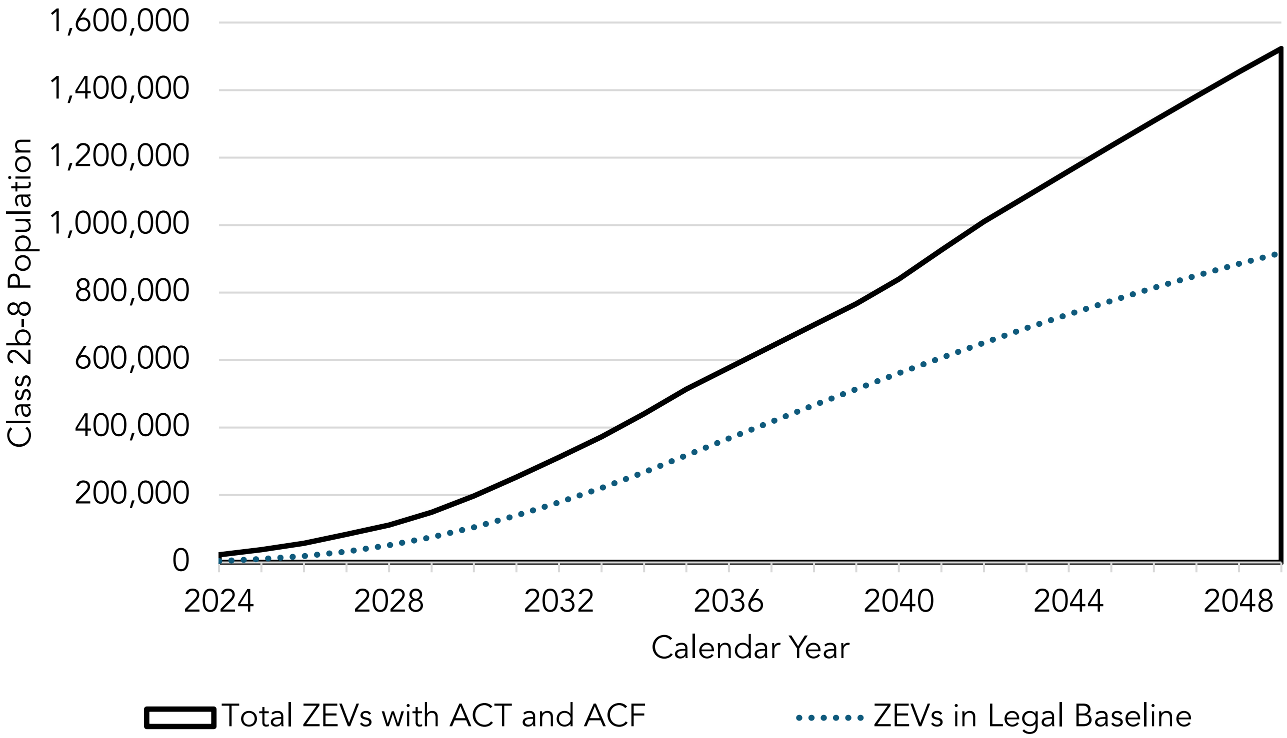
[352] California Air Resources Board, *Appendix F: Emissions Inventory Methods and Results for the Proposed Advanced Clean Trucks Regulation*, 2019 (web link: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2019/act2019/appf.pdf, last accessed August 2022).

Age	Class 4-6 Vocational	Class 7 Vocational	Class 8 Vocational	Class 7 Tractor	Class 8 Tractor
4	80.74%	70.02%	75.59%	62.30%	56.87%
5	78.90%	68.18%	74.00%	55.25%	45.87%
6	77.76%	67.35%	73.92%	49.92%	37.55%
7+	77.50%	67.35%	73.92%	47.51%	33.85%

Staff are not anticipating a prebuy situation beyond what is already expected with the Truck and Bus regulation. Most fleets that would be subject to the proposed ACF regulation are already subject to the Truck and Bus regulation. The Truck and Bus regulation requires significant turnover to 2010 or newer diesel engines prior to 2023 and accelerates vehicle purchases beyond what would be expected without that regulation. The accelerated purchases due to the Truck and Bus regulation are expected to reduce medium- and heavy-duty diesel vehicle purchases in the following years as trucks in the fleet will be newer than is typical for some fleets. This shift in fleet behavior is included in the baseline EMFAC modelling assumptions. In addition, staff are also aware of the current worldwide supply chain delays that would also dampen any short-term prebuy effects due to limited production capability from manufacturers in the immediate future.

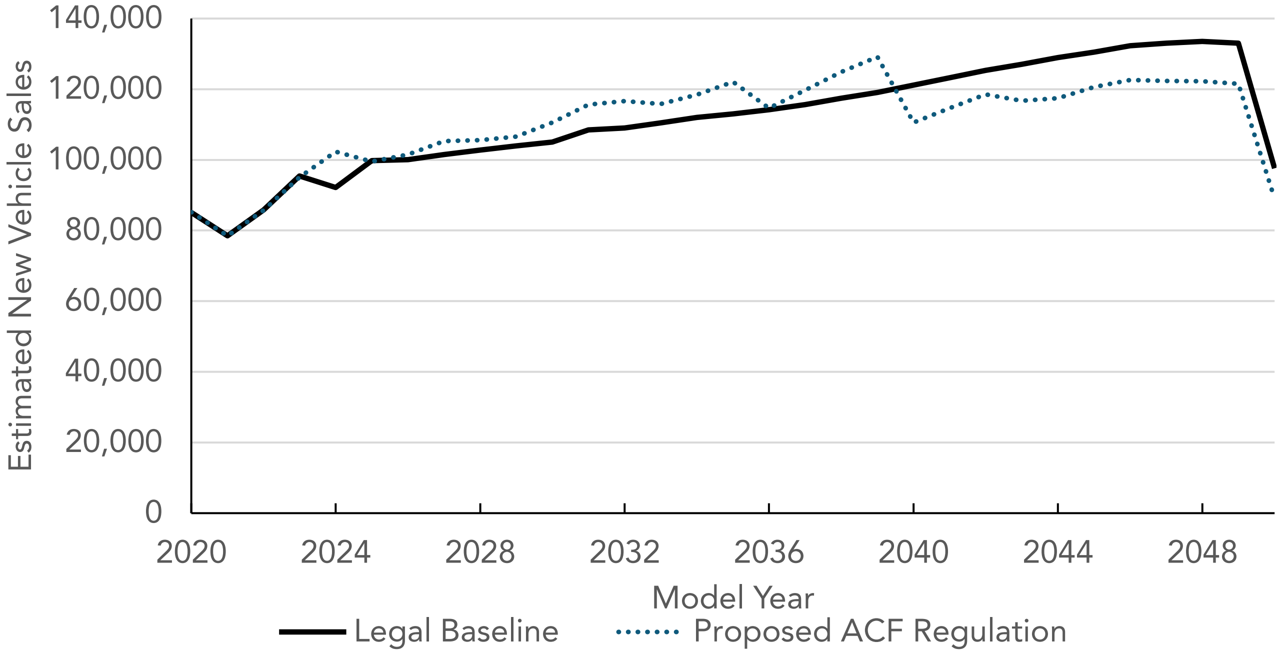
The proposed ACF regulation builds on the ACT regulation's requirement that manufacturers produce and sell increasing numbers of ZEVs in California. Figure 59 illustrates the net result of the 2 policies as well as the number of medium- and heavy-duty ZEVs each regulation would have achieved by itself. Generally, the proposed ACF regulation by itself would be expected to result in more ZEVs deployed than the adopted ACT regulation. Because ZEV sales are not all expected to be purchased by the fleets regulated under the proposed ACF regulation, the combination of the 2 would be expected to result in greater ZEV sales than each regulation achieves on its own. As a result, the proposed ACF regulation would be expected to increase the number of medium- and heavy-duty ZEVs beyond existing regulations from about 320,000 to about 510,000 by 2035, from about 780,000 to about 1,230,000 ZEVs by 2045, and from about 950,000 to about 1,590,000 ZEVs by 2050.

Figure 59: Statewide Population Forecast with the Proposed ACF Regulation



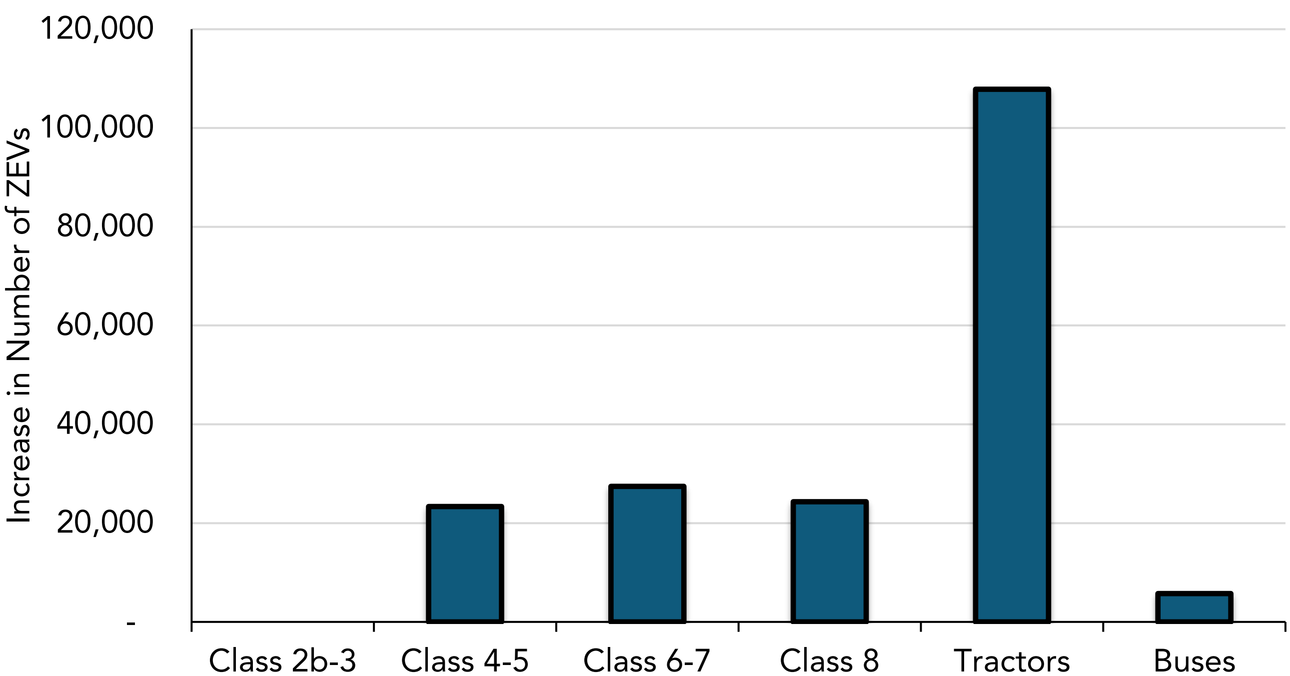
The proposed ACF regulation would result in changes to vehicle purchasing behavior. Because ZEVs are a newer commercial technology, fleets will not initially be able to purchase used ZEVs for a significant period of time. The proposed ACF regulation would also require some fleets to purchase vehicles quicker than their baseline replacement rate to keep up with regulatory milestones. As a result, the proposed ACF regulation is expected to increase new ZEV purchases by fleets. Figure 60 illustrates the projected sales per MY in the baseline and under the proposed ACF regulation. The number of new vehicle sales increases from 2024 to 2039 due to implementation of the high priority and federal fleet and drayage requirements. New vehicle sales are projected decline after 2040 when the phase-in for Group 2 vehicles end before rebounding to their baseline value near 2050.

Figure 60: Estimated New Vehicle Sales per Model Year



The projected increase in ZEVs deployed varies depending on the type of vehicles. The ACT regulation is projected to result in the largest portion of ZEVs deployed in the Class 2b-3 vehicle group and relatively fewer tractors based on that regulation's requirements and estimated sales numbers. The proposed ACF regulation generally places higher requirements on heavier vehicle classes, especially tractors, as previously noted. Figure 61 illustrates the expected increase in number of ZEVs by vehicle grouping in 2035.

Figure 61: Estimated Increase in ZEVs by Vehicle Category in 2035



Staff used the inventory analysis for cost modelling by aligning EMFAC categories into vehicle categories with available cost information. The vehicle categories in EMFAC were grouped into the following vehicle categories:

- Class 2b-3 trucks (GVWR between 8,501 and 14,000 lbs.) representing heavy-duty pickup trucks, cargo vans, and passenger vans;
- Class 4-5 trucks (GVWR between 14,001 and 19,500 lbs.) representing lighter delivery vans and service trucks;
- Class 6-7 single-unit trucks (GVWR between 19,501 and 33,000 lbs.) representing heavier delivery vans, bucket trucks, and others;
- Class 8 single-unit trucks (GVWR above 33,001 lbs.) representing a wide variety of heavy-duty vehicles including dump trucks, construction equipment, and others;
- Solid waste collection vehicles (SWCV) refer to refuse trucks used for urban waste pickup and collection;
- Tractor-trailers representing day cab tractors typically used for drayage and short to regional haul operation as well as sleeper cab tractors used for long-haul trucking; and
- Buses representing primarily cutaway shuttles and motorcoaches.

For each component of the proposed ACF regulation, staff assigned a representative vehicle for each vehicle category to calculate costs. Table 30, Table 31, and Table 32 display the different regulatory components and vehicle categories and what representative vehicle was used for that grouping.

Table 30: State and Local Government Fleet Vehicle Assumptions

Vehicle Category	Representative Vehicle
Class 2b-3	Class 3 Service Truck
Class 4-5	Class 5 Service Truck
Class 6-7	Class 6 Bucket Truck
Class 8	Class 8 Dump Truck
SWCV	Class 8 Refuse Packer
Buses	Class 5 Cutaway Shuttle

Table 31: Drayage Fleet Vehicle Assumptions

Vehicle Category	Representative Vehicle
Tractors	Class 8 Day Cab Tractor

Table 32: High Priority Fleet Vehicle Assumptions

Vehicle Category	Representative Vehicle
Group 1 - Class 2b-3	Class 2b Cargo Van

Vehicle Category	Representative Vehicle
Group 1 - Class 4-5	Class 5 Walk-in Van
Group 1 - Class 6-7	Class 6 Box Truck
Group 1 - Buses	Class 5 Cutaway Shuttle
Group 1 – Yard Tractor	Class 8 Yard Tractor
Group 2 – Class 2b-3	Class 2b Pickup
Group 2 – Class 4-5	Class 5 Service Truck
Group 2 – Class 6-7	Class 6 Bucket Truck
Group 2 – Class 8	Class 8 Dump Truck
Group 2 – SWCV	Class 8 Refuse Packer
Group 2 – Buses	Class 8 Motorcoach
Group 2 – Tractors	Class 8 Day Cab Tractor
Group 3 – Tractors	Class 8 Sleeper Cab Tractor
Group 3 – Specialty	Class 8 Bucket Truck

Throughout the body of the document, staff will refer to the cost elements of sample vehicles from the list above rather than all vehicles for brevity. A list of all vehicle-specific cost elements used in this analysis is provided in Appendix G.

3. Technology Mix Projections

Fleets currently purchase trucks powered by a variety of fuels—most commonly gasoline or diesel, and relatively low volumes of CNG, liquid natural gas, propane, E85, and other fuels. In staff's assumed Legal Baseline conditions, for simplification, Class 2b-3 vehicles and buses are split between gasoline- and diesel-powered based on existing assumptions within the EMFAC database. Class 4-8 vehicles are generally treated as diesel-powered with the exception of refuse trucks and tractors where 60 percent and 1.4 percent, respectively, are modelled to be natural gas powered. Based on EMFAC data, roughly ten percent of Class 4-8 vehicles use a fuel other than diesel, mainly gasoline.

Under the proposed ACF regulation, fleets are anticipated to meet their medium- and heavy-duty ZEV requirements using a combination of BEVs and FCEVs. Additionally, the State and local government fleet and high priority and federal fleet requirements can partly be met with NZEV technologies like PHEVs prior to 2035. It is somewhat challenging to precisely predict which ZE technologies fleets would use for complying with the proposed ACF regulation, especially as battery and fuel cell technologies have different characteristics, and such characteristics will likely change as such technologies continue to advance, and costs continue to decline. Generally, FCEVs commonly have shorter refueling times and are expected to have less sensitivity to weight concerns in long-range applications when compared to a battery-electric counterpart. BEVs can offer greater fuel cost-savings, especially for overnight charging, as electricity is generally a lower cost fuel compared to gasoline, diesel, natural gas, and hydrogen in a return to base duty cycle with sufficient dwell time to recharge the vehicles.

Based on expected manufacturer product availability and vehicle suitability analyses, staff assumes that fleets would comply with the proposed ACF regulation with a combination of battery-electric and fuel cell technologies. Currently, a wide variety of battery-electric trucks in all weight classes and configurations are commercially available. There are several commercially available battery-electric tractors now and limited small-scale deployments of fuel cell electric truck tractors by several small and major truck manufacturers. More information on current vehicle availability is discussed in Chapter I and in Appendix J. Based on manufacturer announcements, the majority of tractors commercially launched within the immediate future will be battery-electric. Manufacturers are simultaneously making investments into fuel cell electric technologies leading to commercialization in the latter half of the decade. As a result, staff is assuming 10 percent of day cab tractors will be FCEV until 2027 and 25 percent afterwards.

For sleeper cab tractors, staff is assuming an even 50:50 split between BEVs and FCEVs as they are phased in to meet 2030 compliance requirements. Both technologies face similar issues where a network of publicly accessible infrastructure is necessary to enable long-distance transportation throughout California and outside the state. For all other vehicles, staff is assuming all purchases would be battery-electric until 2026, purchases starting in 2027 onward would be 90 percent BEV and 10 percent FCEV. Currently, there are a number of medium- and heavy-duty FCEVs being demonstrated in the Class 6 and 8 weight classes.[353,354 ,355,356,357] A Class 8 fuel cell tractor produced by Hyzon Motors will be added to the HVIP catalog in August 2022.[358] Several other manufacturers including Hyundai, Volvo, Hino and Nikola are in the process of developing Class 8 fuel cell trucks or have announced plans and partnerships to do so; however in some instances, timing remains uncertain.[359,360,361]. Staff foresees a portion of regional haul and sleeper cab tractors would be fuel cell powered, but up to this point BEV technologies are the only commercially available

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[353] California Air Resources Board, *LCTI: NorCAL Zero-Emission Regional and Drayage Operations with Fuel Cell Electric Trucks*, 2022 (web link: https://ww2.arb.ca.gov/lcti-norcal-zero-emission-regional-and-drayage-operations-fuel-cell-electric-trucks, last accessed August 2022).
[354] California Air Resources Board, *LCTI: Fast-Track Fuel Cell Truck*, 2022 (web link: https://ww2.arb.ca.gov/lcti-fast-track-fuel-cell-truck, last accessed August 2022).
[355] California Air Resources Board, *LCTI: Fuel Cell Hybrid Electric Delivery Van Deployment*, 2022 (web link: https://ww2.arb.ca.gov/lcti-fuel-cell-hybrid-electric-delivery-van-deployment, last accessed August 2022).
[356] California Air Resources Board, *LCTI: Next Generation Fuel Cell Delivery Van Deployment*, 2022 (web link: https://ww2.arb.ca.gov/lcti-next-generation-fuel-cell-delivery-van-deployment, last accessed August 2022).
[357] California Air Resources Board, *LCTI: Port of Los Angeles "Shore to Store" Project*, 2022 (web link: https://ww2.arb.ca.gov/lcti-port-los-angeles-shore-store-project, last accessed August 2022).
[358] California HVIP, *Incentives for Clean Trucks and Bus*, 2022 (web link: https://californiahvip.org, last accessed August 2022).
[359] Hyundai Truck & Bus, *Hyundai Motor Details Plans to Expand into U.S. Market with Hydrogen-powered XCIENT Fuel Cells at ACT Expo*, 2022 (web link: https://trucknbus.hyundai.com/hydrogen/en/pr-center/newsroom/news-20220524?sn=BL00200410, last accessed August 2022).
[360] Volvo Group, *The Volvo Group and Daimler Truck form Joint Venture for Large Production of Fuel Cells*, 2020 (web link: https://www.volvogroup.com/en/news-and-media/news/2020/apr/news-3640568.html, last accessed August 4, 2022).
[361] Trucks.com, *Hino Debuts XL8 Fuel Cell Heavy-Duty Truck Prototype*, 2021 (website: https://www.trucks.com/2021/08/31/hino-xl8-fuel-cell-truck-prototype/, last accessed August 2022)

heavy-duty ZEVs in these segments and are proving functional for fleets that do not have high range or payload needs.

Although NZEVs are expected to have a lower upfront cost per vehicle than full ZEVs, they still require charging infrastructure and would not have as significant operational cost-savings as BEVs or FCEVs. They are not modeled in the analysis as they are expected to play a transitional role in limited use cases as existing BEVs already meet most fleet needs.

Table 33 outlines the technology assumptions for each vehicle group in the cost analysis. The Legal Baseline scenario and proposed ACF regulation scenario use the same technology distribution, but the number of ZEVs and combustion-powered vehicles will differ between the two scenarios.

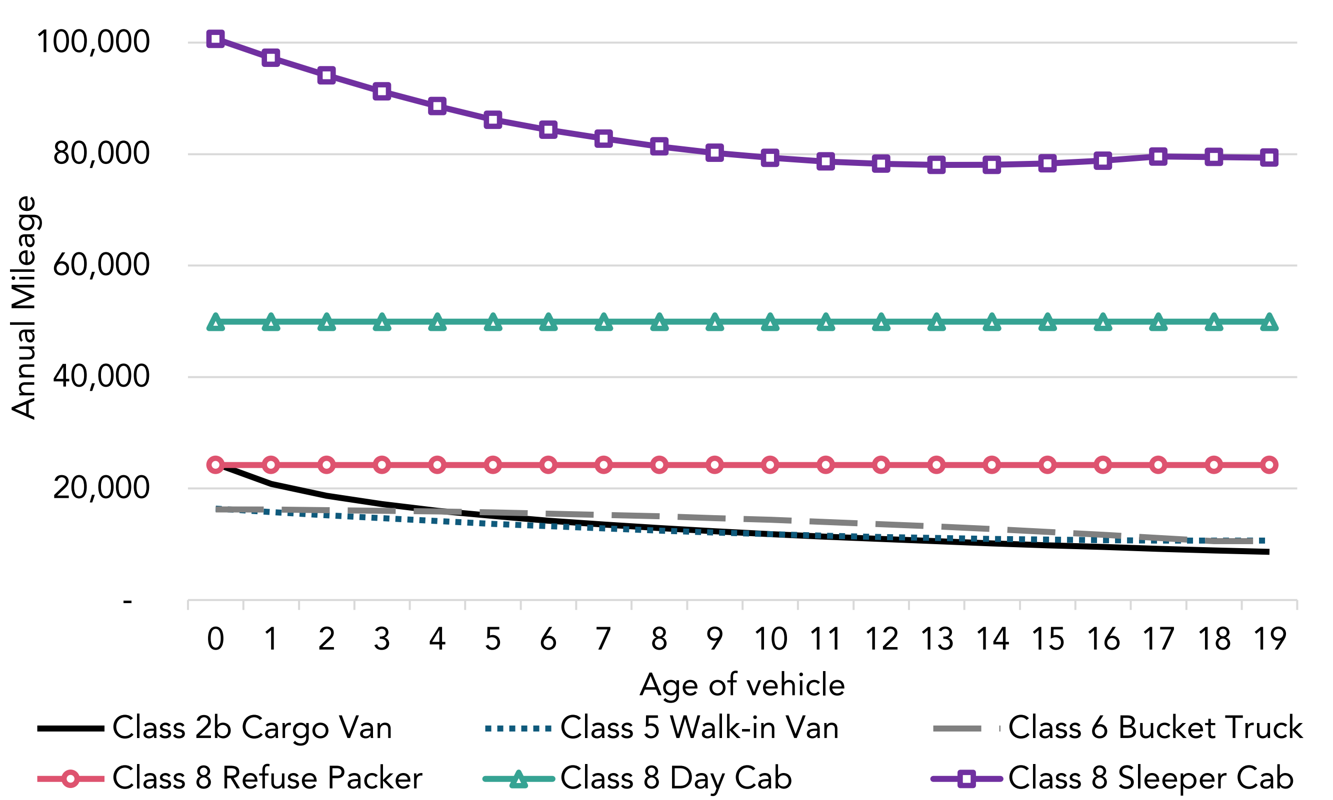
Table 33: Vehicle Groups and Technologies in the Cost Analysis

Vehicle Group	Technology Types
Class 2b-3	Diesel, Gasoline, BEV, FCEV
Class 4-5	Diesel, BEV, FCEV
Class 6-7	Diesel, BEV, FCEV
Class 8	Diesel, BEV, FCEV
SWCV	Diesel, Natural Gas, BEV, FCEV
Class 7-8 Tractor	Diesel, Natural Gas, BEV, FCEV
Buses	Diesel, Gasoline, BEV, FCEV

4. Annual Mileage

Annual mileage factors into a number of costs in this analysis including battery size, fuel costs, maintenance, and LCFS revenue. All annual mileage assumptions are based on EMFAC inventory estimates as representative of a typical vehicle within the category. For most vehicle categories, annual mileage is highest for newer vehicles and drops over time as the vehicle ages. EMFAC data was matched to the different representative vehicles. Figure 62 illustrates the mileage accrual rates for a set of sample vehicles. Mileage accrual assumptions for all representative vehicles are listed in the Vehicle Attribute Appendix within Appendix C.

Figure 62: Sample Annual Mileage Accrual Rates by Vehicle and Age



Staff has modeled an additional PTO operation by the Class 8 specialty vehicles by assuming an effective 50 percent increase in annual mileage as a surrogate for fuel use during stationary operation. A corresponding increase in battery size is modeled and is discuss later.

Staff assumes ZEVs will travel the same distance as their combustion-powered counterparts. As shown in Figure 62, the majority of single-unit trucks such as walk-in vans and refuse trucks travel under 25,000 miles per year which represents 100 miles per day. Most medium- and heavy-duty ZEVs available today can achieve this threshold and future product launches advertise higher range options. For tractors, the majority of in-state tractors travel below 200 miles per day. Manufacturers including Freightliner, Volvo, Tesla, and others have announced ZE tractor launches in 2022-2023 which would be capable of meeting these needs. As technology improves and publicly available infrastructure is built, staff anticipates fleets would be able to manage their fleets and introduce ZEVs where they are suitable to meet their daily needs. This transition to ZEV technology would occur over the course of the next 1 to 2 decades which would provide sufficient time for all vehicle types to transition to ZEV technology and perform the same duty cycle.

5. Upfront Costs

This section describes upfront costs for ICE vehicles and ZEVs. ZEVs are expected to have higher upfront costs due to increased vehicle prices and infrastructure, but these are expected to decline over time. Upfront costs include vehicle costs, infrastructure costs, taxes, and upgrades to maintenance bays.

a) New and Used Vehicle Prices

This section covers the cost to the fleet of purchasing a vehicle. Today and for the foreseeable future, purchases of most BEVs and FCEVs will cost more than their combustion-engine-powered counterparts. However, declining battery and component costs in addition to economies of scale are expected to lower the incremental costs of ZEVs as the market expands.

Base gasoline and diesel new vehicle prices are based on averages of new 2020 MY prices from manufacturers' websites and online truck marketplaces collected in early 2021. [362] New natural gas vehicle prices are derived from sources which estimate the incremental cost of upfitting a gasoline or diesel-powered vehicle to run on natural gas. Table 34 displays sample new vehicle retail prices for a variety of applications and technology types.

Table 34: Sample New Combustion-Powered Vehicle Prices (2021$)

Vehicle Group	Vehicle Price
Class 2b Cargo Van – Gasoline	$35,000
Class 2b Cargo Van – Diesel	$39,000
Class 5 Walk-in Van – Diesel	$87,000
Class 6 Bucket Truck – Diesel	$126,000
Class 8 Refuse Packer – Diesel	$226,000
Class 8 Refuse Packer – Natural Gas	$256,295
Class 8 Day Cab – Diesel	$130,000
Class 8 Day Cab – Natural Gas	$180,000
Class 8 Sleeper Cab – Diesel	$140,000
Class 8 Sleeper Cab – Natural Gas	$230,000

The Federal and California Phase 2 GHG regulations require manufacturers to build trucks that meet specified GHG emissions standards. These requirements start in 2021 MY and ramp up through the 2027 MY. U.S. EPA estimated the per vehicle costs to comply with the federal Phase 2 GHG regulation shown in Table 35.[363] These costs are added to the base cost of combustion-powered vehicles. ZEVs produce zero tailpipe emissions and do not incur increased costs due to the Phase 2 GHG regulation.

Table 35: U.S. EPA Phase 2 Greenhouse Gas Incremental Compliance Costs

Phase 2 Category	2021-2023 MY	2024-2026 MY	2027+ MY
Class 2b-3 Pickup/Van	$524	$963	$1,364
Vocational Vehicles	$1,110	$2,022	$2,662
Tractors	$6,484	$10,101	$12,442

The Heavy-Duty Omnibus rulemaking is a multi-pronged, holistic approach to decrease emissions of new heavy-duty engines sold in California beginning in the 2024 MY. The regulation lowers NOx emissions by lowering tailpipe NOx standards, establishes a new low-

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[362] California Air Resources Board, New Vehicle Cost Analysis, 2021.

[363] United States Environmental Protection Agency, *Final Rule for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2*, 2016 (web link: https://www.govinfo.gov/content/pkg/FR-2016-10-25/pdf/2016-21203.pdf, last accessed August 2022).

load test cycle to ensure emissions reductions are occurring in all modes of operation, strengthens durability testing requirements, lengthens emissions warranty and useful life periods, and establishes more rigorous in-use testing provisions, along with other measures. The costs to a typical fleet purchasing combustion-powered vehicles subject to the Heavy-Duty Omnibus rulemaking based on the certification type and the MY is shown in Table 36Table .[364] These costs are added to the base cost of combustion-powered vehicles, but do not change the cost for ZEVs because they do not have combustion engines and have zero tailpipe emissions. The costs associated with the Heavy-Duty Omnibus regulation are included in the Legal Baseline.

Table 36: Heavy-Duty Omnibus Estimated Increase in Purchase Price

Vehicle Category	Corresponding Weight Class	2024-2026 MY	2027-2030 MY	2031+ MY
Medium-Duty Diesel	Class 3	\$1,554	\$3,916	\$4,354
Medium-Duty Otto	Class 3	\$412	\$412	\$412
Heavy-Duty Otto	Class 4-8	\$506	\$821	\$1,015
Light-Heavy-Duty Diesel	Class 4-5	\$1,687	\$4,741	\$6,041
Medium-Heavy-Duty Diesel	Class 6-7	\$2,469	\$6,063	\$6,923
Heavy-Heavy-Duty Diesel	Class 8/Tractors	\$3,761	\$7,423	\$8,478

The Heavy-Duty Omnibus regulation applies to vehicles sold in California. Staff assumes State and local government fleets purchase all vehicles within California, while out-of-state fleets purchase all vehicles outside of California. Staff assumes a fraction of all other sales occur in California corresponding to the Year 0 values in Table 29. These costs are added to the base cost of combustion-powered vehicles, but do not change the cost for ZEVs because they do not have combustion engines and have zero tailpipe emissions. The costs associated with the Heavy-Duty Omnibus regulation are included in the Legal Baseline.

Staff estimated the cost of medium- and heavy-duty ZEVs for battery-electric and fuel cell powered vehicles by adding electric components costs, fuel cell component costs, energy storage costs, and body costs to a conventional glider vehicle, similar to CARB's approach used in the ACT regulation. Component costs are adjusted to account for the indirect costs associated with production volume and early market complexity. The indirect cost multipliers are derived from the 2019 Argonne National Laboratory Report "Fuel Economy and Cost Estimates for Medium- and Heavy-Duty Vehicles" and are displayed in Table 37 and are applied to the individual component costs. These multipliers are the highest in earliest years when volumes are lowest and new engineering is needed to launch electrified products. Over time, these multipliers decline as economies of scale emerge and ZEV production becomes normalized within the industry. Values for years in between are interpolated.[365] The final retail price of the ZEV is the sum of these individual total component costs. The calculated prices

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[364] California Air Resources Board, *Public Hearing to Consider the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments – Staff Report: Initial Statement of Reasons*, 2020 (web link: https://ww3.arb.ca.gov/regact/2020/hdomnibuslownox/isor.pdf, last accessed August 2022).
[365] Argonne National Laboratory, *Fuel Economy and Cost Estimates for Medium- and Heavy-Duty Vehicles*, 2019 (web link: https://publications.anl.gov/anlpubs/2021/02/165815.pdf, last accessed August 2022).

for BEVs are comparable to battery-electric trucks and vans that are available through the HVIP program today.

Table 37: Indirect Cost Multipliers Applied to Zero-Emission Vehicle Component Costs

Vehicle Category	2020 and Earlier	2025	2030	2035 and Later
Electric machine	1.95	1.55	1.29	1.20
Battery Packs	2.18	1.76	1.48	1.20
Fuel Cell System	2.18	1.76	1.48	1.20
Hydrogen Storage	2.18	1.76	1.48	1.20

Electric component costs including motors and electronic controllers are derived using assumptions from Argonne National Laboratory's 2021 Vehicle Technology Benefit Analysis for medium- and heavy-duty vehicles by averaging the low and high cases.[366] Hydrogen system component costs for the fuel cell stack and hydrogen storage are calculated using data from two Strategic Analysis reports prepared for the Department of Energy which estimated hydrogen fuel cell system costs for medium- and heavy-duty trucks.[367,368]

Generally, heavy-duty vehicles are manufactured in stages. A chassis manufacturer such as Ford or Freightliner installs a powertrain built by themselves or an outside supplier to produce a cab-and-chassis. This is then sent to a body manufacturer to install a body on the vehicle such as a box or bucket truck body. These body costs are modeled separately for ZEVs. The cost of a body can be estimated by measuring the difference between the price of a cab-and-chassis and the finished vehicle with a body. For this analysis, staff assumes bodies requiring PTO such as a bucket truck or refuse truck will cost ten percent extra up until 2030 to account for additional costs of electrifying the PTO. No increased costs are modeled for bodies without PTO.

The cost of battery storage is the largest contributing factor associated with the price of BEVs. Battery pack costs have dropped nearly 90 percent since 2010 and are projected to continue declining. [369] Battery pack costs for medium- and heavy-duty applications are currently higher than for light-duty cars due to smaller volumes and differing packaging requirements even though many use the same cells. For this analysis, staff estimate battery costs using a recent 2021 analysis from the National Academies of Sciences, Engineering, and Medicine and the indirect cost modifiers displayed in Table 37.[370] Figure 63 shows the

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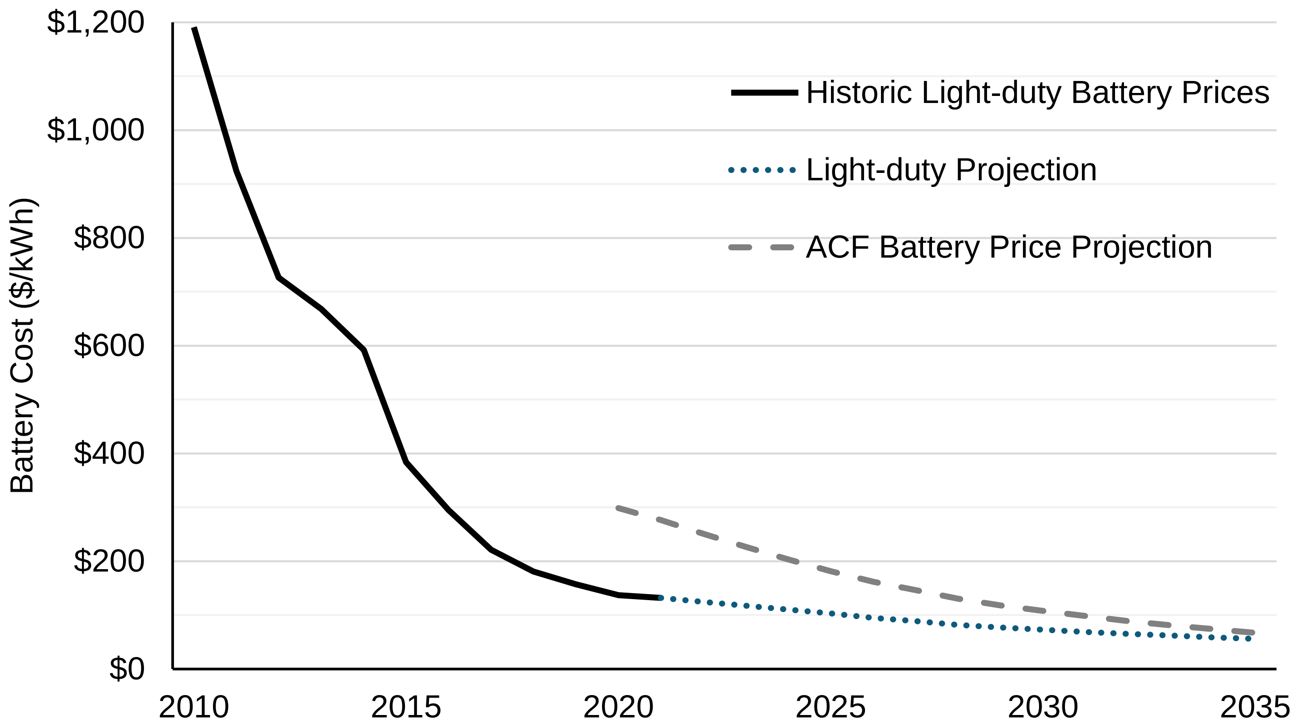
[366] Argonne National Laboratory, *2021 Vehicle Technology Benefit Analysis – Medium- and Heavy-Duty Vehicles - Assumptions*, 2021 (web link: https://anl.app.box.com/s/ml0vlag8merv5xb2jjt5f901cl6rbu38, last accessed August 2022).
[367] Strategic Analysis, *Fuel Cell Systems Analysis*, 2021 (web link: https://www.hydrogen.energy.gov/pdfs/review21/fc163_james_2021_o.pdf, last accessed August 2022).
[368] Strategic Analysis, *Hydrogen Storage Cost Analysis*, 2021 (web link: https://www.hydrogen.energy.gov/pdfs/review21/st100_james_2021_o.pdf, last accessed August 2022).
[369] Bloomberg New Energy Finance, *Battery Pack Prices Fall to an Average of $132/kWh, But Rising Commodity Prices Start to Bite*, 2021 (web link: https://about.bnef.com/blog/battery-pack-prices-fall-to-an-average-of-132-kwh-but-rising-commodity-prices-start-to-bite/, last accessed August 2022).
[370] National Academies of Sciences, Engineering, and Medicine, *Assessment of Technologies for Improving Light-Duty Vehicle Fuel Economy 2025-2035*, 2021 (web link: https://www.nap.edu/read/26092/chapter/1, last accessed August 2022).

historic battery price trend and the battery price projections used in this analysis. The projections used in this analysis are shown in bold.

Figure 63: Historic Battery Price Trends and Battery Price Projections



Staff is not forecasting that this proposed ACF regulation would significantly affect commercial battery prices and ZEV technology. The proposed ACF regulation would affect a portion of California's medium- and heavy-duty trucking fleet, which is very small compared to the worldwide market for batteries in consumer electronics, light-duty vehicles, battery-storage, and other applications. To the extent that this rule increases economies of scale for general ZEV components, infrastructure, and battery production, there may be an accelerated reduction in component and vehicle prices as a result of the rule, but these effects are less certain and are not modelled. The proposed ACF regulation, along with the ACT rule and similar efforts outside California, may cause the cost for battery packs and components specifically designed for medium- and heavy-duty ZEVs to decrease as economies of scale start to emerge in this new market.

The costs for BEVs are modelled using motors and electrical components in line with an existing diesel counterpart's power needs. Battery storage is estimated using the vehicle's average daily mileage based on EMFAC data and the energy efficiency of the EV in 2020. For vehicles which EMFAC models as driving below 100 miles per day, staff assumed the battery will have a minimum capability of driving 100 miles daily. Staff then modeled a 35 percent buffer to account for battery degradation and some operational variability. For Class 2b pickups, staff modeled they will require an additional 50 percent larger battery than would otherwise be calculated to account for the towing needs of these vehicles as well as their operational variability. Similarly, staff modeled that the Class 8 specialty vehicle will require a 50 percent larger battery to accommodate expanded PTO operation as discussed previously. Table 38 lists the specifications of sample BEV.

Table 38: Battery Size Calculation

Representative Vehicle	Daily Mileage	2020 Efficiency (kWh/mi)	Battery Size (kWh)
Class 2b Cargo Van	100	0.6	80
Class 5 Walk-in Van	100	1	135
Class 6 Bucket Truck	100	1.5	205
Class 8 Refuse Packer	100	3.0	405
Class 8 Day Cab	160	2.1	455
Class 8 Sleeper Cab	320	2.1	920

The costs for FCEVs are modeled using motors and electrical components in line with an existing diesel vehicle counterpart's power needs. The battery is assumed to be 10 kWh. The fuel cell stack power output is assumed to be one half the vehicle's peak power needs. The amount of hydrogen storage depends on vehicle size, with larger vehicles requiring more storage: 10 kg for Class 2b-3 vehicles, 20 kg for Class 4-7 vehicles, 40 kg for most Class 8 vehicles and 80 kg for Class 8 sleeper cab tractors.

The estimated vehicle prices in 2021 constant dollars for sample vehicles of all fuel types are shown in Table 39. Based on these projections, ZEV costs are expected to be higher than diesel vehicle costs until at least 2030. After that point, some vehicles may see lower cost for ZEVs versus their diesel-powered counterparts as costs for ZEVs continue declining while combustion-powered costs increase over time. All costs for all MYs are available in the Vehicle Cost Attributes Appendix within Appendix C.

Table 39: New Vehicle Price Forecast (2021$)

Vehicle Group	2025 MY	2030MY	2035 MY
Class 2b Cargo Van - Diesel	$40,137	$40,611	$40,611
Class 2b Cargo Van - Gasoline	$36,137	$36,611	$36,611
Class 2b Cargo Van – Battery-Electric	$54,835	$45,167	$40,361
Class 2b Cargo Van – Fuel Cell Electric	$89,469	$63,567	$48,115
Class 5 Walk-in Van – Diesel	$91,075	$94,884	$96,184
Class 5 Walk-in Van – Battery-Electric	$107,074	$94,260	$87,552
Class 5 Walk-in Van – Fuel Cell Electric	$127,842	$106,944	$92,056
Class 6 Bucket Truck – Diesel	$130,857	$135,206	$136,066
Class 6 Bucket Truck – Battery-Electric	$165,527	$145,791	$142,076
Class 6 Bucket Truck – Fuel Cell Electric	$194,304	$161,337	$146,756
Class 8 Refuse Packer – Diesel	$232,149	$236,566	$237,621
Class 8 Refuse Packer – Natural Gas	$259,189	$260,259	$260,453
Class 8 Refuse Packer – Battery-Electric	$293,965	$257,685	$238,496
Class 8 Refuse Packer – Fuel Cell Electric	$319,852	$272,754	$240,265
Class 8 Day Cab – Diesel	$145,689	$152,115	$153,170
Class 8 Day Cab – Natural Gas	$192,434	$195,513	$195,707
Class 8 Day Cab – Battery-Electric	$204,579	$164,611	$143,371
Class 8 Day Cab – Fuel Cell Electric	$221,352	$174,254	$141,765
Class 8 Sleeper Cab – Diesel	$155,689	$162,115	$163,170
Class 8 Sleeper Cab – Natural Gas	$242,434	$245,513	$245,707
Class 8 Sleeper Cab – Battery-Electric	$295,597	$221,901	$181,883

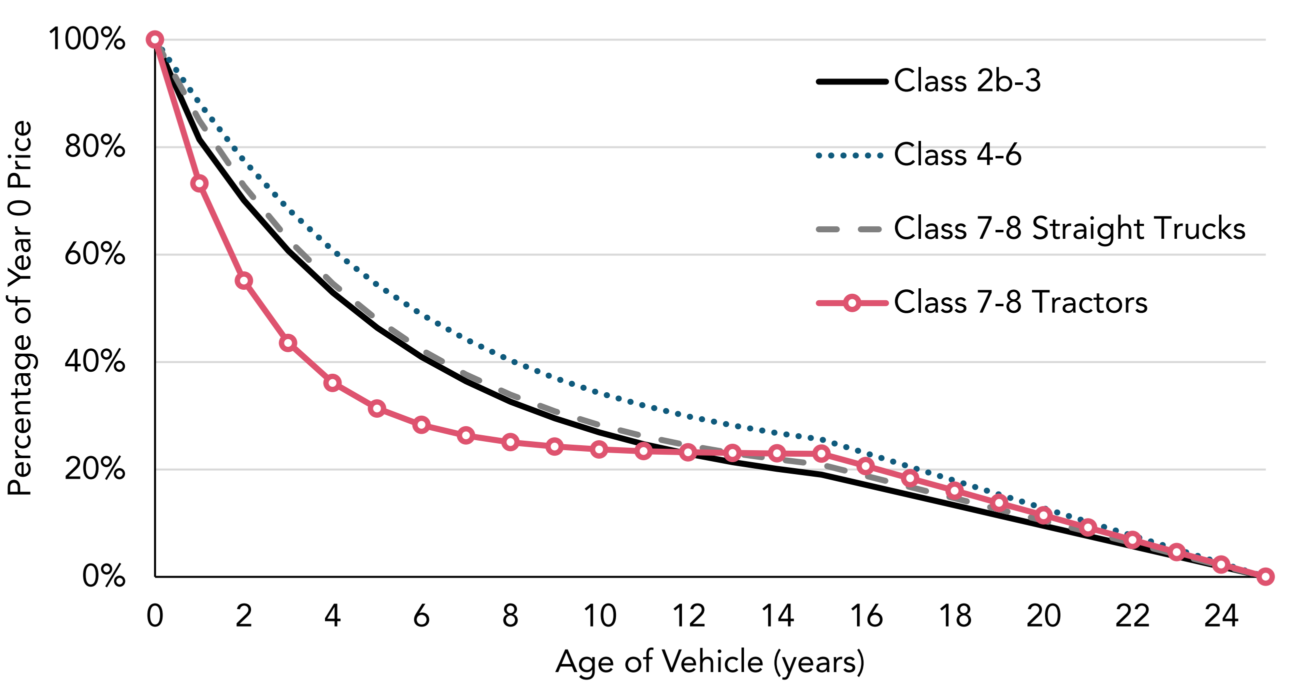
Vehicle Group	2025 MY	2030MY	2035 MY
Class 8 Sleeper Cab – Fuel Cell Electric	$254,774	$203,552	$160,833

Note that this analysis did not include the credits newly available under the recently passed Inflation Reduction Act of 2022. The Inflation Reduction Act provides substantial funding towards medium- and heavy-duty ZEVs with up to $7,500 available for commercial vehicles with a GVWR at or below 14,000 lb. and up to $40,000 for commercial vehicles with a GVWR above 14,000 lbs. These credits will further reduce the costs for ZEVs and will improve the total cost of ownership for ZEVs versus ICE vehicles. In addition, there are no restrictions on using these credits to meet regulatory requirements.

The used vehicle prices for combustion-powered trucks are calculated using major online truck marketplaces such as TruckPaper and Commercial Truck Trader by measuring the price of a given body type over several MYs and weight classes. This analysis provided up to 2,000 data points per MY to calculate the long-term residual values for medium- and heavy-duty vehicles. The trend is calculated by grouping similar trucks, performing a weighted average, then calculating an exponential curve fit for the different groups. The residual value is assumed to linearly decline from its value at 15-years-old to a value of 0 at 25-years-old to reflect that most vehicles are out-of-service or scrapped at that point.

Figure 64 displays the 4 residual value curves calculated for combustion-powered vehicles over a 25-year period. The residual value of ZEVs is assumed to decline at the same rate as combustion-powered trucks.

Figure 64: Residual Values by Vehicle Type and Age



b) Fueling Infrastructure Installation and Maintenance

Infrastructure is necessary to refuel or recharge vehicles. All vehicles need either dedicated refueling infrastructure onsite or publicly available retail stations in order to operate. There are numerous ways infrastructure expenses can be accounted for which would affect the cost to California businesses in different ways. Infrastructure expenses are generally an upfront capital investment needed prior to vehicles being deployed, but infrastructure can last multiple vehicle lifetimes and generally is amortized over its life.

For gasoline, diesel, and natural gas fueled vehicles, staff assumes the fleet is either using existing infrastructure or publicly accessible stations and the infrastructure cost is already incorporated into the fuel cost. As a result, these infrastructure costs are not separately modeled.

For this analysis, staff assumes BEVs would utilize both depot charging and recharging at publicly accessible medium- and heavy-duty retail stations and that it will vary by fleet. Staff estimated the portion of BEVs that would use depot charging versus retail refueling using data from the ACT LER requirement.[371] Vehicles that travel under 200 miles per day and either fuel at base, park at their home base 8 or more hours per day, or return to base daily are assumed to be able to depot charge. Vehicles that do not meet these criteria are assumed to require retail recharging, such as vehicles parked away from company grounds or owned by smaller operators without sufficient access to capital. Non-tractor trucks are assumed to solely depot charge until 2030, as the vast majority of these vehicles have ample opportunity to refuel at a home base during downtime. After 2030 as more vehicles transition to ZE, a portion of the non-tractor fleet is assumed to use retail charging to address more variable operations. Retail refueling assumptions are listed in Table 40. Staff acknowledges there are myriad ways fleets can choose to charge their vehicles and these assumptions are intended to be representative cost scenarios.

Table 40: Percentage of Retail Refueling for Battery-Electric Vehicles by Weight Class and Year

Vehicle Group	2023-2029	2030+
Class 2b-3	0%	15%
Class 4-5 Straight Truck	0%	15%
Class 6-7 Straight Truck	0%	15%
Class 8 Straight Truck	0%	15%
Class 7-8 Day Cab Tractor	25%	25%
Class 7-8 Sleeper Cab Tractor	75%	75%

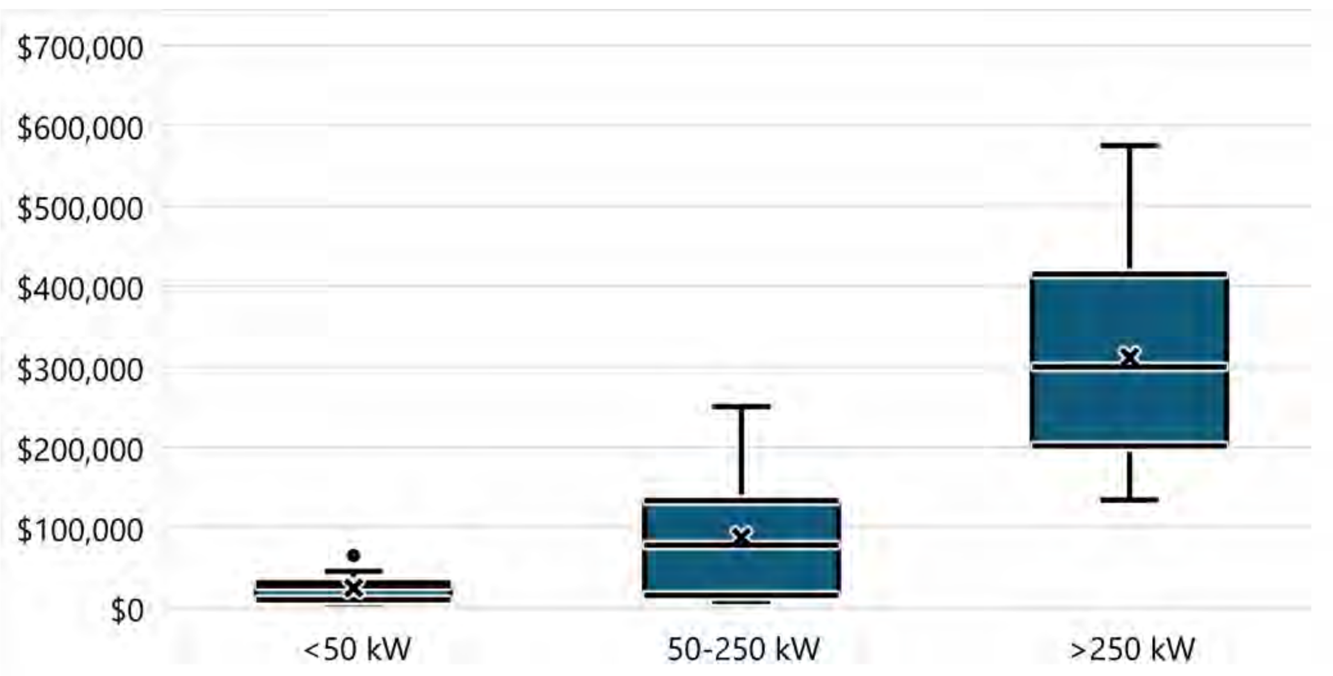
Fleets owning BEVs that do not use retail charging would set up private, behind-the-fence facility-side infrastructure to recharge their vehicles. There are two main cost components of installing charging infrastructure: the cost of the charger itself and the cost of upgrading the site to deliver power to the charger.

[371] Advance Clean Trucks, *Large Entity Reporting Results,* 2021 (web: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks/large-entity-reporting, last accessed August 2022).

Charger costs are derived from the ICCT working paper, "Estimating Electric Vehicle Charging Infrastructure Costs Across Major United States Metropolitan Areas."[372] Generally, smaller trucks can use Level 2 chargers that are similar to the chargers currently used by light-duty vehicles. Class 6 and heavier vehicles are assumed to require higher power direct current chargers. Class 8 vehicles and Class 7-8 tractors are assumed to use a 150 kW charger with 2 ports for each pair of BEVs.

Infrastructure upgrade costs represent costs on the customer side of the meter associated with setting up charging infrastructure at a facility and may include trenching, cabling, conduit, and panels as well as associated infrastructure costs. Staff assumes that nearly all costs associated with utility-side upgrades are the responsibility of the utility as per requirements of AB 841.[373] Soft costs including additional training costs and short-term implementation challenges, such as staff cycling vehicles between chargers, and are captured within subsection "Transitional Costs and Workforce Development". Infrastructure costs are derived from an analysis of BEV deployments conducted by CARB.[374] The data was analyzed to calculate the cost per port and results were broken into 3 groups: below 50 kW, between 50 and 250 kW, and above 250 kW. The results are shown in Figure 65 in a box-and-whisker plot. As depicted, infrastructure costs for fleets can be highly variable based on the layout of the site and the type of upgrades. The average cost is appropriate for a statewide analysis but the infrastructure cost to a given fleet may be higher or lower.

Figure 65: Infrastructure Upgrade Cost per Port and Power



[372] International Council on Clean Transportation, *Estimating electric vehicle charging infrastructure costs across major U.S. metropolitan areas*, 2019 (web link: https://theicct.org/sites/default/files/publications/ICCT_EV_Charging_Cost_20190813.pdf, last accessed August 2022).

[373] AB 841 (Ting, Stats. 2020, ch. 372).

[374] California Air Resources Board, Infrastructure Cost Analysis, 2021.

Table 41 outlines the assumptions for charger power, charger cost, and infrastructure upgrade costs.

Table 41: Charger Power Ratings and Infrastructure Costs Per Vehicle

Vehicle Group	Charger Power (kW)	Charger Cost ($/vehicle)	Infrastructure Upgrade Cost ($/vehicle)
Class 2b-3	19	$5,000	$25,000
Class 4-5	19	$5,000	$25,000
Class 6-7	50	$25,000	$44,000
Class 8	150 kW for 2 vehicles	$37,500	$44,000
Class 7-8 Tractor	150 kW	$75,000	$88,000

Fleets are assumed to amortize their infrastructure costs over a 20-year period with an interest rate of 5 percent. The number of charger installations and infrastructure upgrades each year is based on the increase in ZEV population per year to avoid double-counting infrastructure costs in situations in later years where a ZEV is replacing another ZEV in the fleet. Fleets may be able to offset significant upgrade costs by participating in utility electrification incentives, however due to uncertain long-term availability and qualification criteria, we do not assume so in our analysis. Hydrogen infrastructure costs are incorporated into the hydrogen fuel costs and are not separately modeled here.

Depot and retail chargers for ZEVs require regular maintenance. The maintenance costs of depot chargers are estimated by considering costs for replacing charger heads, connectors, and other components, as well as labor costs for regular inspections. Charger maintenance costs are estimated at $400/year/charger.[375] Staff assume that the maintenance costs for other fueling infrastructures are reflected in the fuel price.

Backup power generation is not included in this analysis. Although some fleets may want backup generation on site, staff does not assume infrastructure costs for the use of on-site backup generation for a number of reasons. First, ZEVs would gradually enter the fleet over time and only a small portion of the fleet would be ZE. Second, power outages affect all fuel types as fuel pumps cannot work without electricity, so similar issues already exist today. Third, mobile fueling and other solutions are currently being developed and present a solution for fleets seeking additional reliability.[376] Some backup generation options such as onsite power storage, present the opportunity to offset some or all of the costs to store energy during off-peak periods to reduce peak demand charges, or by reselling the electricity onto the grid during peak times using vehicle-to-grid technology. [377]

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[375] Alternative Fuels Data Center, *Charging Infrastructure Operation and Maintenance*, 2021 (web link: https://afdc.energy.gov/fuels/electricity_infrastructure_maintenance_and_operation.html, last accessed August 2022).
[376] GM, *GM Plans to Broaden Electrification, Expanding Fuel Cells Beyond Vehicles*, 2022 (web link: https://media.gm.com/media/us/en/gm/home.detail.html/content/Pages/news/us/en/2022/jan/0119-hydrotec.html, last accessed August 2022).
[377] EDF, *California Heavy-Duty Fleet Electrification Summary Report* , 2021 (web link: http://blogs.edf.org/energyexchange/files/2021/03/EDF-GNA-Final-March-2021.pdf, last accessed August 2022).

c) Sales Tax and Federal Excise Tax

Taxes are additional costs levied on the purchase of a vehicle. Because they are based on the purchase price of the vehicle, they are higher for ZEVs due to their higher upfront costs.

Vehicles purchased in California must pay a sales tax on top of the vehicle's purchase price. The sales tax varies across the state from a minimum of 7.25 percent up to 10.50 percent in some municipalities; a value of 8.6 percent was used for staff's analysis based on a statewide average weighted by economic output.[378] This results in higher costs for fleets and higher revenue for State and local governments. Class 8 vehicles are subject to an additional federal excise tax which adds 12 percent to their purchase price.

d) Maintenance Bay Upgrades

Maintenance bays are facilities used to service vehicles. Services performed include inspections, routine maintenance, preventative maintenance, repairs, overhauls and more. Servicing EVs requires separate safety equipment, diagnostic tools, and equipment which would incur costs to the facility.

Based on transit agency data, upgrading a 15-bus maintenance bay to handle battery-electric buses would cost $25,000, and upgrading to handle fuel cell electric buses would cost $750,000.[379] For this analysis, staff assume the cost per maintenance bay is the same and a 15-bus maintenance bay could accommodate 25 trucks. Per vehicle, this works out to be $1,000 per BEV and $30,000 per FCEV. The amount of maintenance bay upgrades each year is based on the increase in ZEV population per year to avoid double-counting in situations where a ZEV is replaced by a ZEV.

6. Operating and Maintenance Costs

Operating and maintenance costs analyzed include fuel costs, diesel exhaust fluid (DEF) costs, LCFS revenue, maintenance costs, midlife costs, and registration fees.

a) Gasoline, Diesel, Natural Gas, Electricity, and Hydrogen Fuel Costs

This section describes operating costs for ICE vehicles and ZEVs. ZEVs are expected to have lower operating costs due to fuel savings, reduced maintenance cost expenses, and LCFS revenue. Operating costs include fuel costs, diesel exhaust fluid consumption, LCFS revenue, maintenance costs, midlife costs, and registration fees.

Fuel costs are calculated using total fuel consumed per year, and the cost of fuel per unit. The total fuel consumed per year is based on the vehicle population per calendar year, the annual mileage traveled by those vehicles, and the fuel economy/fuel efficiency of the vehicles. In general, ZEVs are two to five times as efficient as similar vehicles with ICE technologies and significantly reduce petroleum and other fossil fuel consumption.

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[378] California Department of Tax and Fee Administration, *California City & County Sales & Use Tax Rates*, 2022 web link: https://cdtfa.ca.gov/taxes-and-fees/sales-use-tax-rates.htm, last accessed August 2022).
[379] Transit Agency Subcommittee-Lifecycle Cost Modelling Subgroup, Report of Findings, 2017.

Fuel economy is measured in miles per gallon for gasoline and diesel fueled vehicles, and miles per diesel gallon equivalent for natural gas fueled vehicles. Gasoline, diesel, and natural gas fuel economy is derived from EMFAC inventory projections for each group. Generally, combustion-powered fuel economy is expected to increase until the 2027 MY and remain relatively constant afterwards. The energy efficiency of BEVs and FCEVs is measured in miles per kWh and miles per kg, respectively.[380]

BEV energy efficiency is derived from in-use data collected from a variety of vehicles.[381,382,383] For fuel cell vehicle efficiency, staff applied the LCFS program's EER of 1.9 to the diesel fuel economy to estimate the fuel cell fuel economy as there is limited information which measures the energy efficiency of medium- and heavy-duty FCEVs.

Staff modeled that for both BEVs and FCEVs, the efficiency will improve at the same rate the Phase 2 GHG regulation would require for combustion-powered vehicles until 2027 MY, then remain constant afterwards. This may be a conservative estimate as both technologies are less developed than ICE powertrains and reports have shown recent improvements in the technology.

Table 42 outlines the fuel economy and energy efficiency assumptions for a sample of vehicle groups and technology types over the course of the regulation. Full assumptions are in the Vehicle Attribute Appendix within Appendix C.

Table 42: Sample Vehicle Fuel Economy and Energy Efficiency

Vehicle Group	2024 MY	2027 MY	2031 MY	Unit
Class 2b Cargo Van – Diesel	19.4	19.4	19.3	mpg
Class 2b Cargo Van – Gasoline	14.1	14.1	14.0	mpg
Class 2b Cargo Van – Battery-Electric	1.9	2.0	2.0	mi./kWh
Class 2b Cargo Van – Fuel Cell Electric	42.5	42.4	42.4	mi./kg
Class 5 Walk-in Van – Diesel	9.4	9.5	9.6	mpg
Class 5 Walk-in Van – Battery-Electric	1.1	1.2	1.2	mi./kWh
Class 5 Walk-in Van – Fuel Cell Electric	16.1	17.0	17.0	mi./kg
Class 6 Bucket Truck – Diesel	8.9	9.0	9.1	mpg
Class 6 Bucket Truck – Battery-Electric	0.8	0.8	0.8	mi./kWh
Class 6 Bucket Truck – Fuel Cell Electric	15.1	15.9	15.9	mi./kg
Class 8 Refuse Packer – Diesel	3.2	3.2	3.3	mpg

[380] Fuel economy, as defined in the Energy Policy and Conservation Act of 1975 (EPCA), does not apply to BEVs. *See* 49 U.S.C. §§ 32901(10 & 11) (defining "fuel" as gasoline, diesel oil, or other "liquid or gaseous fuel" that needs conserving and defining "fuel economy" as the average number of miles traveled by an automobile per gallon of gasoline or its equivalent). Moreover, note that medium- and heavy-duty on-highway vehicles are not ''automobiles'' as defined in 49 U.S.C. § 32901(a)(3) (4-wheeled vehicles rated under 10,000 lb. GVWR, excluding work trucks (vehicles rated between 8,500 to 10,000 lb. GVWR and not medium-duty passenger vehicles as defined in 40 C.F.R. § 86.1803-01).

[381] California Air Resources Board, *Battery-Electric Truck and Bus Efficiency Compared to Diesel Vehicles*, 2018 (web link: https://ww2.arb.ca.gov/sites/default/files/2018-11/180124hdbevefficiency.pdf, last accessed August 2022).

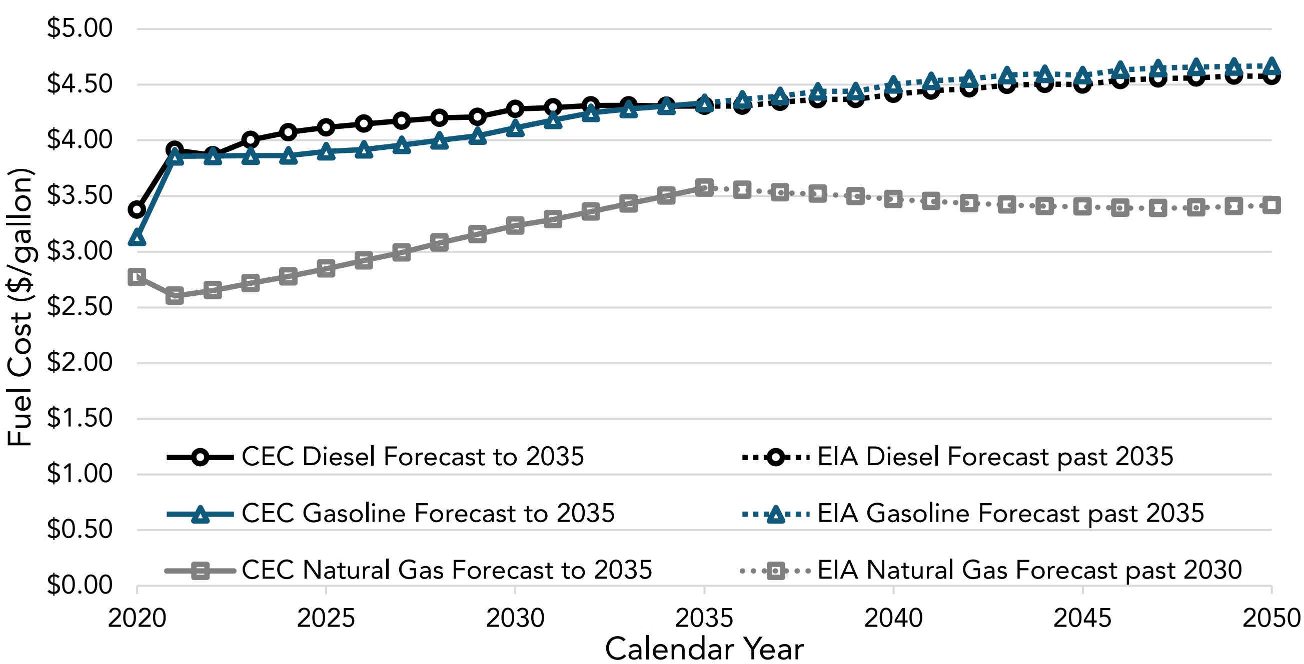
[382] Penn State LTI Bus Research and Testing Center, *Motor Coach Industries D45 CRTeLE*, 2020 (web link: http://apps.altoonabustest.psu.edu/buses/reports/522.pdf?1608733416, last accessed August 2022).

[383] Penn State LTI Bus Research and Testing Center, *GreenPower Motor Company EV Star*, 2020 (web link: http://apps.altoonabustest.psu.edu/buses/reports/515.pdf?1603821665, last accessed August 2022).

Vehicle Group	2024 MY	2027 MY	2031 MY	Unit
Class 8 Refuse Packer – Natural Gas	6.5	6.5	6.6	mpg
Class 8 Refuse Packer – Battery-Electric	0.4	0.4	0.4	mi./kWh
Class 8 Refuse Packer – Fuel Cell Electric	5.2	5.5	5.5	mi./kg
Class 8 Day Cab – Diesel	6.9	7.0	7.0	mpg
Class 8 Day Cab – Natural Gas	6.7	6.8	6.9	mpg
Class 8 Day Cab – Battery-Electric	0.5	0.6	0.6	mi./kWh
Class 8 Day Cab – Fuel Cell Electric	10.9	11.6	11.6	mi./kg
Class 8 Sleeper Cab – Diesel	7.1	7.2	7.2	mpg
Class 8 Sleeper Cab – Natural Gas	6.5	6.5	6.5	mpg
Class 8 Sleeper Cab – Battery-Electric	0.5	0.6	0.6	mi./kWh
Class 8 Sleeper Cab – Fuel Cell Electric	11.0	11.6	11.6	mi./kg

Gasoline and diesel fuel prices to 2035 are taken from the "mid-demand" scenario from CEC "Transportation Energy Demand Forecast."[384] Fuel prices past 2035 are calculated using the Energy Information Administration's (EIA) 2021 Annual Energy Outlook for the Pacific region.[385] The annual percentage change in EIA fuel prices past 2035 is applied to the 2035 CEC gasoline and diesel prices to estimate price changes past 2035. Figure 66 shows the projected prices of gasoline, diesel, and natural gas out to 2050.

Figure 66: Gasoline, Diesel, and Natural Gas Price Forecasts



Electricity costs for BEVs depend on the rate and on how they are charged and include energy costs, fixed fees, and demand fees. Vehicles charged at high power or during peak periods have higher electricity costs than if charging overnight or over an extended period.

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[384] California Energy Commission, *Transportation Energy Demand Forecast*, 2021 (web link: https://efiling.energy.ca.gov/GetDocument.aspx?tn=240934, last accessed August 2022).
[385]-Energy Information Administration, *Annual Energy Outlook 2021*, 2021 (web link: https://www.eia.gov/outlooks/aeo/data/browser/#/?id=3-AEO2021&region=1-9 , last accessed August 2022).

For this analysis, staff assumes the BEVs utilize both depot charging and recharging at publicly accessible medium- and heavy-duty retail stations using the same methodology as discussed previously in “Fueling Infrastructure Installation and Maintenance.”

Electricity prices for depot charging are calculated using CARB’s Battery-Electric Truck and Bus Charging Calculator and assumes a fleet of 20 vehicles using a managed charging strategy with the applicable rate schedule.[386] Tractors are assumed to be charged in a 4-hour shift at night with midday opportunity charging. All other trucks are assumed to charge overnight. Energy costs, monthly fees, demand rates, charger efficiency losses and local electricity taxes are incorporated into these numbers. The cost per kWh is calculated separately for each utility and a weighted average is used to determine the cost per kWh per vehicle in 2021.

Table 43 shows the depot charging electricity price per kWh for each vehicle group and major utility region as well as the weighted statewide average. In general, electricity costs are lower for larger vehicles because they tend to use more electricity which decreases the fixed costs per kWh and allows the use of lower cost rate schedules for larger utility customers. Note that SCE’s newly introduced EV rates, EV-8 and EV-9, have no demand fees from 2019 to 2023 and phase them back over the following five years, with demand fees being fully reintroduced in 2029. However, to simplify the analysis, staff used the full cost of the SCE electricity rate including all demand charges from the beginning of the analysis period rather than discounting the price to reflect the transition period until the demand charges are fully reintroduced.[387]

Table 43: Depot Charging Electricity Cost Calculation for 2021 (2021$/kWh)

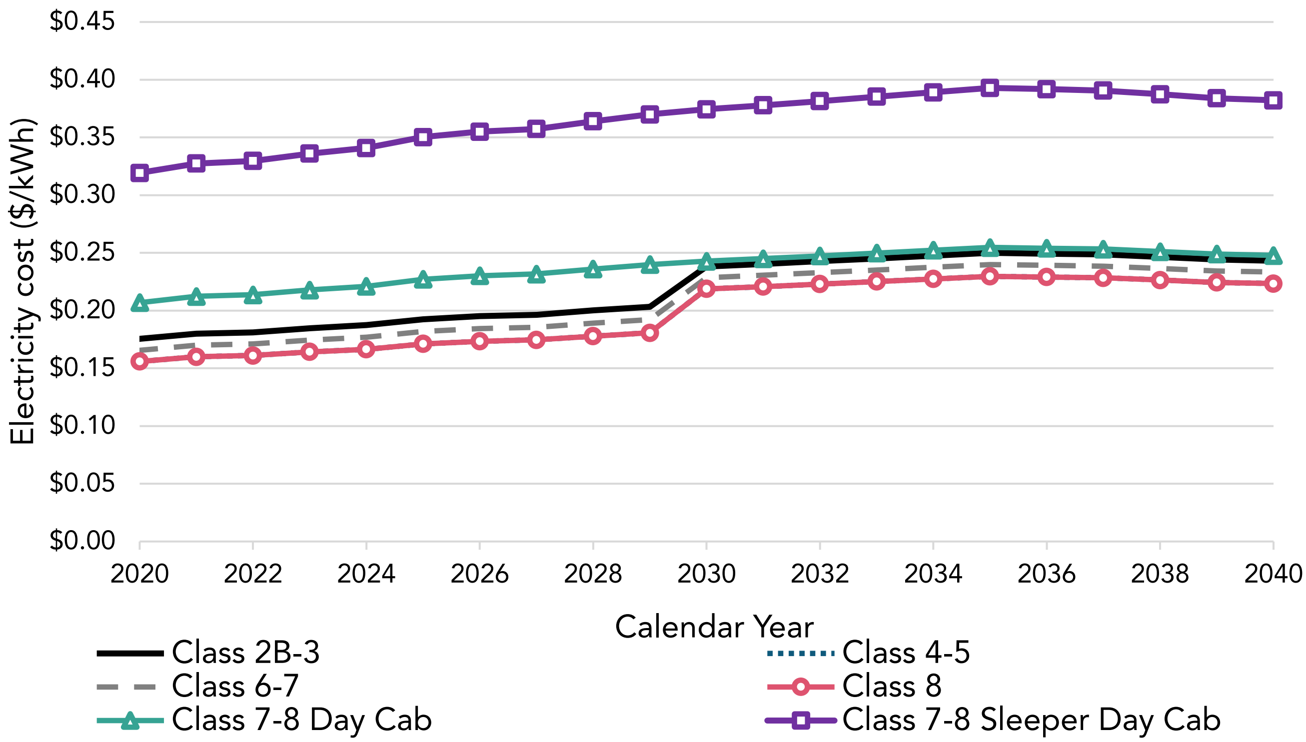
Utility Area	Class 2b-3	Class 4-5	Class 6-7	Class 8	Class 7-8 Tractor
Los Angeles Department of Water and Power	$0.11	$0.11	$0.13	$0.11	$0.17
Pacific Gas and Electric	$0.15	$0.15	$0.16	$0.15	$0.14
Sacramento Municipal Utility District	$0.17	$0.16	$0.16	$0.14	$0.14
San Diego Gas and Electric	$0.21	$0.20	$0.22	$0.20	$0.15
Southern California Edison*	$0.19	$0.15	$0.15	$0.14	$0.15
Weighted Statewide Average	**$0.18**	**$0.16**	**$0.17**	**$0.16**	**$0.16**

For retail charging, staff assumes the price for medium- and heavy-duty retail charging will be similar to current direct current fast charging costs for light-duty vehicles. Staff have used an average of charging costs offered today by Electrify America and EVgo to calculate a rate of $0.36/kWh in 2021.[388] The retail electricity charging prices have been adjusted to account for the higher LCFS credit value for heavy-duty vehicles as compared to light-duty vehicles. This adjustment is discussed further in the “LCFS” Section.

[386] California Air Resources Board, *Battery-Electric Truck and Bus Charging Calculator*, 2021 (web link: https://ww2.arb.ca.gov/resources/documents/battery-electric-truck-and-bus-charging-cost-calculator, last accessed August 2022).
[387] Southern California Edison, Communication via email with Alexander Echele in April 2019.
[388] Electrify America, *Pricing and Plans for EV Charging*, 2021 (web link: https://www.electrifyamerica.com/pricing/, last accessed August 2022).

Electricity rate changes over time are modelled using CEC's "Transportation Energy Demand Forecast."[389] CEC's rate forecast includes current and escalating revenue requirements to support ongoing investments in transmission and distribution infrastructure. Fuel prices past 2035 are calculated using the EIA 2021 Annual Energy Outlook for the Pacific region. [390] The annual percentage change in EIA electricity prices past 2035 is applied to the 2035 CEC electricity to estimate future price changes. Results per vehicle type are shown in Figure 67.

Figure 67: Electricity Price Forecasts



For this analysis, hydrogen stations are assumed to be available at strategic locations around seaports or major distribution hubs where the infrastructure costs are included in the hydrogen fuel price rather than reflecting costs for stations installed in a depot. This model is currently used for light-duty hydrogen stations and medium- and heavy-duty diesel sales and appears most appropriate for medium- and heavy-duty hydrogen fueling. Hydrogen fuel costs are modeled using CEC's "Transportation Energy Demand Forecast."[391] Past 2035, the price of hydrogen continues to decline linearly. Hydrogen costs over time are shown in Figure 68.

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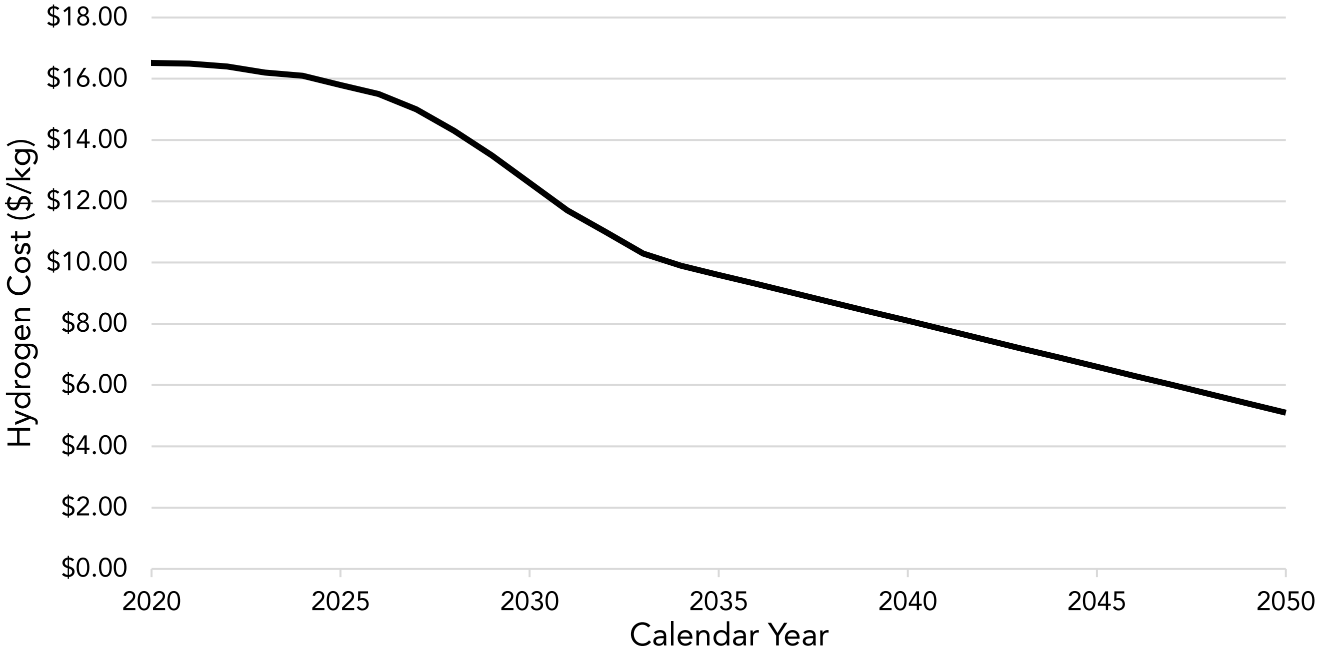
[389] California Energy Commission, *Transportation Energy Demand Forecast*, 2021 (web link: https://efiling.energy.ca.gov/GetDocument.aspx?tn=240934, last accessed August 2022).
[390] Energy Information Administration, *Annual Energy Outlook 2021*, 2021 (web link: https://www.eia.gov/outlooks/aeo/data/browser/#/?id=3-AEO2021&region=1-9 , last accessed August 2022).
[391] California Energy Commission, *Transportation Energy Demand Forecast*, 2021 (web link: https://efiling.energy.ca.gov/GetDocument.aspx?tn=240934, last accessed August 2022).

Figure 68: Hydrogen Fuel Price Forecasts



The cost of fuel displayed above includes fuel taxes. State and local taxes on fuel are listed below in Table 44.

Table 44: Local and State Taxes on Fuel

Fuel Type	Local Tax	State Tax
Gasoline	3.70% sales tax	$0.51/gal excise tax*
Diesel	4.5% sales tax	8.6% sales tax + $0.38/gal excise tax
Natural Gas	0	$0.887/gasoline gallon equivalent use tax
Electricity	3.53% utility user tax**	$0.0003/kWh
Hydrogen	0	0

*Local government portion is $0.22/gal and State government portion is $0.29/gal.
**Statewide population-weighted average

Staff acknowledge that both short-term and long-term forecasts for fuel and energy prices can change over time due to unexpected shocks in the economy. For example, The U.S. Energy Information Administration's (EIA) Short-Term Energy Outlook forecasts for Brent crude oil spot prices in 2022 have varied between $70 to $105 per barrel from the December 2021 to March 2022 forecast releases.[392,393] In the 2019, 2020, 2021, and 2022 releases of the U.S. EIA's Annual Energy Outlook, the predicted average annual real growth rate from 2021 through 2050 of transportation diesel fuel price varies from 1.0 percent, 1.5 percent, 1.5 percent, and 0.8 percent.[394] Similar patterns hold for the long-run projections on

[392] U.S Energy Information Administration, *Short-Term Energy Outlook December*, 2021 (web link: https://www.eia.gov/outlooks/steo/archives/Dec21.pdf, last accessed August 2022).
[393] U.S. Energy Information Administration, *Short-Term Energy Outlook March*, 2022 https://www.eia.gov/outlooks/steo/archives/Mar22.pdf, last accessed August 2022).
[394] U.S. Energy Information Administration, *Annual Energy Outlook 2019-2022, Table 3 Energy Prices by Sector and Sources, Pacific Region*, 2022 (web link: https://www.eia.gov/outlooks/aeo/, last accessed August 2022).

transportation gasoline prices and electricity prices, with relatively smaller adjustments for electricity prices. These different forecasts could result in changes in the cost and savings estimates for the proposed ACF regulation and the alternatives. If the realized fuel prices differ from what is forecasted, there will be proportional changes in the fuel costs and cost-savings.

b) Diesel Exhaust Fluid Consumption

Diesel-powered vehicles equipped with modern emissions control devices require diesel exhaust fluid (DEF) to reduce NOx in the exhaust stream. Argonne National Laboratory estimates DEF consumption as being 2 percent of total fuel usage in their online 2020 AFLEET tool.[395] This assumption will be applied to the fuel economy discussed previously to estimate the DEF consumption per mile. DEF is assumed to cost $2.80 per gallon per Argonne.

c) Low Carbon Fuel Standard Revenue

The LCFS regulation creates a market mechanism that incentivizes low carbon fuels, and was amended in 2018 and 2019 to increase the EER for Class 4-8 trucks from 2.7 to 5.0, reduce the carbon intensity target to 20 percent reduction by 2030, and clarify how hydrogen station operators can receive credits. The LCFS regulation now requires the carbon intensity of California's transportation fuels to decrease by 20 percent through the 2030 timeframe and maintains the standard afterwards. Electricity and hydrogen are eligible to earn LCFS credits which can be sold and used to offset the costs of these fuels. Fossil gasoline and diesel are generally not eligible for LCFS credits.

Fleets who own and operate their infrastructure generate credits based on the amount of fuel or energy they dispense. Credit values for different fuel types are calculated using the LCFS Credit Price Calculator.[396] For this analysis, staff is projecting an LCFS credit price of $200 until 2030, then declining linearly to $25 in 2045 and remaining constant thereafter. An electric Class 2b-3 vehicle would earn $0.158/kWh in 2024 using grid electricity while an electric Class 4-8 vehicle would earn roughly $0.262/kWh in 2024 at this credit price. Staff assume hydrogen is produced from 33 percent renewable feedstock as required by SB 1505.[397] This results in Class 4-8 vehicles earning $1.422/kg in 2024 at this credit price. LCFS credit revenue for a given fuel drops slightly over time as the program standards tighten and maintains upward pressure on the credit price.

For retail electricity refueling, staff conservatively assume that most LCFS credit revenue is not passed on to fleets directly, as the credit value is already incorporated into the retail price. As described previously, retail charging station costs are based off of what light-duty retail stations are charging today, which includes revenue they receive from the LCFS program. One key difference between light-duty and heavy-duty BEVs is that heavy-duty

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[395] Argonne National Laboratory, *Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) Tool*, 2020 (web link: https://greet.es.anl.gov/afleet, last accessed August 2022).
[396] California Air Resources Board, *LCFS Credit Price Calculator*, 2021(web link: https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/dashboard/creditvaluecalculator.xlsx, last accessed August 2022).
[397] SB 1505 (Lowenthal, Stats. 2006 ch. 877).

vehicles earn substantially more LCFS credits due to their higher EER value. To reflect this, staff applied this higher EER value to the retail electricity price by calculating the difference between light-duty and heavy-duty LCFS revenue and scaling the revenue by the credit value over time. This adjustment reduces the price of heavy-duty retail charging by $0.12/kWh by 2024 declining to $0.01/kWh by 2045. This adjustment is applied to the retail charging electricity cost.

This analysis reflects that the LCFS value associated with natural gas is already included in the retail price to the fleet owner. Fossil natural gas is expected to be a deficit generator in the LCFS program for the majority of this analysis and will not generate revenue. While RNG does generate LCFS credits, the credits are typically claimed by the fuel producer and used to offset the higher cost of RNG. Therefore, the net cost to the fleet owner using RNG is essentially the same as fossil-based natural gas.

d) Maintenance Costs

Maintenance costs reflect the cost of labor and parts for routine maintenance, preventative maintenance, and repairing broken components, and does not include costs reflected in the next section "Midlife Costs" where engine rebuilds, battery replacements, or fuel cell stack refurbishments are described. Maintenance costs for EVs are generally assumed to be lower than for diesel in part due to their simpler design and fewer moving components.

Maintenance costs for combustion-powered vehicles are based on numerous studies published assessing maintenance costs for vehicles over a representative timeframe. The maintenance cost for the selected representative vehicles was calculated by identifying all sources where the maintenance cost appeared for the representative vehicles and averaging the values. All maintenance cost sources are listed in the Vehicle Attribute Appendix.

BEVs and FCEVs are assumed to have 40 percent lower vehicle maintenance costs compared to gasoline and diesel based on an aggregation of sources and data.[398] While numerous reports assume ZEVs can achieve maintenance costs of 50 percent or greater compared to gasoline or diesel, the lack of long-term data on maintenance costs presents uncertainty for modelling purposes; therefore, the staff analysis uses the more conservative estimate.

Table 45 illustrates the maintenance for a set of sample vehicles. Maintenance cost assumptions for all representative vehicles are listed in the Vehicle Attribute Appendix within Appendix C. All prices have been adjusted to 2021 dollars using a consumer price index.

Table 45: Sample Vehicle Maintenance Costs per Mile

Vehicle Group	Maintenance Cost ($/mi.)
Class 2b Cargo Van – Diesel	$0.337
Class 2b Cargo Van – Gasoline	$0.337
Class 2b Cargo Van – Battery-Electric	$0.202

[398] Argonne National Laboratory, *Comprehensive Total Cost of Ownership Quantification for Vehicles with Different Size Classes and Powertrains*, 2021 (web link: https://www.arb.ca.gov/regact/2018/ict2018/appg.pdfhttps://www.arb.ca.gov/msprog/bus/maintenance_cost.pdf, last accessed August 2022).

Vehicle Group	Maintenance Cost ($/mi.)
Class 2b Cargo Van – Fuel Cell Electric	$0.202
Class 5 Walk-in Van – Diesel	$0.210
Class 5 Walk-in Van – Battery-Electric	$0.126
Class 5 Walk-in Van – Fuel Cell Electric	$0.126
Class 6 Bucket Truck – Diesel	$0.199
Class 6 Bucket Truck – Battery-Electric	$0.119
Class 6 Bucket Truck – Fuel Cell Electric	$0.119
Class 8 Refuse Packer – Diesel	$0.943
Class 8 Refuse Packer – Natural Gas	$0.943
Class 8 Refuse Packer – Battery-Electric	$0.566
Class 8 Refuse Packer – Fuel Cell Electric	$0.566
Class 8 Day Cab – Diesel	$0.198
Class 8 Day Cab – Natural Gas	$0.198
Class 8 Day Cab – Battery-Electric	$0.119
Class 8 Day Cab – Fuel Cell Electric	$0.119
Class 8 Sleeper Cab – Diesel	$0.159
Class 8 Sleeper Cab – Natural Gas	$0.159
Class 8 Sleeper Cab – Battery-Electric	$0.095
Class 8 Sleeper Cab – Fuel Cell Electric	$0.095

e) Midlife Costs

Midlife costs are the cost of rebuilding or replacing major propulsion components due to wear or deterioration. These costs do not include general maintenance on vehicles—these are included in the "Maintenance Costs" Section. The frequency and cost of a midlife rebuild varies across the different technologies. For combustion-powered vehicles, this would be a midlife rebuild, for BEVs this would be a battery replacement, and for a hydrogen FCEV this would be a fuel cell stack refurbishment.

The frequency of a diesel engine rebuild varies based on the vehicle's weight class. Table 46 shows the anticipated diesel engine useful life based on years or miles traveled. The cost of an engine rebuild is estimated to be one quarter of the total price without a body.

Table 46: Useful Life of Diesel Engines

Vehicle/Engine Category	Useful Life (Years/Miles)
Class 4-5 (Light-Heavy-Duty)	15/270,000
Class 6-7 (Medium-Heavy-Duty)	12/350,000
Class 8 (Heavy-Heavy-Duty)	12/800,000

Data is limited for BEVs, but ZEV manufacturers are currently offering vehicles with warranties of 8 or more years and up to 500,000 miles on their products. [399,400,401,402,403] Staff estimates that the battery will be replaced every 500,000 miles and the cost of the replacement is assumed to be the size of the battery in kWh multiplied by the price per kWh at the time of the replacement.

For FCEVs, the consulting firm Ricardo has estimated that a fuel cell stack refurbishment is necessary every seven years and costs one third the cost of a new fuel cell stack at the time of refurbishment. [404]

Fleets generally do not rebuild older vehicles as there is limited return on investment when a vehicle is approaching the end of its life. Staff does not model any rebuilds occurring after the vehicle is 20 years old.

Based on the above assumptions, Table 47 shows when sample vehicles are assumed to incur midlife costs. This approach may overestimate the cost of ZEVs when compared with combustion vehicles. A table of when each representative vehicle is assumed to incur its midlife cost is shown in the Vehicle Attribute Appendix.

Table 47: Frequency of Midlife Rebuilds

Vehicle Group	Midlife Occurrence (year)
Class 2b Cargo Van - Gasoline	N/A
Class 2b Cargo Van - Diesel	N/A
Class 2b Cargo Van – Battery-Electric	N/A
Class 2b Cargo Van – Fuel Cell Electric	7, 14
Class 5 Walk-in Van – Diesel	15
Class 5 Walk-in Van – Battery-Electric	N/A
Class 5 Walk-in Van – Fuel Cell Electric	7, 14
Class 6 Bucket Truck – Diesel	12
Class 6 Bucket Truck – Battery-Electric	N/A
Class 6 Bucket Truck – Fuel Cell Electric	7, 14
Class 8 Refuse Packer – Diesel	12
Class 8 Refuse Packer – Natural Gas	12

399 Department of Energy, *Batteries: 2020 Annual Progress Report*, 2020 (web link: https://www1.eere.energy.gov/vehiclesandfuels/downloads/VTO_2020_APR_Batteries_compliant_.pdf, last accessed August 2022).
400 BYD, *The BYD K9*, 2019 (web link: https://en.byd.com/wp-content/uploads/2019/07/4504-byd-transit-cut-sheets_k9-40_lr.pdf, last accessed August 2022).
401 New Flyer, *Xcelsior Charge*, 2019 (web link: https://www.newflyer.com/site-content/uploads/2019/06/Xcelsior-CHARGE-web.pdf, last accessed August 2022).
402 Proterra, *Catalyst: 40 Foot Bus – Performance Specifications*, 2019 (web link: https://mk0proterra6iwx7rkkj.kinstacdn.com/wp-content/uploads/2019/06/Proterra-Catalyst-40-ft-Spec-Sheet.pdf, last accessed August 2022).
403 Steinbuch, *Tesla Model S Degradation Data*, 2015 (web link: https://steinbuch.wordpress.com/2015/01/24/tesla-model-s-battery-degradation-data/, last accessed August 2022).
404 Ricardo, *Economics of Truck TCO and Hydrogen Refueling Stations*, 2016 (web link: https://cafcp.org/sites/default/files/8_Economics-of-Hydrogen-Refueling-Stations-Ricardo_CaFCP-Bus-Team-meeting-Aug2016.pdf, last accessed August 2022).

Vehicle Group	Midlife Occurrence (year)
Class 8 Refuse Packer – Battery-Electric	N/A
Class 8 Refuse Packer – Fuel Cell Electric	7, 14
Class 8 Day Cab – Diesel	12
Class 8 Day Cab – Natural Gas	12
Class 8 Day Cab – Battery-Electric	10
Class 8 Day Cab – Fuel Cell Electric	7, 14
Class 8 Sleeper Cab – Diesel	8, 19
Class 8 Sleeper Cab – Natural Gas	8, 19
Class 8 Sleeper Cab – Battery-Electric	5, 11, 17
Class 8 Sleeper Cab – Fuel Cell Electric	7, 14

For example, the midlife costs of a 2024 MY day cab tractor would be:

- Diesel, natural gas: midlife overhaul in 2036 at a cost of $32,500;
- Battery-electric: battery replacement in 2034 at a cost of $33,717; and
- Fuel cell electric: Fuel cell stack refurbishments in 2031 and 2038 at a cost of $10,460 in 2031 and $5,544 in 2038.

f) Registration Fees

Vehicles operating and registered in California must pay an annual registration fee. The registration fee varies based on the vehicle's cost, age, and weight. These calculations are different for combustion-powered vehicles and ZEVs.

Combustion-powered vehicles and ZEVs are subject to the following fixed fees based on the DMV online calculator.[405] These are constant annual fees for every vehicle which are shown in Table 48 and Table 49.

Table 48: Fixed Registration Fees for Internal Combustion Engine Vehicles

Diesel Fee Name	Amount
Current Registration	$61
CVRA Registration Fee	$122
CVRA Service Authority for Freeway Emergencies Fee	$3
CVRA Fingerprint ID Fee	$3
CVRA Abandoned Vehicle Fee	$3
CVRA California Highway Patrol Fee	$46
Current Air Quality Management District	$6
Current Cargo Theft Interdiction Program Fee	$3
CVRA Weight Decal Fee	$3
Alt Fuel/Tech Registration Fee	$3
CVRA Auto Theft Deterrence/DUI Fee	$4
Reflectorized License Plate Fee	$1
Total	**$258**

[405] California Department of Motor Vehicles, *California New Vehicle Fees*, 2021 (web link: https://www.dmv.ca.gov/portal/dmv/detail/portal/feecalculatorweb, last accessed August 2022).

Table 49: Fixed Registration Fees for ZEVs

ZEV Fee Name	Amount
Current Registration	$61
Current California Highway Patrol	$28
CVRA Service Authority for Freeway Emergencies Fee	$1
CVRA Fingerprint ID Fee	$1
CVRA Abandoned Vehicle Fee	$1
Current Air Quality Management District	$6
Alt Fuel/Tech Registration Fee	$3
CVRA Auto Theft Deterrence/DUI Fee	$2
Reflectorized License Plate Fee	$1
Road Improvement Fee	$100
Total	**$204**

All vehicles registered in California must pay a Transportation Improvement Fee based on the retail price of the vehicle. As of 2021, the fee is $171 for vehicles priced between $35,000 and $60,000, and $192 for vehicles priced above $60,000.

All registered vehicles are assessed a Vehicle License Fee which is equal to the vehicle price multiplied by 0.65 percent and a separate percentage schedule. This separate percentage schedule is shown in Table 50.

Table 50: Vehicle License Fee Decline over Time

Year	1	2	3	4	5	6	7	8	9	10	11+
Percentage	100%	90%	80%	70%	60%	50%	40%	30%	25%	20%	15%

For commercial ICE vehicles, vehicle owners are assessed an annual weight fee based on the vehicle's potential maximum loaded weight. For EVs, the weight fee is based on its unladen weight. The estimated weight fees are shown in Table 51.

Table 51: Weight Fees for Internal Combustion Engine Vehicles and Zero-Emission Vehicles

Weight Class	Diesel Weight Fee	ZEV Weight Fee
Class 2b-3	$210	$266
Class 4-5	$447	$358
Class 6-7	$546	$358
Class 8	$1,270	$358
Class 7-8 Tractor	$2,064	$358

Overall, ZEV's pay lower registration fees over the vehicle's life although it may be higher in the initial years of registration. This difference is greater for heavier vehicles due to the large difference in annual weight fees.

7. Other Costs

This section describes costs that do not fit under upfront costs or operating costs. These include residual values, depreciation, insurance, transitional costs and workforce development, reporting costs, and battery recycling.

a) Residual Values

The residual value represents the value of the vehicle at the point where the initial purchaser sells the vehicle to another party. This value depends on numerous factors including the type of vehicle, its age, and the vehicle's propulsion technology and becomes more significant when modeling vehicle replacement cycles that are less than 12 years. The residual value for a vehicle is calculated using the same methodology described for used vehicles in the subsection titled "New and Used Vehicle Prices." For combustion-powered vehicles, this is the price of the used vehicle when it is sold out of state. This analysis reflects the net change to the initial purchaser of the vehicle. New vehicle sales in California are expected to increase and as a result more used combustion-powered vehicles are sold out of the state. The residual value represents the increase in sales out of state.

Sales between California fleets are not reflected within this analysis as such sales do not represent a net change to the State—the two fleets are exchanging cash for a vehicle asset which represents no net change.

b) Depreciation

Depreciation represents an asset's loss in value over time. This loss can be claimed as an expense and used to decrease a business's tax burden. Vehicles owned and used by businesses can have their depreciation quantified using values provided by the Internal Revenue Service Publication 946 regarding property depreciation which may be recovered when itemizing deductions from taxes.[406] These deductions are referred to as the Modified Accelerated Cost Recovery System and are considered to be cost-savings.

The cost-savings from depreciation can be calculated by multiplying the vehicle's purchase price by the Modified Accelerated Cost Recovery System depreciation rate and the corporate tax rate. Per the Internal Revenue Service Publication, most trucks follow a 5-year depreciation schedule while tractors follow a 3-year deprecation schedule. ZEVs and combustion-powered vehicles use the same depreciation rates. The amount of deprecation year-over-year is shown in Table 52.

Table 52: Depreciation Rate by Age

Age	0	1	2	3	4	5	6+
Truck	20.00%	32.00%	19.20%	11.52%	11.52%	5.76%	0%
Tractor	33.33%	44.45%	14.81%	7.41%	0%	0%	0%

The vehicle value depreciated per year is multiplied by the corporate tax rate to determine the amount of tax savings per year. The California corporate tax rate is 8.84 percent, and the

[406] Internal Revenue Service, *Publication 946 (2020), How To Depreciate Property*, 2020 (web link: https://www.irs.gov/pub/irs-pdf/p946.pdf, last accessed August 2022).

federal corporate tax rate is 21 percent.[407,408] State and local government fleets are not assumed to claim depreciation as they do not pay State or federal taxes.

c) Insurance

Fleets purchase insurance policies to protect against financial loss and a variety of unexpected events including damaging other property, damage to the vehicle, medical coverage in the event of an accident, and other situations. Because ZEVs are anticipated to cost more than their combustion-powered counterparts, vehicle coverage is anticipated to be more costly as well.

Table 53 shows the estimated cost of various insurance coverage components based on several sources staff identified.[409,410,411]

Table 53: Estimated Annual Semi-Truck Insurance Policy Costs

Types of Insurance Coverage	Policy Cost
Primary Liability	$6,000
General Liability	$550
Umbrella Policy	$600
Physical Damage	$2,000
Bobtail Insurance	$375
Uninsured/Underinsured Motorist	$75
Occupational Accident	$1,900

Physical damage is the only coverage element that depends on the cost of the vehicle being operated. The other coverage types are not dependent on the cost of the vehicle. For example, if truck were to crash into a signpost, the cost of the truck would not affect the cost of paying to replace the signpost.

By dividing the "Physical Damage" by the sleeper cab vehicle cost in Table 34, this portion is found to represent coverage costs 1/70th of the price of a new semi-truck; for the purpose of this analysis, staff assumes the "Physical Damage" insurance cost is proportional to 1/70th the cost of the vehicle when new. Insurance costs for a vehicle decline over time as the value of the vehicle decreases. Staff assumes the insurance costs decline at the same rate as shown in subsection "New and Used Vehicle Prices" on page 181.

407 Franchise Tax Board, *Business Tax Rates*, 2021 (web link: https://www.ftb.ca.gov/file/business/tax-rates.html, last accessed August 2022).
408 Internal Revenue Service, *Publication 542, Corporation*, 2021 (web link: https://www.irs.gov/publications/p542, last accessed August 2022).
409 Forerunner Insurance Group, *What does Average semi truck insurance costs for owner operators?*, 2018 (web link: https://www.forerunnerinsurance.com/what-does-average-semi-truck-insurance-costs-for-owner-operators/, last accessed August 2022).
410 Commercial Truck Insurance HQ, *Average Semi Truck Insurance Cost*, 2019 (web link: https://www.commercialtruckinsurancehq.com/average-semi-truck-insurance-cost, last accessed August 2022).
411 Strong Tie Insurance, *Why You Need a Commercial Semi Truck Insurance Coverage*, 2021 (web link: https://www.strongtieinsurance.com/semi-truck-insurance/, last accessed August 2022).

d) Transitional Costs and Workforce Development

Transitioning to a new technology has inherent costs associated with its deployment, including shifts in operational and maintenance practices. These recurring costs include operator and technician trainings, purchasing and upgrading of software, securing additional spare parts, and others.

Limited information is available for this type of transitional cost, but discussions regarding this topic occurred during the development of the ICT regulation. Based on discussions with transit agencies, staff assumes that these "other costs" associated with ZEB deployments are equivalent to 2.5 percent of bus prices for all powertrains and should go down over time for ZEBs as they become more common.[412]

In the cost analysis for the proposed ACF regulation, staff make similar assumptions that the workforce training and transitional costs are equal to 2.5 percent of the incremental cost difference between a baseline combustion vehicle and a ZEV, given that the transitions transit agencies will be making are similar to changes made by trucking fleets. These costs continue until 2030 at which point the technology will have developed to a point where these transitional costs become BAU for trucking fleets.

e) Reporting Costs

Fleets subject to the proposed ACF regulation would need to report information annually to demonstrate compliance. Reporting would include company contact information, vehicle registration information, and engine family numbers for tractors approaching the end of their useful life. Staff estimates that to report annually, a fleet of 50 vehicles would need an average of 12.5 hours and would be proportionally longer based on the number of vehicles. Staff anticipates most fleets would already have the information requested available in databases. This time estimate includes collecting information from vehicles, placing the information into a spreadsheet, verifying the information, and reporting it into a CARB database. The hourly staffing cost is assumed to be $24.13 per hour for the employee assigned to pull the information.[413]

Staff does not expect additional reporting costs for manufacturers as a result of the 2040 100 percent medium- and heavy-duty ZEV sales requirement. Manufacturers are already required to report information to CARB under the ACT regulation. This new 100 percent sales for all Class 2b-8 vehicles requirement will not increase the amount of information reported and as a result will not have an incremental cost over the Legal Baseline.

f) Battery Recycling, Repurposing, and Disposal

The energy capacity of the batteries used in ZEVs will naturally degrade over their useful lives and require battery replacements. When battery capacity is not sufficient for meeting daily range needs for a truck or bus, it is expected that there will be a second life for the batteries.

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[412] Transit Agency Subcommittee-Lifecycle Cost Modeling Subgroup, Report of Findings, 2017.
[413] U.S. Bureau of Labor Statistics, *Occupational Outlook Handbook – Diesel Service Technicians and Mechanics*, 2021 (web link: https://www.bls.gov/ooh/installation-maintenance-and-repair/diesel-service-technicians-and-mechanics.htm, last accessed August 2022).

Used batteries can be repurposed into other applications such as stationary storage, then at the end of those battery lives can be recycled and non-recyclable materials can be disposed.

The cost for battery recycling at the end of battery life is not included here, because this cost could be offset by the residual value of the battery. The end of life may be a revenue source depending on whether the battery can be recycled and repurposed or could become a cost if it must be disposed of. Light-duty vehicle batteries are already being repurposed for second life applications including stationary storage.[414,415] Even today, some lithium-ion battery manufacturers provide an attractive residual value to customers upon the retirement of a battery. Therefore, staff believes that the residual value will offset the recycling cost and become a revenue source, but does not include a residual battery value in the economic analysis.

8. Total Costs

The proposed ACF regulation would increase the number of medium- and heavy-duty ZEVs purchased in California relative to the Legal Baseline scenario. This means that all costs would be above and beyond the costs already expected with the ACT regulation. The increased ZEVs sales have higher upfront capital costs initially for the vehicle and infrastructure investments, but lower operating costs over time resulting in net savings for truck transportation in California. When assuming all costs are borne by fleets operating in California the proposed ACF regulation results in a net cost of -$22.2 billion between 2020 and 2050 compared to the Legal Baseline scenario. This represents a substantial net decrease in costs and does not include indirect health cost-savings. In other words, the proposed ACF regulation is projected to result in net cost savings to California. Figure 69 and Table 54 illustrates the incremental difference in costs between the proposed ACF regulation and the Legal Baseline scenario. Note that the incremental cost increases and decreases are mainly due to the number of ZEVs purchased in a given time frame, the actual incremental cost of ZEVs is declining steadily over this timeframe. In Figure 69, the cost components are grouped as shown in Table 54.

Table 54: Summarized Cost Items

Cost Category	Components
Vehicle Cost	Vehicle Cost, Sales Tax, Federal Excise Tax, Residual Values
Fuel Cost	Gasoline, Diesel, Electricity, Hydrogen Fuel Cost, Fuel Taxes
LCFS Revenue	LCFS Revenue
Infrastructure	Charger Costs, Infrastructure Upgrades, Charger Maintenance
Maintenance	Vehicle Maintenance Costs, Maintenance Bay Upgrades
Midlife	Midlife Costs
Other	DEF Consumption, Registration Fees, Depreciation, Insurance, Transitional Costs, Reporting Costs

[414] Nissan Motor Corporation, *Nissan LEAF batteries to light up Japanese town*, 2018 (web link: https://newsroom.nissan-global.com/releases/180322-01-e?lang=en-US&la=1&downloadUrl=%2Freleases%2F180322-01-e%2Fdownload, last accessed August 2022).

[415] BMW Group, BMW Group, *Northvolt and Umicore join forces to develop sustainable life cycle loop for batteries* (web link: https://www.press.bmwgroup.com/global/article/detail/T0285924EN/bmw-group-northvolt-and-umicore-join-forces-to-develop-sustainable-life-cycle-loop-for-batteries, last accessed August 2022).

Figure 69: Total Estimated Direct Costs of Proposed ACF Regulation Relative to the Legal Baseline Scenario (Million 2021$)

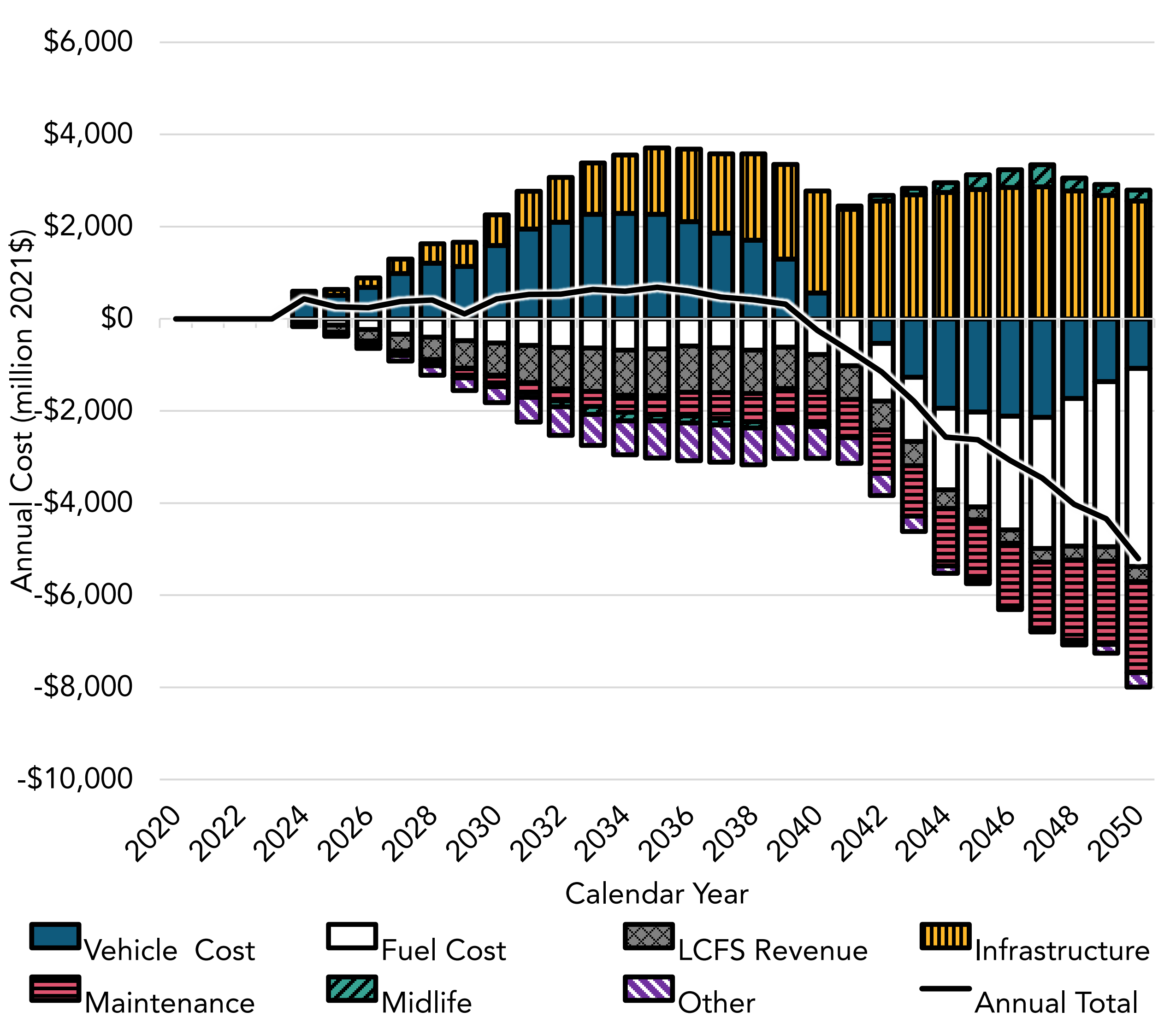

Table 55: Total Incremental Direct Costs of Proposed ACF Regulation Relative to Legal Baseline Scenario (Million 2021$)

Year	Vehicle Price	Sales and Excise Tax	EVSE & Infrastructure Installation	Maintenance Bay Upgrades	Fuel Cost	DEF Consumption	LCFS Revenue	Maintenance Cost	Midlife Costs	Registration Fees	Transitional Costs	Residual Values	Depreciation	Insurance Cost	Reporting Cost	Total Costs	Total Savings	Total*
2024	$374	$128	$68	$18	-$73	-$1	-$83	-$28	-$4	$2	$47	$0	-$33	$12	$3	$652	-$222	**$426**
2025	$447	$73	$124	$12	-$140	-$3	-$152	-$57	-$7	-$3	$31	-$9	-$79	$15	$3	$706	-$450	**$253**
2026	$612	$145	$205	$18	-$236	-$5	-$249	-$94	-$14	-$11	$40	-$79	-$119	$22	$3	$1,045	-$806	**$236**
2027	$939	$264	$311	$82	-$333	-$9	-$368	-$149	-$28	-$23	$62	-$221	-$186	$33	$3	$1,696	-$1,318	**$374**
2028	$1,104	$195	$423	$92	-$401	-$13	-$482	-$193	-$39	-$34	$63	-$94	-$256	$37	$3	$1,917	-$1,512	**$402**
2029	$1,216	$329	$530	$84	-$474	-$18	-$600	-$237	-$57	-$48	$58	-$412	-$315	$49	$3	$2,268	-$2,162	**$103**
2030	$1,620	$402	$665	$135	-$529	-$25	-$695	-$302	-$82	-$64	$76	-$435	-$404	$62	$4	$2,965	-$2,535	**$427**
2031	$2,004	$442	$822	$155	-$581	-$32	-$805	-$368	-$106	-$83	$0	-$497	-$500	$75	$4	$3,501	-$2,973	**$524**
2032	$2,183	$373	$977	$159	-$625	-$38	-$891	-$426	-$128	-$101	$0	-$463	-$566	$81	$4	$3,776	-$3,239	**$533**
2033	$2,367	$273	$1,115	$148	-$640	-$43	-$938	-$472	-$174	-$119	$0	-$371	-$591	$79	$4	$3,986	-$3,349	**$634**
2034	$2,434	$378	$1,266	$181	-$683	-$51	-$975	-$552	-$191	-$146	$0	-$526	-$622	$84	$4	$4,347	-$3,745	**$598**
2035	$2,431	$393	$1,439	$216	-$659	-$60	-$1,010	-$631	-$134	-$175	$0	-$558	-$661	$88	$4	$4,571	-$3,888	**$680**
2036	$2,102	$239	$1,572	$179	-$595	-$67	-$1,002	-$693	-$151	-$201	$0	-$230	-$638	$82	$4	$4,178	-$3,576	**$598**
2037	$1,866	$252	$1,719	$203	-$629	-$75	-$975	-$765	-$142	-$231	$0	-$259	-$578	$77	$4	$4,120	-$3,653	**$463**
2038	$1,733	$247	$1,879	$225	-$683	-$83	-$940	-$838	-$132	-$262	$0	-$277	-$534	$73	$4	$4,162	-$3,749	**$409**
2039	$1,384	$178	$2,052	$244	-$620	-$90	-$892	-$885	-$103	-$285	$0	-$265	-$474	$65	$4	$3,927	-$3,613	**$310**
2040	$539	-$170	$2,215	$294	-$779	-$97	-$815	-$995	-$45	-$310	$0	$191	-$319	$35	$4	$3,279	-$3,530	**-$256**
2041	$40	-$137	$2,375	$305	-$1,019	-$105	-$728	-$1,134	$72	-$341	$0	$93	-$132	$14	$4	$2,903	-$3,597	**-$698**
2042	-$459	-$113	$2,556	$332	-$1,253	-$114	-$633	-$1,268	$120	-$370	$0	$39	$2	-$2	$4	$3,054	-$4,211	**-$1,162**
2043	-$1,308	-$437	$2,693	$227	-$1,398	-$117	-$522	-$1,322	$138	-$380	$0	$476	$189	-$29	$4	$3,728	-$5,514	**-$1,790**
2044	-$1,978	-$373	$2,741	$170	-$1,776	-$120	-$402	-$1,416	$210	-$398	$0	$410	$402	-$47	$4	$3,937	-$6,509	**-$2,576**
2045	-$2,050	-$292	$2,806	$201	-$2,062	-$125	-$280	-$1,508	$318	-$414	$0	$317	$515	-$54	$4	$4,161	-$6,786	**-$2,629**
2046	-$2,123	-$245	$2,850	$208	-$2,473	-$129	-$287	-$1,589	$385	-$427	$0	$254	$561	-$58	$0	$4,258	-$7,333	**-$3,075**
2047	-$2,147	-$191	$2,866	$205	-$2,848	-$134	-$296	-$1,666	$478	-$439	$0	$201	$573	-$58	$0	$4,323	-$7,780	**-$3,457**
2048	-$1,751	-$149	$2,771	$0	-$3,205	-$139	-$305	-$1,738	$285	-$451	$0	$171	$541	-$56	$0	$3,768	-$7,794	**-$4,026**
2049	-$1,404	-$120	$2,679	$0	-$3,583	-$144	-$315	-$1,803	$234	-$461	$0	$158	$468	-$53	$0	$3,539	-$7,882	**-$4,343**
2050	-$1,128	-$92	$2,557	$0	-$4,302	-$155	-$329	-$1,976	$234	-$499	$0	$144	$389	-$49	$0	$3,324	-$8,530	**-$5,206**
Total*	**$11,046**	**$1,992**	**$44,275**	**$4,095**	**-$32,598**	**-$1,993**	**-$15,969**	**-$23,106**	**$937**	**-$6,274**	**$377**	**-$2,240**	**-$3,366**	**$579**	**$83**	**$63,384**	**-$85,547**	**-$22,163**

*Note: Totals may differ due to rounding.

Further detailed information on the costs of the different fleets subject to the proposed ACF regulation versus the Legal Baseline are discussed in more detail in the Additional Cost Information Appendix.

Deploying more medium- and heavy-duty ZEVs due to the proposed ACF regulation would result in a net decrease in costs to the California economy. Fleets would be expected to have higher vehicle costs and infrastructure expenses, but would also save money overall on fuel, LCFS revenue, maintenance savings, increased depreciation benefits, and other factors. Despite these potential savings, some fleets remain reluctant in shifting to ZEV technology.

The issues affecting decision-making regarding ZEVs are being analyzed in numerous reports.[416] Common themes identified include:

- **High vehicle upfront costs.** Today, a ZEV can range from 20 percent higher cost to as much as 2 to 3 times more than a similar conventional vehicle. While these costs are anticipated to decline, the higher upfront cost of ZEVs can place a barrier in vehicle purchasing patterns. These costs are often a more significant barrier to smaller fleets with limited access to capital and higher borrowing costs. A combination of declining costs, incentives, and innovative financing models can defray these upfront investments and reduce the impact of these issues.
- **Inertia of combustion-powered vehicles**. Diesel and gasoline vehicles enjoy an inherent advantage versus newer technologies solely due to their established footprint in the market. Business models, duty cycles, agreements, and other core business practices are based on the established trends of fossil fuel powered vehicles. Fleets would need to spend additional time and resources planning for a transition to ZEV technologies that does not exist when staying with the status quo.
- **Uncertainty and lack of data.** Fleets have a wealth of information available about how their existing vehicles operate based on historical data which has been gathered for decades. Information on medium- and heavy-duty ZEVs such as prices, residual values, battery deterioration, fuel economy, maintenance, and other factors are not as readily available for fleets. This information gap creates challenges in the decision-making process for fleets.
- **One-to-one replacement.** Fleets have voiced concerns that a ZEV would not be able to perform the same work as an existing combustion-powered vehicle on a one-to-one basis due to payload, mileage, or other issues for every duty cycle. However, from the fleet operational data we collected, we see that ZEVs can meet most daily needs on a one-to-one basis today provided the ZEV is placed in applications where it is suitable. The regulation is also phased-in in a manner that recognizes the vehicle types and applications that are already well suited to electrification and that technology will continue to advance. As the technology continues to improve, more applications can transition to ZE without compromise. The proposed ACF regulation schedules are designed to match projected vehicle capabilities and includes provisions to address situations where a ZEV is not available or where a given ZEV cannot meet the fleet owner's duty cycle needs.

[416] Electrification Coalition, *Electrifying Freight: Pathways to Accelerating the Transition*, 2020 (web link: https://www.electrificationcoalition.org/wp-content/uploads/2020/11/Electrifying-Freight-Pathways-to-Accelerating-the-Transition.pdf, last accessed August 2022).

- **Electricity rate structures.** Typical commercial and industrial rate structures are not always optimized for medium- and heavy-duty electrification. These rates have been traditionally designed for steady electricity usage with high fixed loads, not the intermittent usage associated with ZEV charging. This can result in higher electricity costs for fleets that are charging their vehicles in low-duration, high-power sessions if charger utilization is low. In response to these issues, the state's three largest IOUs, PG&E, SCE, and SDG&E, have all proposed commercial ZEV electricity rates. These new rates address issues that fleets are currently facing and will lower the cost of charging for ZEVs. This makes them a more competitive option versus their combustion counterparts. Further efforts are being made by the public utilities.
- **Stranded assets.** Fleets who have made investments in combustion-powered vehicles and infrastructure installed at their facilities want to ensure they can use their assets for the time period set forth in Health and Safety Code Section 43021(a). Some fleets who have made investments into on-site fueling infrastructure include refuse fleets and public fleets who have installed CNG infrastructure. The proposed ACF regulation allows fleets to keep their vehicles for their full useful life as defined SB 1, which ensures existing vehicles and their supporting infrastructure can be used until the end of that asset's lifetime. [417] To the degree fleets opt to retire or replace vehicles early, they would be doing so because they view that course as the superior economic compliance choice. Similarly, staff does not foresee stranded assets issues for digesters built to comply with SB 1383 since the CNG vehicles and RNG fueling infrastructure can be used throughout their useful lives.[418] Similarly, for BEV charging infrastructure and consistent with other studies, a useful life of 20 years is assumed for CNG fueling infrastructure.[419,420] Additionally, CPUC's SB 1440[421] decision directs RNG towards other sectors; aligning with strategies identified in the 2022 Scoping Plan Update (draft). Finally, future revenue sources such as CPUC's potential "Renewable Gas Standard" could play an important role in providing long-term certainty for the RNG market. Therefore, economic impacts of asset "stranding" are not likely to occur as no assets would be immediately stranded. Similarly, staff does not foresee stranded assets issues for digesters built to comply with SB 1383 since the CNG vehicles and RNG fueling infrastructure can be used throughout its useful life.
- **Infrastructure planning and installation.** Switching from primarily diesel and gasoline to ZE technologies represents a significant shift for fleets. ZEVs require a different refueling strategy to fleets that can be a challenge with insufficient planning. Some issues identified include lead times for construction and interconnection, grid reliability, accommodating site layout and parking considerations, and site load management. However, numerous efforts are underway to address these issues. Under direction of SB 350, CPUC has approved applications from the state's IOUs for

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[417] SB 1 (Beall, Stats. 2017, ch. 5).
[418] SB 1383 (Lara, Stats. 2016, ch. 395).
[419] National Renewable Energy Laboratories. March 2015. Building a Business Case for Compressed Natural Gas in Fleet Applications. (web link: *https://afdc.energy.gov/files/u/publication/business_case_cng_fleets.pdf*, last accessed August 2022).
[420] Clean Fuel Connection. Permitting CNG and LNG Stations Best Practices Guide for Host Sites and Local Permitting Authorities. (web link: *https://www.baaqmd.gov/~/media/files/strategic-incentives/alt-fuels/cng-and-lng-best-practices-9-30-14-final.pdf*, last accessed August 2022).
[421] SB 1440 (Hueso, Stats. 2018 ch. 739).

nearly $700 million over 5 years to support utility investments in medium-duty, heavy-duty, and off-road vehicle electrification.[422] These programs will provide utility experience in delivering power to fleet's locations. CEC's EnergIIZE program launched in early 2022 will provide a streamlined source of funding to commercial fleets and fuel providers for charging and hydrogen fueling infrastructure over the next few years. Private companies have also formed to streamline the process of fleet electrification by offering an all-in-one package to fleets. These programs are not included in the staff cost analysis and would lower the actual cost to fleets.

9. Cost-Effectiveness

Overall, the proposed ACF regulation would result in significant emissions reductions, but the net costs are lower than the Legal Baseline. For this reason, the costs and benefits are compared as a benefit-cost ratio. Costs are all cost elements listed in Table 55 with a positive costs and cost-savings are all cost elements with a negative cost i.e., a savings. Changes to costs due to taxes and fees are removed from benefits as these savings to fleets are a cost to government, resulting in no net benefit. The benefit-cost ratio is the then calculated by taking the ratio of total benefit and total cost. Table 56 shows the estimated benefit-cost ratio for the proposed ACF regulation.

Table 56: Benefit-Cost Ratio of the Proposed ACF Regulation (billion $2021)

Regulation	Total Costs	Cost-Savings (benefit)	Health Benefits	Tax and Fee Revenue	Total Benefit*	Net Benefit**	Benefit-Cost Ratio
Proposed ACF regulation	$63.4	$85.5	$57.8	-$33.0	$110.3	$46.9	1.7

*Total benefit is the sum of cost savings, health benefits, and tax and fee revenue.
**Net benefit is the total benefit minus the total costs.

C. Fiscal Impacts

The proposed ACF regulation would impact State and local government expenditures through the purchase and operation of new vehicles and would impact revenues generated from a variety of State and local taxes and vehicle registration fee revenues that are collected.

These revenues, particularly those from State and local gasoline taxes and registration fees, are used to fund transportation projects across the state including road maintenance, construction of state highways and local streets, transit facilities and operation, and active transportation projects as described in Table 57 below. Thus, increases or decreases would impact funds available for these projects at the state, county, and local levels for use on road and transportation infrastructure improvements. We note that, though outside of this specific analysis, the transition towards ZEVs and its impacts on some of these revenues, are the subject of continued policy development given the importance of the services funded. Thus,

[422] SB 350 (De León, Stats. 2015, ch. 547).

though this analysis does not assume the creation of new specific revenue-raising measures, such measures, such as roadway pricing strategies, are not unlikely. For example, one of the key actions listed in the Climate Action Plan for Transportation Infrastructure is to convene a Roadway Pricing Working Group to create an inventory of various ongoing efforts across the state and outline state and federal statutory and administrative opportunities and barriers to equitable implementation of various roadway pricing applications currently under consideration by local and regional partners — including, but not limited to, cordon pricing, congestion pricing, and other dynamic pricing tools.[423] Additionally, the 2022 Scoping Plan Update lists actions such as permitting implementation of a suite of roadway pricing strategies by 2025 in support of adopted Sustainable Communities Strategies.[424]

Table 57: Transportation Funding Source and Purpose

Revenue Source and Account/Program	Allocation Funding Purpose
Gasoline Excise Tax—State Highway Account	highway projects and transportation maintenance and operational needs
Gasoline Excise Tax—Road Maintenance and Rehabilitation Account	prioritized road maintenance and rehabilitation projects for State and local transportation systems
Gasoline Excise Tax—Highway Users' Tax Account	local streets and roads projects
Diesel Excise Tax—Public Transportation Account	transit and intercity and commuter rail operating programs and projects.
Diesel Excise Tax—Road Maintenance and Rehabilitation Account	prioritized road maintenance and rehabilitation projects for the State and local transportation systems.
Diesel Excise Tax—State Highway Account	highway projects and transportation maintenance and operational needs.
Diesel Excise Tax—Trade Corridors Enhancement Account	trade corridor projects
State Sales Tax (Diesel)—State Transit Assistance	transit purposes as outlined in the Transportation Development Act; local transit operation and capital purposes
State Sales Tax (Diesel)—State Rail Assistance Program	intercity and commuter rail agencies for operation and capital purposes
Zero-Emission Vehicle Registration Fee—Road Maintenance and Rehabilitation Account	basic road maintenance, rehabilitation, critical safety projects and other transportation initiatives, including complete street components for the State and local transportation systems

[423] CAPTI. March 2021. Climate Action Plan for Transportation Infrastructure (web link: *https://calsta.ca.gov/-/media/calsta-media/documents/capti-2021-calsta.pdf*, last accessed August 2022).
[424] California Air Resources Board, *California's 2022 Climate Change Scoping Plan*, Appendix E: Sustainable Communities, 2022 draft (web link: *https://ww2.arb.ca.gov/sites/default/files/2022-05/2022-draft-sp-appendix-e-sustainable-and-equitable-communities_0.pdf*, last accessed August 2022).

Revenue Source and Account/Program	Allocation Funding Purpose
Motor Vehicle Registration Fees—California Highway Patrol and Department of Motor Vehicles	traffic law enforcement and regulations
Local Sales Tax Measures[425]—City/County Road Funds	Maintenance, new construction, engineering/administration, right of way, mass transit, and other
Local Sales Tax Measures—Regional Transportation Planning Agencies/Transit Operators	transit operations, transit planning

1. Fiscal Impacts to Local Government

This section describes the fiscal impact of the proposed ACF regulation to local government agencies. This includes the individual cost elements and the total fiscal impact.

a) Local Government Fleet Cost Passthrough

The local government fleet is estimated to make up roughly 81 percent of California's public fleet based the total public fleet population and information from the Department of General Services.[426] All local government fleets are subject to the proposed ACF regulation with requirements beginning for most fleets in 2024. Fleets located in designated counties would face their first requirements in 2027. A proportionate amount of the total costs outlined in Table 55 would be assumed to pass-through to local governments. Cost passthrough has been split into three categories—upfront costs, operating costs, and operating savings.

b) Utility User Taxes

Many cities and counties in California levy a Utility User Tax on electricity usage. This tax varies from city to city and ranges from no tax to 11 percent. A value of 3.53 percent was used in this analysis representing a population-weighted average.[427] By increasing the amount of electricity used, there would be an increase in the amount of the utility user tax revenue collected by cities and counties.

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[425] Counties can adopt a sales tax increase for transportation programs. The passage of a local sales tax measure requires 2/3 of local voter approval, generally lasting 20 to 30 years. Twenty-five counties have implemented sales tax measures for their transportation needs; and 4 transit authorities have approved permanent local tax measures.

[426] Department of General Services, *California State Fleet, 2015-2021*, 2022 (web link: https://data.ca.gov/dataset/1b31c08e-b1a7-4459-8aef-41cfff61fc5e/resource/362ad8ca-1b50-4542-88e5-5973cf729c7f/download/fleet-asset-management-system-open-data-2015-2021.csv, last accessed August 2022).

[427] California State Controller's Office, *User Utility Tax Revenue and Rates*, 2017 (web page: https://sco.ca.gov/Files-ARD-Local/LocRep/2016-17 Cities UUT.pdf, last accessed August 2022).

c) Gasoline and Diesel Fuel Taxes

Fuel taxes on gasoline and diesel fund transportation improvements at the state, county, and local levels. Displacing gasoline and diesel with electricity and hydrogen would decrease the total amount of gasoline and diesel dispensed in the state, resulting in a reduction in fuel tax revenue collected by local governments. Natural gas is not taxed by local governments and therefore is not included in this section. The local tax on fuel is listed in Table 58.

d) Local Sales Taxes

Sales taxes are levied in California to fund a variety of programs at the State and local level. The proposed ACF regulation would require the sale of medium- and heavy-duty ZEVs in California resulting in a direct increase in sales tax revenue collected by local governments in the initial years of the regulation. Overall, local sales tax revenue may increase less than the direct increase from vehicle sales if overall business spending does not increase.

e) Fiscal Impacts on Local Government

Table 58 shows the estimated fiscal cost to local governments due to the proposed ACF regulation relative to the Legal Baseline scenario. The fiscal impact to local government is estimated to be $234 million over the first 3 years of the regulation and $3.6 billion over the regulatory analysis period to 2050. These costs are not reimbursable pursuant to Section 6 of Article XIII B of the California Constitution and Part 7 (commencing with Section 17500) of Division 4 of the Government Code. These costs are not reimbursable because this action neither compels local agencies to provide new governmental functions (i.e., it does not require such agencies to provide additional services to the public), nor imposes requirements that apply only on local agencies or school districts.[428] Instead, this regulatory action establishes requirements that apply to all individuals and entities that own or operate regulated vessels and facilities. This action also does not compel local agencies to increase the actual level or quality of services that they already provide the public.[429] For the foregoing reasons, any costs incurred by local agencies to comply with this regulatory action are not reimbursable.[430]

Table 58: Estimated Fiscal Impacts to Local Government (Million 2021$)

Year	Local Government Fleet Upfront Cost Passthrough	Local Government Fleet Operational Cost Passthrough	Local Government Fleet Operational Saving Passthrough	Utility User Tax Revenue	Local Gasoline and Diesel Fuel Taxes	Local Sales Tax	Total Fiscal Impact*
2024	-$93	-$10	$27	$4	$92	$59	$80
2025	-$95	-$10	$56	$8	$84	$19	$63
2026	-$103	-$11	$83	$14	$73	$34	$91
2027	-$164	-$21	$128	$22	$59	$61	$85

[428] County of Los Angeles v. State of California (1987) 43 Cal.3d 46, 56.
[429] San Diego Unified School Dist. v. Commission on State Mandates (2004) 33 Cal.4th 859, 877.
[430] County of Los Angeles v. State of California, 43 Cal.3d. 46, 58.

Year	Local Government Fleet Upfront Cost Passthrough	Local Government Fleet Operational Cost Passthrough	Local Government Fleet Operational Saving Passthrough	Utility User Tax Revenue	Local Gasoline and Diesel Fuel Taxes	Local Sales Tax	Total Fiscal Impact*
2028	-$165	-$21	$170	$30	$47	$39	$100
2029	-$154	-$21	$206	$41	$30	$84	$186
2030	-$148	-$20	$216	$57	$8	$99	$211
2031	-$150	-$12	$237	$75	-$15	$109	$245
2032	-$148	-$14	$255	$93	-$36	$95	$245
2033	-$146	-$15	$267	$111	-$55	$72	$233
2034	-$145	-$17	$271	$132	-$80	$96	$258
2035	-$143	-$17	$274	$158	-$107	$97	$262
2036	-$146	-$18	$292	$180	-$130	$44	$221
2037	-$149	-$19	$293	$202	-$156	$49	$220
2038	-$152	-$19	$294	$224	-$182	$46	$212
2039	-$155	-$19	$313	$247	-$204	$29	$211
2040	-$158	-$19	$310	$270	-$236	-$65	$103
2041	-$160	-$18	$303	$294	-$272	-$51	$97
2042	-$161	-$18	$299	$320	-$308	-$47	$84
2043	-$163	-$18	$295	$334	-$326	-$116	$5
2044	-$152	-$19	$288	$340	-$344	-$99	$14
2045	-$143	-$19	$280	$353	-$363	-$79	$29
2046	-$136	-$20	$284	$364	-$386	-$65	$40
2047	-$118	-$21	$285	$374	-$408	-$52	$61
2048	-$101	-$21	$289	$384	-$428	-$41	$83
2049	-$88	-$21	$294	$395	-$449	-$33	$98
2050	-$74	-$22	$298	$413	-$488	-$26	$101
Total	**-$3,708**	**-$479**	**$6,607**	**$5,439**	**-$4,577**	**$357**	**$3,638**

*Note: Totals may differ due to rounding.

2. Fiscal Impacts to State Government

This section describes the fiscal impact of the proposed ACF regulation to the State government. This includes the individual cost elements and the total fiscal impact.

a) CARB Staffing and Resources

To implement the proposed ACF regulation, CARB would require permanent staffing resources. CARB estimates 32.5 positions and $2,000,000 in contract funding would be necessary to implement the proposed ACF regulation. CARB requests 1.25 Air Resources Supervisor II (ARS II), 1.25 Office Technicians, 4 Air Resources Supervisor I (ARS I), 3 Air Resources Engineers (ARE), 9 Air Pollution Specialists (APS), 3 Air Resources Technician I (ART I), and 11 Air Resources Technician II (ART II) for a total of 32.5 new positions to carry out duties associated with the implementation of the proposed ACF regulation.

The proposed ACF regulation affects various fleets with differing requirements. It would need subject matter experts to perform tasks as follows totaling 32.5 positions. Resource needs are estimated based on past experience implementing the Truck and Bus regulation from 2010 to present.

- 1.25 ARS II to oversee section managers with staff performing ACF tasks.
- 1.25 Office Technician to provide administrative support for affected branches.
- 4 ARS I to oversee ACF program implementation.
- 1 personnel year (PY) (ART II) for funding coordination, compliance checks, and implementation of the ZEV Partner Program.
- 1 PY (APS) solely dedicated for outreach.
- 1 PY (APS) handling expert compliance assistance calls, emails, letter responses, outreach materials, presentations, training, and website updates.
    - This includes remediation to meet ADA requirements.
- 6 PYs (3 ART I and 3 ART II) to reply to reporting system emails.
    - This includes initial assessment for all extension/exemption requests.
- 4 PYs (2 ARE and 2 APS) for compliance verification, TRUCRS system improvements, maintenance, and testing.
- 1 PY (APS) for compliance tool creation and maintenance, procedure development, form creation and updates, and assigned projects.
- 1 PY (ART II) for enforcement coordination (e.g., citations, audits, registration holds, and enforcement database checks).
- 1 PY (APS) for DMV data analyses to ensure compliance and respond to data requests, including those through Public Records Act.
- 3 PY (1 ARE, 1 APS, and 1 ART II) for processing extension/exemption requests.
- 7 PY (2 APS and 5 ART II) to implement the drayage portion of the ACF regulation.
    - Assist fleet representatives with CARB registration.
    - Verify annual compliance reporting requirements for the legacy fleet.
    - Provide technical assistance, answer calls and emails.
    - Analyze reported data sets.
    - Maintain an updated CARB Online System for drayage trucks.

Table 59 shows the total number of additional positions and estimated cost per position.

Table 59: Estimated CARB Staffing Needs (Million 2021$)

Position	Number of Positions	Initial Budget Year Cost ($/year per person)	Ongoing Cost ($/year per person)
Air Resources Supervisor II	1.25	$280,000	$279,000
Air Resources Supervisor	4	$256,000	$255,000
Air Resources Engineer	3	$220,000	$219,000
Air Pollution Specialist	9	$211,000	$210,000
Air Resources Technician II	11	$105,000	$104,000
Air Resources Technician I	3	$87,000	$86,000
Office Technician	1.25	$97,000	$96,000

In addition to staffing needs, the proposed ACF regulation would require modifying two separate reporting systems to handle reporting for the new regulations to verify and track compliance as the requirements are phased in. Staff is estimating $2,000,000 in FY 2023-2024 to upgrade two existing reporting systems and to convert them to a Salesforce system (cloud) environment. Beginning FY 2024-2025 there would be an ongoing $400,000 for maintenance and ongoing fees to run the two systems. The Truck Regulations Upload and Compliance Reporting System would be updated to reflect the new requirements for fleets subject to the proposed ACF regulation requirements for high priority and federal fleets and for State and local government fleets. The upgraded drayage reporting system would be used for fleets subject to the proposed ACF regulation requirements for drayage truck fleets and regulated ports and railyards.

To the extent there are changes made to the proposed ACF regulation that increase staff resources or if the resources outlined above are not approved, additional revenue sources such as fleet owner reporting fees might be necessary to implement the proposed ACF regulation.

b) State Fleet Cost Pass-Through

The State government fleet is estimated to make up 19 percent of California's public fleet based the total public fleet population and information from the Department of General Services. [431] A proportionate amount of the total costs outlined in Table 60 would be assumed to pass-through the State governments. Cost passthrough has been split into three categories—upfront costs, operating costs, and operating savings.

c) Gasoline, Natural Gas, and Diesel Fuel Taxes

Fuel taxes on gasoline, natural gas, and diesel are used to fund transportation improvements at the state, county, and local levels. Displacing these combustion fuels with electricity and hydrogen would decrease the total amount of gasoline, natural gas, and diesel dispensed in the state. This would result in a reduction in revenue collected by the State for use in multiple levels of government. As noted above, though outside the scope of this analysis, State policy efforts continue to explore replacement revenue sources in light of the need for the ZE transition and the continuing need to fund vital services.

d) Energy Resources Fee

The Energy Resource Fee is a $0.0003/kWh surcharge levied on consumers of electricity purchased from electrical utilities. The revenue collected is deposited into the Energy Resources Programs Account of the General Fund which is used for ongoing energy programs and projects deemed appropriate by the Legislature, including but not limited to, activities of CEC.

e) Registration Fees

The State collects registration fees to fund transportation improvements at the state, county, and local levels. The fee structure for ZEVs is different from diesel vehicles with some fees

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[431] Department of General Services, *California State Fleet, 2015-2021*, 2022 (web link: https://data.ca.gov/dataset/1b31c08e-b1a7-4459-8aef-41cfff61fc5e/resource/362ad8ca-1b50-4542-88e5-5973cf729c7f/download/fleet-asset-management-system-open-data-2015-2021.csv, last accessed August 2022).

such as the Vehicle License Fee being higher and others such as weight fees being lower. These differences result in lower registration fees for the ZEVs which would reduce revenue collected by the State for use in transportation services.

f) State Sales Tax

Sales taxes are levied in California to fund a variety of programs at the state and local level. This proposed ACF regulation would require the sale of medium- and heavy-duty ZEVs in California resulting in higher sales tax collected by the State government in the initial years of the regulation.

g) Depreciation

In California, the State collects corporate income tax from businesses based on their net profit for the year at a rate of 8.84 percent. Depreciation can be treated as an expense and would reduce the tax burden for a fleet and decrease tax revenue for the State.

h) Fiscal Impacts on State Government

Table 60 shows the estimated fiscal impacts to the State government due to the proposed ACF regulation relative to Legal Baseline conditions. The fiscal impact to the State government is estimated to be -$357 million over the first 3 years of the regulation and -$33.8 billion over the regulatory analysis period to 2050.

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Table 60: Estimated Fiscal Impacts on State Government (Million 2021$)

Year	CARB Staffing and Resources	State Government Fleet Upfront Cost Passthrough	State Government Fleet Operational Cost Passthrough	State Government Fleet Operational Saving Passthrough	State Fuel Taxes	Energy Resources Fees	Registration Fees	State Sales Taxes	Depreciation	Total Fiscal Impact*
2023	-$5	$0	$0	$0	$0	$0	$0	$0	$0	**-$5**
2024	-$6	-$22	-$2	$6	-$27	$0	$2	$50	-$33	**-$32**
2025	-$6	-$22	-$2	$13	-$47	$0	-$3	$16	-$79	**-$130**
2026	-$6	-$24	-$3	$19	-$76	$0	-$11	$29	-$119	**-$190**
2027	-$6	-$39	-$5	$30	-$123	$1	-$23	$52	-$186	**-$299**
2028	-$6	-$39	-$5	$40	-$164	$1	-$34	$33	-$256	**-$430**
2029	-$6	-$36	-$5	$48	-$226	$1	-$48	$71	-$315	**-$516**
2030	-$6	-$35	-$5	$51	-$308	$1	-$64	$83	-$404	**-$686**
2031	-$6	-$35	-$3	$56	-$393	$1	-$83	$92	-$500	**-$871**
2032	-$6	-$35	-$3	$60	-$471	$2	-$101	$80	-$566	**-$1,040**
2033	-$6	-$34	-$4	$63	-$535	$2	-$119	$61	-$591	**-$1,163**
2034	-$6	-$34	-$4	$64	-$628	$2	-$146	$81	-$622	**-$1,292**
2035	-$6	-$34	-$4	$64	-$732	$3	-$175	$82	-$661	**-$1,462**
2036	-$6	-$34	-$4	$68	-$817	$3	-$201	$37	-$638	**-$1,591**
2037	-$6	-$35	-$4	$69	-$911	$3	-$231	$41	-$578	**-$1,652**
2038	-$6	-$36	-$4	$69	-$1,010	$4	-$262	$39	-$534	**-$1,740**
2039	-$6	-$36	-$4	$73	-$1,095	$4	-$285	$24	-$474	**-$1,798**
2040	-$6	-$37	-$4	$73	-$1,196	$4	-$310	-$55	-$319	**-$1,850**
2041	-$6	-$37	-$4	$71	-$1,309	$5	-$341	-$43	-$132	**-$1,797**
2042	-$6	-$38	-$4	$70	-$1,426	$5	-$370	-$40	$2	**-$1,806**
2043	-$6	-$38	-$4	$69	-$1,472	$5	-$380	-$98	$189	**-$1,735**
2044	-$6	-$36	-$4	$68	-$1,516	$5	-$398	-$84	$402	**-$1,569**
2045	-$6	-$34	-$4	$66	-$1,574	$5	-$414	-$67	$515	**-$1,513**
2046	-$6	-$32	-$4	$67	-$1,642	$6	-$427	-$55	$561	**-$1,534**
2047	-$6	-$28	-$5	$67	-$1,707	$6	-$439	-$44	$573	**-$1,583**
2048	-$6	-$24	-$5	$68	-$1,772	$6	-$451	-$35	$541	**-$1,676**
2049	-$6	-$21	-$5	$69	-$1,838	$6	-$461	-$28	$468	**-$1,815**
2050	-$6	-$17	-$5	$70	-$1,985	$7	-$499	-$22	$389	**-$2,070**
Total*	**-$162**	**-$870**	**-$112**	**$1,550**	**-$25,000**	**$88**	**-$6,274**	**$301**	**-$3,366**	**-$33,845**

*Note: Totals may differ due to rounding.

D. Sensitivity Analyses

This chapter provides additional information on how the total direct costs of the proposed ACF regulation, referred to as the "main scenario", would shift by changing various inputs and assumptions. These sensitivity scenarios are not changes to the cost modelling for the main scenario but are intended to provide additional information to stakeholders. Sensitivity scenarios are presented with an increase or decrease of ten percent unless stated otherwise.

1. Higher Combustion Fuel Costs

This sensitivity analysis models a scenario where fuel costs for combustion fuels including diesel, gasoline, and natural gas are ten percent higher than modeled in the main scenario.

2. Lower Combustion Fuel Costs

This sensitivity analysis models a scenario where fuel costs for combustion fuels including diesel, gasoline, and natural gas are ten percent lower than modeled in the main scenario.

3. $6/gal Combustion Fuel Costs

This sensitivity analysis models a scenario where fuel costs for gasoline and diesel are constantly $6/gal.

4. Higher Zero-Emission Vehicle Fuel Prices

This sensitivity analysis models a scenario where fuel costs for ZE fuels including electricity and hydrogen are ten percent higher than modeled in the main scenario.

5. Lower Zero-Emission Vehicle Fuel Prices

This sensitivity analysis models a scenario where fuel costs for ZE fuels including electricity and hydrogen are ten percent lower than modeled in the main scenario.

6. Higher Zero-Emission Vehicle Prices

This sensitivity analysis models a scenario where vehicle costs for battery-electric and FCEVs are ten percent higher than modeled in the main scenario.

7. Lower Zero-Emission Vehicle Prices

This sensitivity analysis models a scenario where vehicle costs for battery-electric and FCEVs are ten percent lower than modeled in the main scenario.

8. Higher Hydrogen Fuel Cell Electric Vehicle Fraction

This sensitivity analysis models a scenario where FCEVs have ten percent higher penetration than modeled in the main scenario. The increase is reflected in Table 61.

Table 61: Modeled Fuel Cell Electric Vehicle Penetration in Higher Hydrogen Fuel Cell Electric Vehicle Fraction Scenario

Vehicle Group	2024-2026	2027 and beyond
All Class 2b-8 non-tractors	10%	20%
Class 7-8 day cab tractors	20%	35%
Class 7-8 sleeper cab tractors	60%	60%

9. Lower Hydrogen Fuel Cell Electric Vehicle Fraction

This sensitivity analysis models a scenario where FCEVs have ten percent higher penetration than modeled in the main scenario. The decrease is reflected in Table 62.

Table 62: Modeled Fuel Cell Electric Vehicle Penetration in Higher Hydrogen Fuel Cell Electric Vehicle Fraction Scenario

Vehicle Group	2024-2026	2027 and beyond
All Class 2b-8 non-tractors	0%	0%
Class 7-8 day cab tractors	0%	15%
Class 7-8 sleeper cab tractors	40%	40%

10. More Retail Refueling for Battery-Electric Vehicles

This sensitivity analysis models a scenario where retail refueling is utilized by ten percent more BEVs than assumed in the main scenario. The increase is reflected in Table 63.

Table 63: Percentage of Retail Refueling for Battery-Electric Vehicles by Weight Class and Year in More Refueling for Battery-Electric Vehicles Sensitivity Analysis

Vehicle Group	**2023-2029**	**2030+**
Class 2b-3	10%	25%
Class 4-5 Straight Truck	10%	25%
Class 6-7 Straight Truck	10%	25%
Class 8 Straight Truck	10%	25%
Class 7-8 Day Cab Tractor	15%	15%
Class 7-8 Sleeper Cab Tractor	65%	65%

11. Less Retail Refueling for Battery-Electric Vehicles

This sensitivity analysis models a scenario where retail refueling is utilized by ten percent less BEVs than assumed in the main scenario. The decrease is reflected in Table 64.

Table 64: Percentage of Retail Refueling for Battery-Electric Vehicles by Weight Class and Year in Less Refueling for Battery-Electric Vehicles Sensitivity Analysis

Vehicle Group	2023-2029	2030+
Class 2b-3	0%	5%
Class 4-5 Straight Truck	0%	5%
Class 6-7 Straight Truck	0%	5%
Class 8 Straight Truck	0%	5%
Class 7-8 Day Cab Tractor	15%	15%
Class 7-8 Sleeper Cab Tractor	65%	65%

12. Higher Low Carbon Fuel Standard Credit Price

This sensitivity analysis models a scenario where LCFS credit prices remain at a value of $200 until 2030, then decline linearly to $100 in 2045 and remaining constant thereafter.

13. Lower Low Carbon Fuel Standard Credit Price

This sensitivity analysis models a scenario where LCFS credit prices remain at a value of $100 until 2030, then decline linearly to $25 in 2045 and remaining constant thereafter.

14. Summary of Results

Table 65 describes the results of the sensitivity analysis.

Table 65: Direct Costs of Proposed ACF Regulation and Sensitivity Scenarios Relative to Legal Baseline Scenario (Million 2021$)

Year	Main Scenario	High Combustion Fuel Costs	Low Combustion Fuel Costs	$6/gal Combustion Fuel Cost	Higher ZEV Fuel Costs	Lower ZEV Fuel Costs	High ZEV Price	Lower ZEV Price	Higher FCEV Fraction	Lower FCEV Fraction	More BEV Retail Fueling	Less BEV Retail Refueling	Higher LCFS Credit Values	Lower LCFS Credit Values
2024	**$426**	$413	$440	$361	$436	$423	$531	$322	$533	$417	$440	$424	$426	$469
2025	**$253**	$227	$279	$134	$271	$247	$367	$139	$326	$225	$277	$243	$253	$332
2026	**$236**	$190	$281	$36	$267	$224	$386	$86	$315	$178	$276	$214	$236	$367
2027	**$374**	$298	$450	$50	$436	$352	$608	$141	$534	$214	$434	$338	$374	$570
2028	**$402**	$300	$504	-$23	$492	$368	$654	$151	$590	$212	$482	$351	$402	$659
2029	**$103**	-$39	$244	-$483	$233	$45	$363	-$157	$313	-$121	$208	$32	$103	$430
2030	**$427**	$231	$622	-$339	$613	$328	$730	$124	$682	$159	$564	$289	$427	$831
2031	**$524**	$273	$776	-$450	$774	$387	$857	$192	$826	$222	$697	$351	$499	$997
2032	**$533**	$230	$836	-$624	$841	$360	$875	$192	$845	$215	$739	$327	$473	$1,058
2033	**$634**	$289	$979	-$684	$994	$431	$987	$281	$926	$331	$868	$400	$530	$1,186
2034	**$598**	$192	$1,004	-$958	$1,027	$351	$984	$212	$903	$285	$864	$332	$440	$1,174
2035	**$680**	$205	$1,154	-$1,138	$1,193	$376	$1,076	$283	$970	$389	$984	$376	$455	$1,279
2036	**$598**	$69	$1,127	-$1,436	$1,177	$237	$963	$233	$846	$357	$930	$266	$301	$1,193
2037	**$463**	-$129	$1,056	-$1,752	$1,110	$51	$828	$99	$672	$247	$821	$106	$85	$1,039
2038	**$409**	-$250	$1,068	-$2,004	$1,126	-$55	$783	$35	$595	$221	$791	$27	-$61	$957
2039	**$310**	-$405	$1,024	-$2,306	$1,096	-$208	$678	-$58	$444	$173	$715	-$95	-$262	$819
2040	**-$256**	-$1,045	$533	-$3,034	$588	-$834	$73	-$585	-$143	-$377	$169	-$681	-$930	$193
2041	**-$698**	-$1,569	$174	-$3,692	$203	-$1,335	-$332	-$1,063	-$650	-$750	-$254	-$1,141	-$1,480	-$318
2042	**-$1,162**	-$2,116	-$207	-$4,391	-$202	-$1,861	-$774	-$1,549	-$1,183	-$1,144	-$700	-$1,624	-$2,063	-$861
2043	**-$1,790**	-$2,782	-$797	-$5,056	-$809	-$2,514	-$1,453	-$2,127	-$1,894	-$1,689	-$1,325	-$2,255	-$2,795	-$1,584
2044	**-$2,576**	-$3,603	-$1,549	-$5,928	-$1,600	-$3,299	-$2,238	-$2,913	-$2,754	-$2,395	-$2,119	-$3,033	-$3,671	-$2,471
2045	**-$2,629**	-$3,698	-$1,561	-$6,135	-$1,642	-$3,367	-$2,269	-$2,989	-$2,893	-$2,357	-$2,173	-$3,085	-$3,830	-$2,629
2046	**-$3,075**	-$4,196	-$1,953	-$6,626	-$2,078	-$3,826	-$2,712	-$3,437	-$3,399	-$2,748	-$2,606	-$3,543	-$4,309	-$3,075
2047	**-$3,457**	-$4,627	-$2,287	-$7,114	-$2,450	-$4,220	-$3,087	-$3,826	-$3,837	-$3,078	-$2,975	-$3,939	-$4,729	-$3,457
2048	**-$4,026**	-$5,243	-$2,809	-$7,808	-$3,008	-$4,801	-$3,609	-$4,442	-$4,501	-$3,551	-$3,530	-$4,522	-$5,341	-$4,026
2049	**-$4,343**	-$5,609	-$3,077	-$8,219	-$3,314	-$5,129	-$3,887	-$4,797	-$4,838	-$3,849	-$3,832	-$4,853	-$5,702	-$4,343
2050	**-$5,206**	-$6,572	-$3,840	-$9,400	-$4,148	-$6,019	-$4,720	-$5,692	-$5,746	-$4,665	-$4,673	-$5,739	-$6,631	-$5,206
Total*	**-$22,163**	-$38,879	-$5,445	-$78,935	-$6,292	-$33,206	-$13,257	-$31,063	-$21,438	-$22,793	-$13,846	-$30,350	-$36,719	-$14,333

*Note: Totals may differ due to rounding.

E. Fleet Examples

The following are a set of examples to illustrate the potential costs of the proposed ACF regulation to a fleet. The fleets in these examples do not purchase any ZEVs in the baseline to illustrate the maximum potential costs.

1. Delivery Fleet

Table 66 illustrates an example delivery fleet that owns 100 Class 5 walk-in vans and 100 Class 8 day cab tractors. This example can represent a fleet who moves goods to and from warehouses along freight corridors and to local distribution hubs. The costs from 2020-2050 are shown for a fleet in the Legal Baseline that only owns diesel vehicles purchased new in California, and under the proposed ACF regulation scenario where the fleet would transition all their vehicles from diesel to battery-electric. In the baseline, the fleet operates its vehicles 10 years before replacing them and as a result buys 10 box trucks and 10 day cabs tractors per year. Under the proposed ACF regulation, the fleet would meet the ZEV milestones targets set under the high priority fleet requirements and add ZEVs to the fleet. In the early years of the proposed ACF regulation, the fleet can comply by ensuring a portion of its new purchases are ZEVs, but as the fleet approaches its 100 percent requirements it will need to accelerate replacement to ensure all diesel-powered vehicles leave the fleet and are replaced by ZEVs. This scenario assumes the fleet meets the minimum compliance requirements and assumes the fleet does not purchase any ZEVs early to avoid accelerated replacement. All other mileage and cost assumptions are the same as described previously in this section.

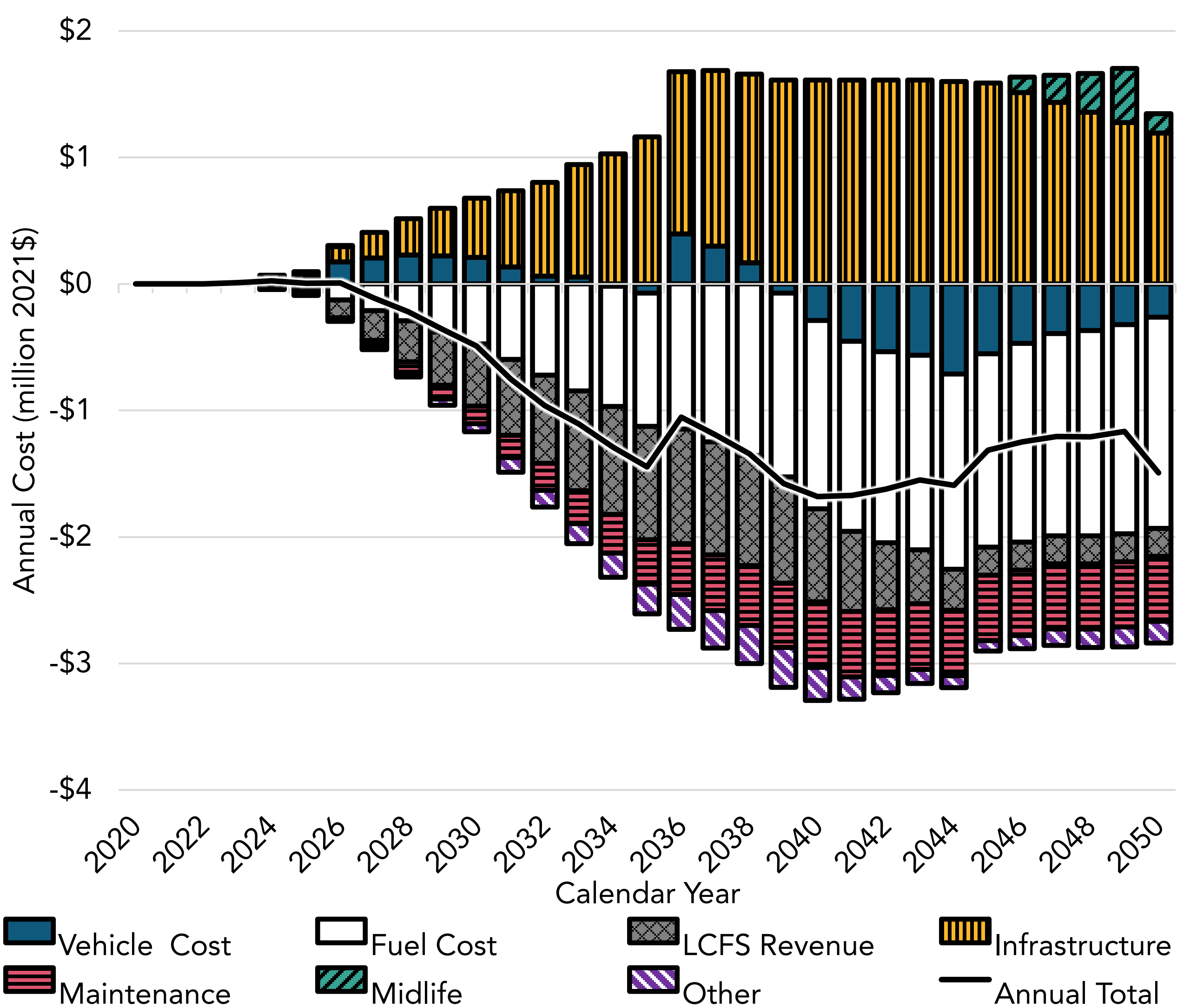
The costs over the analysis period are lower for the battery-electric fleet as compared to the diesel fleet (even with infrastructure costs included); however, the upfront capital expenses are higher initially but become lower after about 2035. Access to capital or financing will be critical for fleets to take advantage of the overall savings of medium- and heavy-duty ZEVs. Table 66 and Figure 70 shows the estimated costs for examples of a typical business.

Table 66. Typical Business Cumulative Cost Example 2024 to 2050 (2021$)

Cost Line Items	Legal Baseline 2030	Proposed ACF Regulation 2030	Legal Baseline 2040	Proposed ACF Regulation 2040	Legal Baseline 2050	Proposed ACF Regulation 2050	Difference 2050
Vehicle Price	$14,685,731	$15,642,581	$45,035,881	$47,818,215	$75,443,467	$73,298,665	-$2,144,802
Sales and Excise Tax	$2,698,173	$2,865,414	$6,655,722	$6,938,354	$10,613,271	$10,277,552	-$335,719
EVSE & Infrastructure Costs	$0	$1,521,346	$0	$13,334,088	$0	$28,131,027	$28,131,027
Maintenance Bay Upgrades	$0	$48,274	$0	$219,195	$0	$230,975	$230,975
Fuel Cost	$31,129,984	$29,577,440	$68,629,847	$56,212,495	$107,407,314	$79,251,569	-$28,155,744
DEF Consumption	$420,289	$376,413	$904,788	$509,296	$1,384,947	$509,296	-$875,651
LCFS Revenue	$0	-$1,667,673	$0	-$9,745,633	$0	-$12,987,057	-$12,987,057
Maintenance Cost	$10,338,830	$9,849,816	$23,200,191	$18,928,186	$36,061,552	$26,624,399	-$9,437,153

Cost Line Items	Legal Baseline 2030	Proposed ACF Regulation 2030	Legal Baseline 2040	Proposed ACF Regulation 2040	Legal Baseline 2050	Proposed ACF Regulation 2050	Difference 2050
Midlife Costs	$1,040,667	$1,040,667	$1,040,667	$1,040,667	$1,040,667	$2,263,707	$1,223,040
Registration Fees	$3,476,624	$3,345,371	$7,797,402	$6,338,450	$12,124,155	$8,639,178	-$3,484,977
Transitional Costs	$0	$214,835	$0	$214,835	$0	$214,835	$214,835
Residual Values	-$5,317,209	-$5,317,209	-$11,920,089	-$13,200,401	-$18,847,839	-$19,214,791	-$366,952
Depreciation	-$3,517,882	-$3,748,519	-$12,059,103	-$12,928,904	-$20,648,988	-$20,114,349	$534,639
Insurance Cost	$1,420,767	$1,463,448	$3,227,538	$3,296,439	$5,048,820	$4,898,627	-$150,193
Reporting Cost	$0	$9,652	$0	$21,717	$0	$33,782	$33,782
Total	**$56,375,973**	**$55,221,857**	**$132,512,843**	**$118,996,999**	**$209,627,367**	**$182,057,416**	**-$27,569,951**

Figure 70: Estimated Costs of Proposed ACF Regulation to the Example Typical Business (Million 2021$)



2. Drayage Owner-Operator

This example is a drayage truck owner-operator subject to the drayage truck requirements. Drayage truck owners generally own one to three tractors and represent approximately 25 percent of drayage businesses. This percentage is based on vehicle identification numbers for tractors registered at the San Pedro Bay and Oakland seaports compared to California's DMV address registration data.

In the Legal Baseline scenario, the operator purchases a 2014 MY diesel day cab tractor in 2022 and operates it for 12 years. Following that, the operator would continue the pattern of purchasing an 8-year-old diesel day cab tractor and operating it for 12 years. In this example, the drayage operator purchases 8-year-old used tractors in 2034 and 2046.

Under this proposed ACF regulation example, the operator owns a 2014 MY diesel day cab tractor purchased in 2022. The drayage operator would likely turn over their diesel tractor at the end of 2029 when the tractor is 15-years-old (average age or MY of tractors reaching 800,000 miles) and has exceeded the useful life and would replace it with a new 2030 MY battery-electric tractor which they would operate for 20 years.

Most assumptions are the same as previously described in this document; however, some modifications were made for this example to better illustrate the costs the small business would face:

- The drayage operator is assumed to finance their vehicles for 5 years at an interest rate of 15 percent;
- The drayage operator would not install infrastructure themselves and instead would rely solely on retail charging; and
- No transitional costs associated with maintenance or infrastructure planning are assumed as these are costs are associated with organizational shifts within a large business.

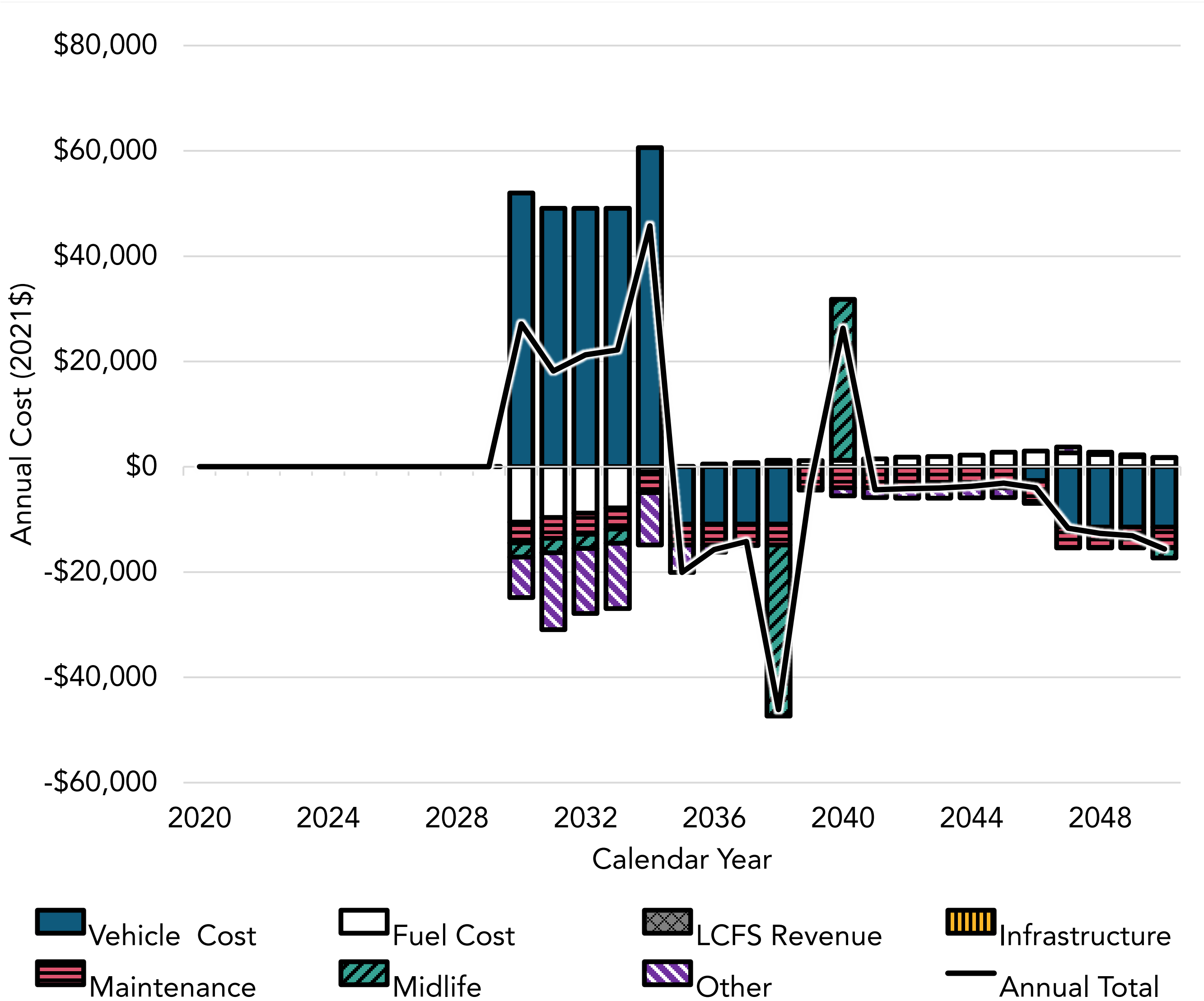
Table 67 and Figure 71 illustrate the costs for the example small business. The small business would see a net savings by 2040 and thereafter but would need to make significant upfront capital expenses in 2030 to purchase a new battery-electric tractor rather than buying another used diesel tractor. Incentives, financing assistance, and other programs offered will be helpful to support smaller operators with upfront capital expenses.

Table 67. Small Business Cumulative Cost Example 2024 to 2050

Cost Line Items	Legal Baseline 2030	Proposed ACF Regulation 2030	Legal Baseline 2040	Proposed ACF Regulation 2040	Legal Baseline 2050	Proposed ACF Regulation 2050	Difference 2050
Vehicle Price	$0	$49,106	$54,449	$245,531	$111,694	$245,531	$133,837
Sales and Excise Tax	$0	$33,745	$7,483	$33,745	$15,351	$33,745	$18,394
EVSE & Infrastructure Costs	$0	$0	$0	$0	$0	$0	$0
Maintenance Bay Upgrades	$0	$0	$0	$0	$0	$0	$0
Fuel Cost	$286,310	$275,812	$618,647	$585,387	$943,662	$932,196	-$11,466

Cost Line Items	Legal Baseline 2030	Proposed ACF Regulation 2030	Legal Baseline 2040	Proposed ACF Regulation 2040	Legal Baseline 2050	Proposed ACF Regulation 2050	Difference 2050
DEF Consumption	$3,862	$3,380	$8,157	$3,380	$12,182	$3,380	-$8,803
LCFS Revenue	$0	$0	$0	$0	$0	$0	$0
Maintenance Cost	$79,265	$75,302	$178,347	$134,751	$277,429	$194,200	-$83,229
Midlife Costs	$21,667	$18,958	$62,292	$49,534	$94,792	$80,110	-$14,681
Registration Fees	$22,732	$21,915	$49,388	$34,591	$76,134	$43,736	-$32,399
Transitional Costs	$0	$0	$0	$0	$0	$0	$0
Residual Values	$0	-$30,854	-$29,858	-$854	-$46,547	-$30,854	$15,693
Depreciation	$0	-$8,287	-$14,492	-$66,113	-$27,760	-$66,113	-$38,353
Insurance Cost	$4,431	$6,342	$9,172	$14,971	$13,697	$19,574	$5,876
Reporting Cost	$0	$48	$0	$109	$0	$169	$169
Total	$418,267	$445,466	$943,587	$1,005,031	$1,470,634	$1,455,672	-$14,961

Figure 71: Estimated Costs of Proposed ACF Regulation to the Example Small Business (2021$)



3. Pickup Truck Buyer

There are no direct costs on individuals as a result of this Proposed ACF regulation. Staff estimates that manufacturers may see increased costs as a result of this rule's 100 percent ZEV sales requirement beginning 2040 MY and will likely pass the costs through to individuals in the state through increased incremental prices. These individuals will also see increases and decreases in costs due to different costs for ZEVs versus ICE vehicles.

This example is an individual who purchases a new Class 2b-3 pickup truck in 2040. Individuals are not directly regulated by the proposed ACF regulation but will be indirectly affected by the 2040 100 percent ZEV sales requirement. A significant portion of vehicle sales in the Class 2b-3 weight classes are pickup trucks purchased by individuals for their personal usage.

In the Legal Baseline scenario, the individual would buy a 2040 MY gasoline powered Class 2b-3 pickup in 2040 and operate it for ten years. Under the proposed ACF regulation, the individual would instead purchase a 2040 MY battery-electric Class 2b-3 pickup truck and operate it for ten years.

Most assumptions are the same as in the core cost analysis; however, some assumptions have been changed to reflect differences between costs to an individual versus costs to a fleet. Information has been taken from the ACC II SRIA.[432]

- Infrastructure costs are assumed to be $200 for the charging cord and $680 to install a charging port in the individual's garage. No maintenance costs are assumed. Infrastructure costs are not amortized.
- Electricity costs have been modified to cost at $0.25/kWh in 2026 and increase over time.
- The individual does not receive any revenue from the LCFS regulation.
- No depreciation is assumed.

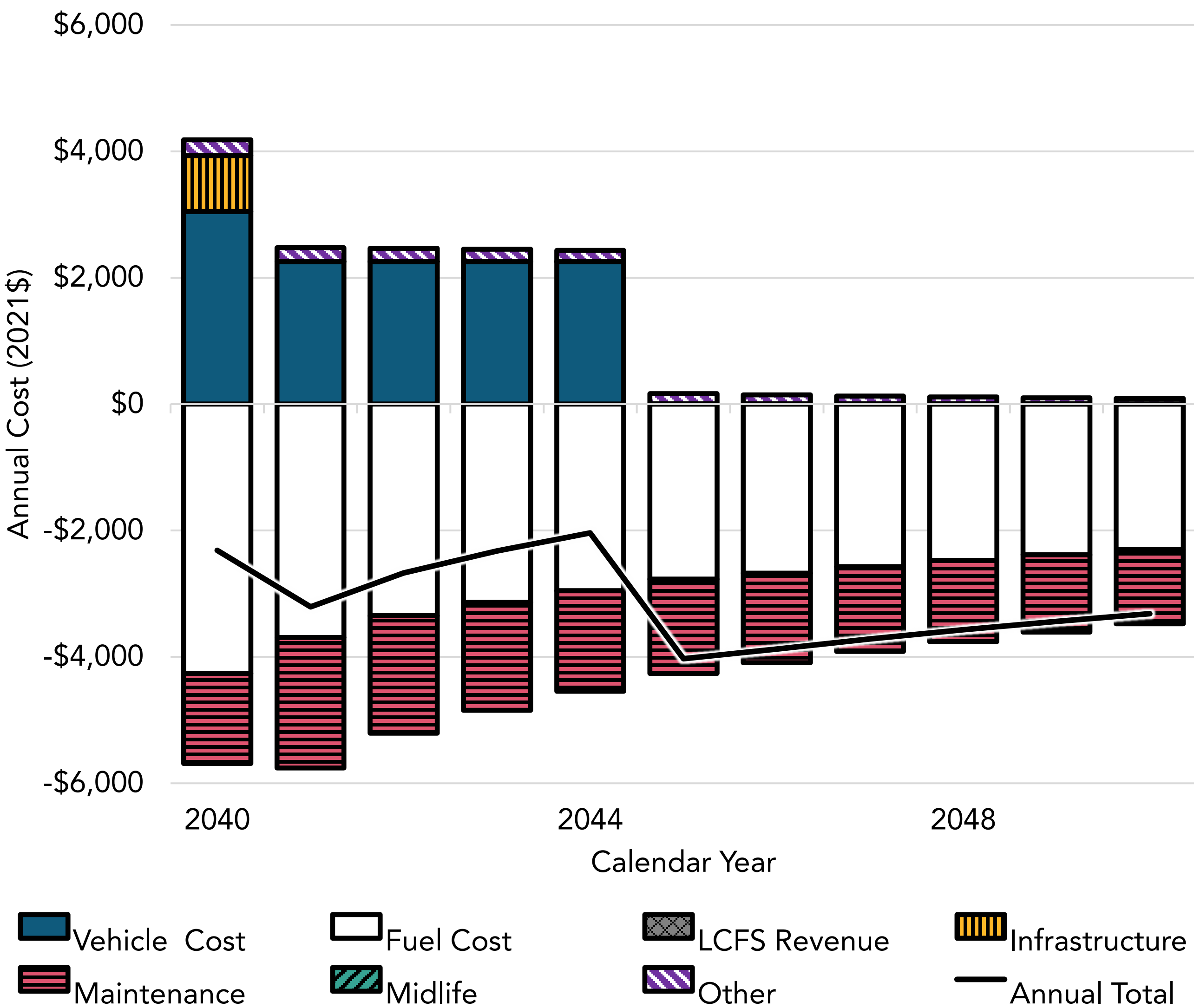
Table 68 and Figure 72 illustrate the costs for the example individual. The individual would see increased vehicle and infrastructure costs, but fuel and maintenance savings offset these costs and lead to a payback in under a year.

Table 68: Pickup Truck Buyer Cumulative Cost Example

Cost Line Items	Legal Baseline 2050	Proposed ACF Regulation 2050	Difference 2050
Vehicle Price	$45,864	$57,132	$11,268
Sales and Excise Tax	$3,235	$4,029	$795
EVSE & Infrastructure Costs	$0	$935	$935
Maintenance Bay Upgrades	$0	$1,155	$1,155
Fuel Cost	$57,862	$25,289	-$32,573
DEF Consumption	$0	$0	$0
LCFS Revenue	$0	$0	$0
Maintenance Cost	$43,937	$26,362	-$17,575
Midlife Costs	$0	$0	$0
Registration Fees	$7,831	$8,817	$986
Transitional Costs	$0	$0	$0
Residual Values	$0	$0	$0
Depreciation	$0	$0	$0
Insurance Cost	$3,092	$3,868	$775
Reporting Cost	$0	$0	$0
Total	$161,821	$127,587	-$34,234

[432] California Air Resources Board, *Advanced Clean Cars II Proposed Amendments to the Low Emission, Zero Emission, and Associated Vehicle Regulations: Standardized Regulatory Impact Analysis*, 2022 (web link: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/accii/appc1.pdf, last accessed August 2022).

Figure 72: Estimated Costs of Proposed ACF Regulation to Pickup Truck Buyer (2021$)



F. Macroeconomic Analysis

1. Methods for Determining Economic Impacts

This section describes the estimated total impact of the proposed ACF regulation on the California economy. The proposed ACF regulation would result in incremental cost and cost-savings for businesses to comply with the regulation. These costs would result in direct changes in expenditures in the economy and are passed on to businesses. These changes in expenditures by businesses would indirectly affect employment, output, and investment in sectors that move freight and provide services to affected businesses.

These direct and indirect effects would lead to induced effects, such as changes in personal income that affect consumer expenditures across other spending categories. The total economic impact is the sum of these effects and is presented in this section. The total economic impact of the proposed ACF regulation is simulated relative to the baseline scenario using the cost estimates described in Section B. The analysis focuses on the changes in major macroeconomic indicators from 2022 to 2050, including employment, output, personal income, and gross state product (GSP). The years of the analysis are used to simulate the proposed ACF regulation through more than 12 months post full implementation.

Regional Economic Models, Inc. (REMI) Policy Insight Plus Version 2.5.0 is used to estimate the macroeconomic impacts of the proposed ACF regulation on the California economy. REMI is a structural economic forecasting and policy analysis model that integrates input-output, computable general equilibrium, econometric and economic geography methodologies.[433] REMI Policy Insight Plus provides year-by-year estimates of the total impacts of the proposed ACF regulation, pursuant to the requirements of Senate Bill 617 and the California Department of Finance (DOF).[434] Staff used the REMI single region, 160 sector model with the model reference case adjusted to reflect California DOF's most current publicly available economic and demographic projections.[435,436]

Specifically, REMI model's National and Regional Control was updated to conform to the most recent California DOF economic forecasts which include United States Real Gross Domestic Product (GDP), income, and employment, as well as California civilian employment by industry, released with the Governor's Budget on January 10, 2022, and DOF demographic forecasts for California population forecasts, last updated in July 2021.[437,438,439,440] After the DOF economic forecasts end in 2025, CARB staff made assumptions that post-2025, economic variables would continue to grow at the same rate projected in the REMI baseline forecasts.

2. Inputs and Assumptions of the Assessment

The estimated economic impact of the proposed ACF regulation is sensitive to modeling assumptions. This section provides a summary of the assumptions and inputs used to

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433 REMI, *Models*, 2022 (web link: https://www.remi.com/model/pi/, last accessed August 2022).

434 SB 617 (Calderon, Stats. 2011, ch. 496); Gov. Code section 65850.52.

435 California Legislature, *Senate Bill 617*, October 2011(web link: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201120120SB617, last accessed August 2022).

436 California Department of Finance, *Chapter 1: Standardized Regulatory Impact Analysis for Major Regulations – Order of Adoption*, December 2013(web link: https://dof.ca.gov/wp-content/uploads/Forecasting/Economics/Documents/Order_of_Adoption-12012013.pdf, last accessed August 2022).

437 California Department of Finance, *Economic Research Unit. National Economic Forecast – Annual & Quarterly. Sacramento: California*, November 2021. (web link: https://dof.ca.gov/wp-content/uploads/Forecasting/Economics/Documents/United-States-Economic-Forecast-MR-2022-23.xlsx, last accessed August 2022).

438 California Department of Finance, *Economic Research Unit. California Economic Forecast – Annual & Quarterly. Sacramento: California,* November 2021 (web link: https://dof.ca.gov/wp-content/uploads/Forecasting/Economics/Documents/California-Economic-Forecast-MR-2022-23.xlsx, last accessed August 2022).

439 California Department of Finance, *Economic Research Unit. National Deflators: Calendar Year averages: from 1929, April 2021. Sacramento: California*, January 2022 (web link: https://dof.ca.gov/wp-content/uploads/Forecasting/Economics/Documents/Implicit-Price-Deflators-CY.xlsx, last accessed August 2022).

440 California Department of Finance, *Demographic Research Unit. Report P-3: Population Projections, California, 2010-2060 (Baseline 2019 Population Projections; Vintage 2020 Release) Sacramento: California*, July 2021 (web link: https://dof.ca.gov/forecasting/demographics/projections/, last accessed August 2022).

determine the suite of policy variables that best reflect the macroeconomic impacts of the proposed ACF regulation. The direct costs and savings estimated in Section C and the non-mortality related health benefits estimated in Section B are translated into REMI policy variables and used as inputs for the macroeconomic analysis.[441]

The direct costs of the proposed ACF regulation, as described in Section C, would include changes in upfront costs to fleets for the increased purchase of ZEVs and decreased purchase of ICE vehicles. The net change in vehicle costs is input into the economic model as an increase in production costs for all industries in California that operate fleets anticipated to be affected by the proposed ACF regulation. Fleets which use ZEVs would realize changes in production costs related to their change in fuel mix, operations costs, and maintenance and repair costs. Fleets would also need to make investments in infrastructure to support their use of the ZEVs, which would increase their production costs. Fleets that own ZEV infrastructure to charge their vehicles would be able to generate LCFS credits and receive a direct financial benefit. Fleets required to accelerate the retirement of their non-ZEVs may see an increased residual value from resale of the vehicles on the used market, as described in the Direct Costs section of this report. This however is not expected to result in any statewide economic impact, as other fleets would also be purchasing the vehicles at the higher residual value, directly offsetting revenue received by the seller as an expenditure to the buyer. Finally, changes in fleets' vehicle purchases, fuel use, and other activities would reduce the amount paid in federal, State, and local taxes and fees. The total change in taxes and fees businesses pay are modeled as a reduction in production costs for the fleets.

Table 69: Share of Vehicles Owned and Operated by Fleets Affected by the High Priority and Federal Fleet Requirements of the Proposed ACF Regulation

Major Sectors	NAICS	Share of Vehicles
Agriculture and Natural Resources	111-115, 21	5.12%
Construction	23	9.35%
Manufacturing	31-33	4.37%
Retail and Wholesale	42, 44-45	15.44%
Transportation and Public Utilities	22, 48, 492-493	50.40%
Finance, Insurance & Real Estate	52, 53	1.13%
Services	51, 54-56, 61, 62, 71, 72, 81	14.14%
Government (Public Administration)	92	0.05%

Costs and savings incurred by fleets would result in corresponding changes in final demand for industries supplying those particular goods or services as shown in Table 70. The term "fleets" in the table includes all of the industries with businesses operating affected vehicles. As fleets' purchase of vehicles are estimated to be primarily from out-of-state manufacturers, demand changes for the corresponding ZEV supply chain cannot be directly modeled as a change in final demand in California. In order to account for this, staff estimates the share of

[441] Refer to Section G: Macroeconomic Appendix for a full list of REMI inputs for this analysis.

demand which may be fulfilled by California businesses, based on California's share of national output for the industry (electrical component manufacturing).[442] All other changes in demand are included in this analysis. The infrastructure upgrades necessary for fleet use of ZEVs is assumed to be provided by businesses in the construction sector (NAICS 23). The EVSE and maintenance is assumed to be supplied by businesses in the Other Electrical Equipment and Component Manufacturing industry (NAICS 3359). The change in demand for vehicle maintenance and midlife rebuild is realized by the automotive repair and maintenance industry (NAICS 8111). The reduction in gasoline and diesel fuel demand is assumed to be incurred by the Petroleum and Coal Products manufacturing industry (NAICS 324), while the decrease in natural gas demand occurs for the Natural gas distribution industry (NAICS 2212). The increased demand for electricity and hydrogen fuel is assumed to be provided by the Electric power generation, transmission, and distribution industry (NAICS 2211) and Basic Chemical manufacturing industry (NAICS 3251), respectively. The reporting cost and the workforce training and development are assumed to be provided by the Office administrative services (NAICS 5611, 5612) and private education services industries (NAICS 61), respectively. The change in demand for gasoline stations (NAICS 4471) selling some of the products above, is estimated based on the retail margin for that industry and entered in as change in final demand for the retail sector (NAICS 44-45).[443] Finally, the LCFS credits generated by fleets that install and use EVSE are assumed to be purchased by producers of fossil fuels, which pass those costs through in the price of fuel; this is modeled as an increase in fuel costs for individuals and businesses in California.

Table 70: Sources of Changes in Production Cost and Final Demand by Industry

Source of Cost or Savings for Fleets	Industries with Changes in Final Demand (NAICS)
Vehicle Prices	*Upfront cost:* Electrical Component Manufacturing.[a] (3363)
Infrastructure upgrades	*Upfront cost:* Construction (23)
Electric Vehicle Supply Equipment	*Upfront cost:* Other Electrical Equipment and Component Manufacturing. (3359)
EVSE maintenance	*Upfront cost:* Construction (23)
Vehicle maintenance and midlife rebuild	*One-time and recurring cost:* Automotive Repair and Maintenance (8111)
Gas and diesel fuel	*Recurring cost:* Petroleum and Coal Products Manufacturing. (324)
Natural gas	*Recurring cost:* Natural Gas Distribution (2212)
Hydrogen fuel	*Recurring cost:* Basic Chemical Manufacturing (3251)
Diesel Exhaust Fluid	*Recurring cost: Agricultural Chemical Manufacturing. (3253)*

[442] Based on REMI Policy Insight Plus (v 2.4.1), California's share of national output is 2.3 percent for motor vehicle parts manufacturing. (3,363) in 2019.

[443] A gross margin 10.5 percent is used, based on the average gross margin of small and medium gasoline stations (NAICS 4471) from *Bizminer*, 2022 (web link: https://www.bizminer.com/, last accessed August 2022).

Source of Cost or Savings for Fleets	Industries with Changes in Final Demand (NAICS)
Workforce training and education	*Recurring costs:* Education Services; Private (61)
Reporting	*One-time cost:* Office Administrative Services; Facilities Support Services (5611, 5612)
LCFS credit generation	*Recurring cost:* Fuel prices[b]

[a] The Industry Sales policy variable is used here rather than Exogenous Final Demand.
[b] Individuals and each industry share of cost resulting from increasing fuel prices is based on data from REMI v2.5 (see the Macroeconomic Appendix for the distribution).

In addition to these changes in production costs and final demand for businesses, there would also be economic impacts as a result of the fiscal effects, primarily from changes in fuel and sales tax revenue, depreciation, and registration fees, as described in Section D. The changes in fuel tax revenue would change the production costs for fleets and the corresponding change in government revenue is modeled as a change in State and local government spending, assuming this revenue reduction is not offset elsewhere. Additional CARB staff and resources in support of this regulation are modeled as changes in State government employment and spending. The change in federal excise tax revenue and depreciation is outside the scope of the economic model and not evaluated here.

The health benefits resulting from the emissions reductions of the proposed ACF regulation would reduce healthcare costs for individuals on average. This reduction in healthcare cost is modeled as a decrease in spending for hospitals, with a reallocation of this spending towards other goods and increased savings. The GHG emissions reductions benefits, as valued through the SC-CO_2, represent the avoided damage from climate change worldwide per metric ton of CO_2e. These benefits fall outside the scope of our economic model and are not evaluated here.

3. Results of the Assessment

The results from the REMI model provide estimates of the impact of the proposed ACF regulation on the California economy. These results represent the annual incremental change from the implementation of the proposed ACF regulation relative to the baseline scenario. The California economy is forecasted to grow through 2050, therefore, negative statewide impacts reported here should be interpreted as a slowing of growth and positive impacts as an acceleration of growth resulting from the proposed ACF regulation. The results are reported here in tables for every four years from 2022 through 2050.

a) California Employment Impacts

Table 71 presents the impact of the proposed ACF regulation on total employment in California across all industries. Employment comprises estimates of the number of jobs, full-time plus part-time, by place of work for all industries. Full-time and part-time jobs are counted at equal weight. Employees, sole proprietors, and active partners are included, but unpaid family workers and volunteers are not included. The employment impacts represent the net change in employment, which consist of positive impacts for some industries and negative impacts for others. The proposed ACF regulation is estimated to initially result in a slightly positive employment impact through about 2026 after which the trend reverses with a negative employment impact through rest of the regulatory horizon. The results are further described at the industry level in the following paragraph. These changes in employment do not exceed 0.2 percent of baseline California employment across the entire regulatory horizon.

Table 71: Total California Employment Impacts

Metric	2026	2030	2034	2038	2042	2046	2050
California Employment	25,955,120	25,988,237	26,215,483	26,620,729	27,193,545	27,865,042	28,673,835
% Change	0.00%	-0.07%	-0.13%	-0.16%	-0.13%	-0.09%	-0.15%
Change in Total Jobs	21	-18,835	-33,107	-43,138	-34,577	-25,572	-41,990

The total employment impacts shown above are net of changes at the industry level. The overall trend in employment changes by major sector are illustrated in Figure 73 and Table 72 shows the changes in employment by industries that would be directly impacted by the proposed ACF regulation. As the requirements of the proposed ACF regulation go into effect the industries generally realizing reductions in production cost or increases in final demand would see an increase in employment growth. This initially includes the construction sector as businesses install EVSE and make other facility upgrades, and the electric power sector due to increased demand. The directly affected fleets, which primarily operate in the transportation and warehousing sector, would initially see a decrease in employment due to higher vehicle costs, but as those vehicles are operated the operational savings build up over time, reducing production costs for the industry reducing the negative impact. The reduced spending on maintenance and repair costs for ZE trucks would result in a downward trend in employment for the industry.

The largest decrease in employment results from the public sector, which is estimated to realize a decrease in fuel and sales tax revenue and registration fees. This foregone revenue may eventually be replaced by revenue from other sources, in which case these negative job impacts to State and local government would be diminished. The transition towards ZEVs and its impacts on some of these revenues are the subject of continued policy development. Although this analysis does not assume the creation of new specific revenue-raising measures, measures such as roadway pricing strategies under discussion in California have the potential to generate revenue. For example, the four largest metropolitan planning organizations in California, representing over 80 percent of the population, have proposed a suite of pricing measures in their sustainable communities strategies to meet regional GHG reduction targets set by CARB. Caltrans is convening the State Roadway Pricing Working Group to provide State leadership and support for the implementation of local, regional, and State efforts to implement such strategies. However, this is outside the scope of the proposed ACF regulation and not evaluated here. It is important to note that many of these negative job impacts represent a structural shift for these industries that directly correspond to substantial benefits to ZEV owners who would have much lower operational costs from the lower fuel expenses and reduced maintenance and repair of ZEVs.

Figure 73: Job Impacts by Major Sector

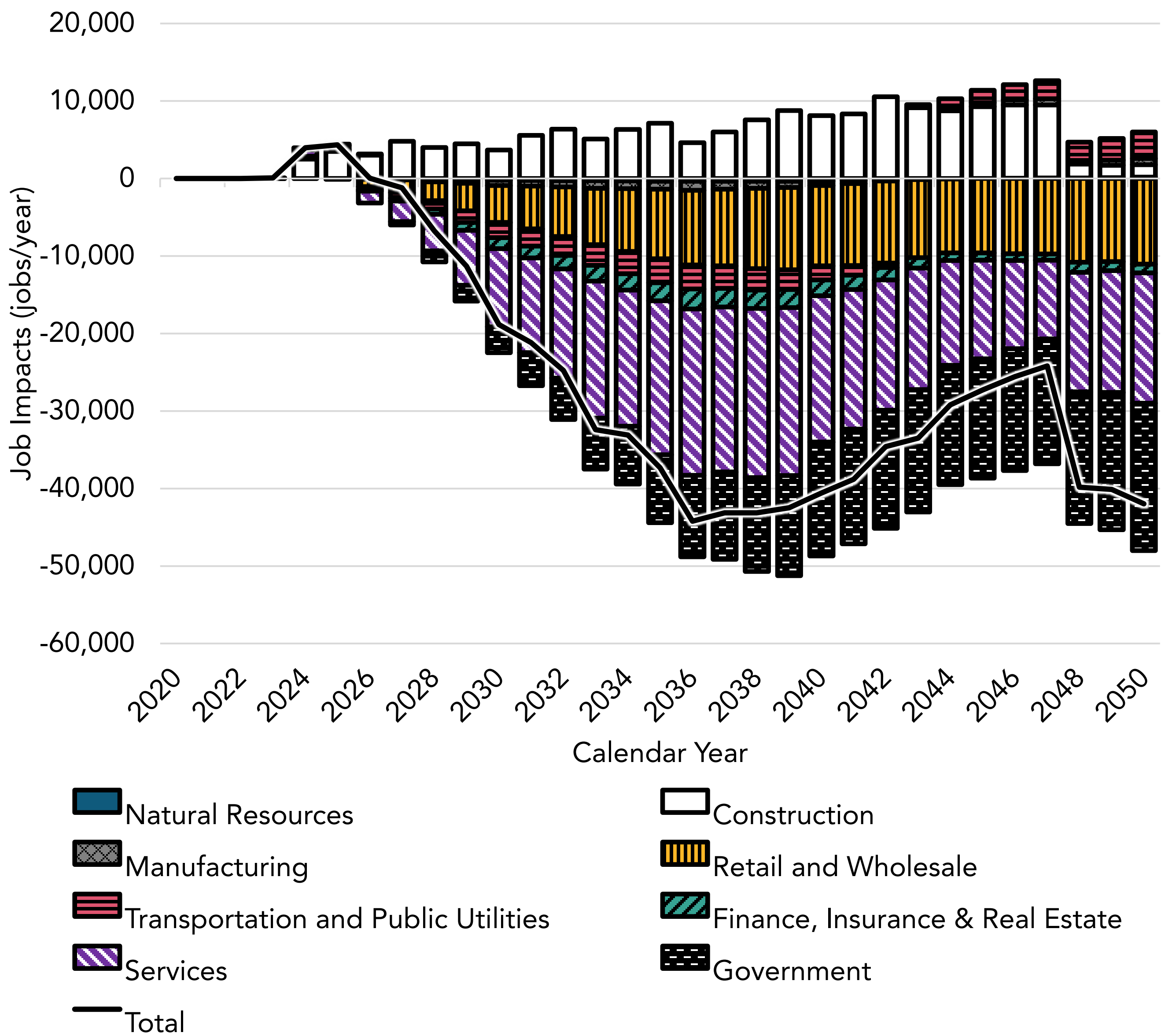


Table 72: Employment Impacts by Primary and Secondary Industries

Industry	Metric	2026	2030	2034	2038	2042	2046	2050
Transportation and Warehousing (48, 492-493)	% Change	0.00%	-0.12%	-0.22%	-0.26%	-0.14%	-0.01%	0.06%
	Change in Jobs	-70	-1,718	-3,238	-3,967	-2,229	-160	1,001
Electric power generation, transmission and distribution (2211)	% Change	0.20%	0.92%	2.30%	3.93%	5.73%	6.07%	6.66%
	Change in Jobs	75	332	791	1,302	1,819	1,882	2,013
Natural gas distribution (2212)	% Change	-0.07%	-0.35%	-0.66%	-0.95%	-1.12%	-1.15%	-1.30%
	Change in Jobs	-9	-43	-80	-112	-127	-128	-141

Industry	Metric	2026	2030	2034	2038	2042	2046	2050
Construction (23)	% Change	0.22%	0.28%	0.48%	0.57%	0.67%	0.69%	0.11%
	Change in Jobs	3,009	3,660	6,327	7,573	9,124	9,468	1,610
Petroleum and coal products manufacturing (324)	% Change	-0.16%	-0.83%	-1.62%	-2.40%	-3.07%	-3.20%	-3.62%
	Change in Jobs	-20	-100	-189	-270	-333	-340	-376
Retail trade (44-45)	% Change	-0.04%	-0.20%	-0.35%	-0.45%	-0.43%	-0.41%	-0.45%
	Change in Jobs	-829	-3,870	-6,605	-8,481	-8,438	-8,277	-9,437
Automotive repair and maintenance (8111)	% Change	-0.39%	-1.63%	-2.95%	-4.02%	-3.76%	-3.07%	-4.95%
	Change in Jobs	-903	-3,778	-6,834	-9,343	-8,750	-7,174	-11,634
State & Local Government	% Change	0.01%	-0.14%	-0.30%	-0.48%	-0.59%	-0.61%	-0.72%
	Change in Jobs	162	-3,375	-7,474	-12,132	-15,218	-15,747	-19,019

b) California Business Impacts

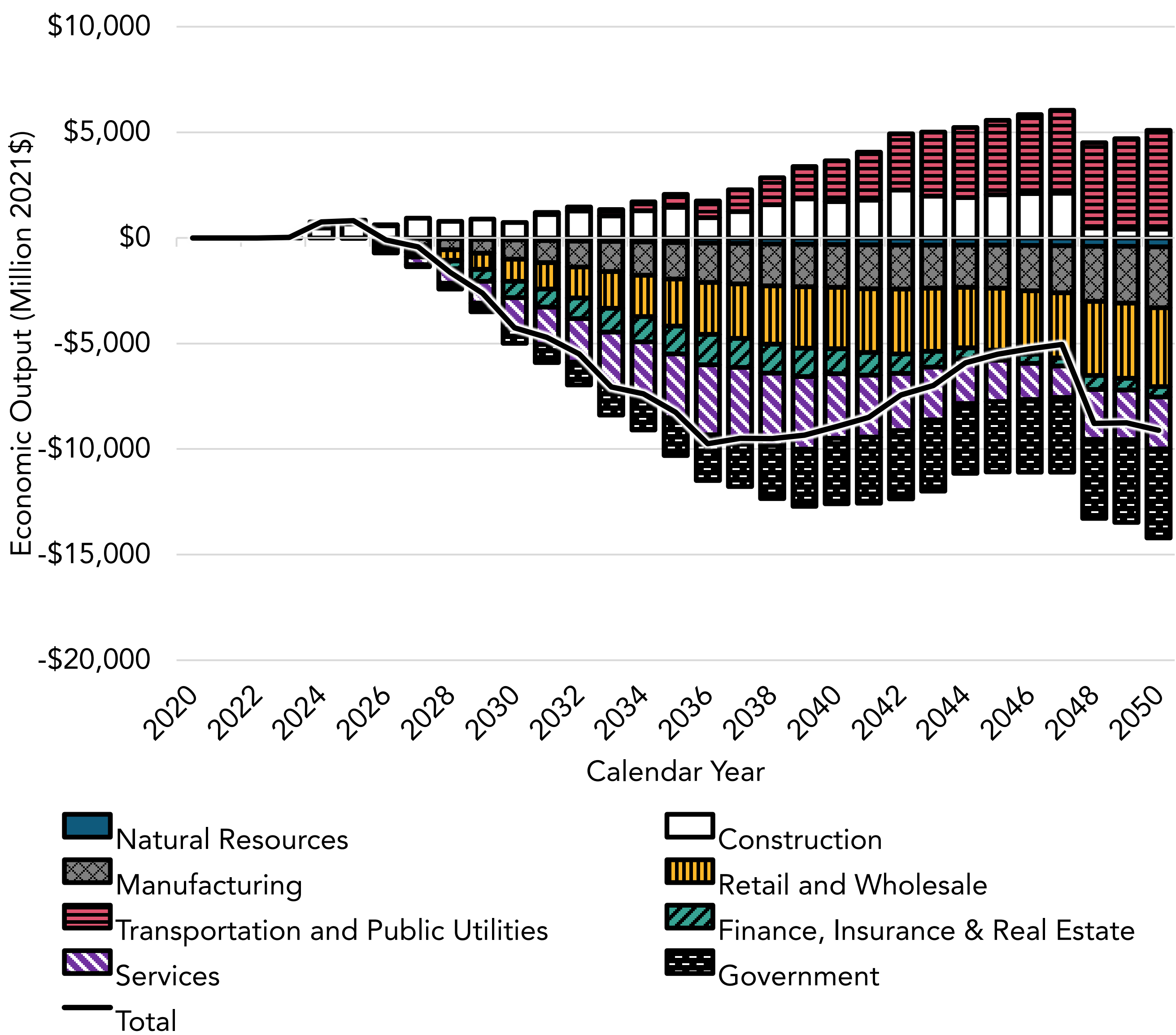
Gross output is used as a measure for business impacts as it represents an industry's sales or receipts and tracks the quantity of goods or services produced in a given time period. Output growth is the sum of output in each private industry and State and local government as it contributes to state GDP and is affected by production cost and demand changes. As production cost increases or demand decreases, output is expected to contract, but as production costs decline or demand increases, industry would likely experience output growth.

The results of the proposed ACF regulation show a decrease in output of $99 million in 2030 and a decrease of $5.3 billion in 2050 as shown in Table 73. The trend in output changes is illustrated by major sector in Figure 74. Similar to the employment impacts, there would initially be positive impacts on output for construction and electric power sectors, which trend towards positive impacts over time as the operational savings accumulate, leading to output growth. There would be negative impacts on output in the oil and gas extraction, automotive repair and maintenance, and public sectors. The negative output impact on manufacturing is primarily driven by the petroleum and coal products manufacturing industry, which is estimated to see a relatively large decrease in final demand for diesel and gasoline.

Table 73: Change in Output Growth in California by Industry

Industry	Metric	2026	2030	2034	2038	2042	2046	2050
California Economy	Output (2021M$)	6,064,336	6,365,917	6,725,733	7,189,243	7,777,733	8,433,448	9,169,339
	% Change	0.00%	0.00%	-0.07%	-0.11%	-0.13%	-0.10%	-0.06%
	Change (2021M$)	0	-99	-4,256	-7,379	-9,506	-7,440	-5,253
Transportation and Warehousing (48, 492-493)	% Change	0.00%	-0.01%	-0.17%	-0.31%	-0.39%	-0.30%	-0.09%
	Change (2021M$)	0	-18	-351	-685	-905	-731	-226
Electric power generation, transmission and distribution (2211)	% Change	0.00%	0.20%	0.93%	2.31%	3.96%	5.56%	6.13%
	Change (2021M$)	0	102	494	1,284	2,310	3,434	4,014
Natural gas distribution (2212)	% Change	0.00%	-0.07%	-0.35%	-0.67%	-0.96%	-1.14%	-1.15%
	Change (2021M$)	0	-7	-39	-76	-112	-138	-144
Construction (23)	% Change	0.00%	0.23%	0.28%	0.49%	0.58%	0.80%	0.71%
	Change (2021M$)	0	581	732	1,284	1,574	2,261	2,108
Petroleum and coal products manufacturing (324)	% Change	0.00%	-0.16%	-0.83%	-1.63%	-2.41%	-3.05%	-3.21%
	Change (2021M$)	0	-154	-855	-1,782	-2,800	-3,795	-4,288
Retail trade (44-45)	% Change	0.00%	-0.04%	-0.21%	-0.36%	-0.47%	-0.47%	-0.43%
	Change (2021M$)	0	-120	-624	-1,173	-1,665	-1,920	-1,985
Automotive repair and maintenance (8111)	% Change	0.00%	-0.39%	-1.66%	-3.02%	-4.13%	-3.75%	-3.20%
	Change (2021M$)	0	-103	-449	-844	-1,199	-1,133	-1,006
State & Local Government	% Change	0.00%	0.01%	-0.14%	-0.30%	-0.48%	-0.59%	-0.60%
	Change (2021M$)	0	32	-674	-1,519	-2,517	-3,237	-3,427

Figure 74: Change in Output in California by Major Sector



c) Impacts on Investment in California

Domestic private investment consists of purchases of residential and nonresidential structures and of equipment and software by private businesses and nonprofit institutions. It is used as a proxy for impacts on investments in California because it provides an indicator of the future productive capacity of the economy.

The relative changes to growth in private investment for the proposed ACF regulation are shown in Table 74 and shows a decrease of private investment of about $1.0 billion in 2030 which trends towards an increase of $2.49 billion in 2050. These changes in investment do not exceed 0.4 percent baseline investment across the regulatory horizon.

Table 74: Change in Gross Domestic Private Investment Growth

Metric	2026	2030	2034	2038	2042	2046	2050
Private Investment (2021M$)	547,621	571,932	605,292	646,614	693,307	742,261	795,973
% Change	-0.03%	-0.18%	-0.19%	-0.07%	0.17%	0.33%	0.31%
Change (2021M$)	-172	-1,040	-1,141	-453	1,200	2,436	2,492

d) Impacts on Individuals in California

The proposed ACF regulation would impose no direct costs on individuals in California. However, the costs incurred by affected businesses and the public sector would cascade through the economy and affect individuals.

One measure of this impact is the change in real personal income, which is income received from all sources, including compensation of employees and government and business transfer activity, adjusted for inflation. This is an aggregate statewide measure of personal income change, representing a net of income lost from jobs foregone in some sectors and jobs gained in other sectors. Table 75 estimates annual change in real personal income across all individuals in California due to the proposed ACF regulation. Total personal income growth decreases by about $3.86 billion in 2030 but the impact begins to diminish after 2040, resulting in a decrease of about $2.1 billion by 2050, not exceeding 0.2 percent of the baseline. The change in personal income estimated here can also be divided by the California population to show the average or per capita impact on personal income. The change in personal income growth is estimated to decrease $19 per person in 2030, which trends positive over time resulting in an increase of $68 per person in 2050.[444]

Table 75: Impacts on Individuals in California

Metric	2026	2030	2034	2038	2042	2046	2050
Personal Income (2021M$)	2,861,550	3,187,013	3,477,682	3,737,691	4,040,484	4,378,592	4,745,721
% Change	-0.02%	-0.11%	-0.17%	-0.18%	-0.11%	-0.05%	-0.04%
Change (2021M$)	-764	-3,855	-6,195	-7,140	-4,745	-2,180	-2,071
Personal Income per capita (2021$)	68,996	76,178	81,152	86,202	91,813	98,550	106,058
% Change	-0.02%	-0.08%	-0.08%	-0.05%	0.03%	0.06%	0.06%
Change (2021$)	-19	-64	-71	-44	25	62	68

[444] The sign of the change in personal income per capita differs from overall personal income due to population growth changes estimated by the REMI model as a result of the proposed ACF regulation.

e) Impacts on Gross State Product

GSP is the market value of all goods and services produced in California and is one of the primary indicators of economic growth. It is calculated as the sum of the dollar value of consumption, investment, net exports, and government spending. Under the proposed ACF regulation, GSP growth would be anticipated to decrease by about $2.42 billion in 2030 and by $4.28 billion in 2050 as shown in Table 76. These changes do not exceed 0.2 percent of baseline GSP. This metric summarizes impacts discussed above, including consumer spending, investment, and government spending. This is why the results trend negative, as the decrease in consumer and government spending in California would outweigh the increase in investment resulting from the proposed ACF regulation.

Table 76: Change in Gross State Product

Metric	2026	2030	2034	2038	2042	2046	2050
GSP (2021M$)	3,666,219	3,893,045	4,161,493	4,471,810	4,822,161	5,207,097	5,630,591
% Change	0.00%	-0.06%	-0.10%	-0.12%	-0.08%	-0.04%	-0.08%
Change (2021M$)	-43	-2,420	-4,169	-5,276	-3,796	-2,293	-4,276

f) Creation or Elimination of Businesses

The REMI model cannot directly estimate the creation or elimination of businesses. However, changes in jobs and output for the California economy described above can be used to understand some potential impacts. The overall jobs and output impacts of the proposed ACF regulation would be small relative to the total California economy, representing changes of no greater than 0.2 percent. However, impacts to specific industries are larger as described in previous sections. While there would initially be negative impacts on the transportation and warehousing sector, these diminish over time. The trend of increasing demand for the construction sector to provide services related to EV charging has the potential to lead to an expansion or creation of businesses over time. While the electric power sector similarly sees large increases in demand, its services are provided by public utilities, which would not directly impact business creation. The decreasing trend in demand for gasoline and diesel fuel following from this proposed ACF regulation has the potential to result in the elimination of businesses in this industry and downstream industries, such as gasoline stations and vehicle repair businesses, if sustained over time.

g) Incentives for Innovation

The proposed ACF regulation provides flexibility for fleets to purchase ZEVs ahead of the proposed schedules. Private and public fleet owners that purchase ZEVs before they are required would be able to count them towards a future compliance requirement to gain flexibility when making future vehicle purchase. This may encourage fleets to make ZEV purchases early for vehicles that are well suited to their needs which could provide flexibility to purchase ICE vehicles in later years. High priority and federal fleets could purchase Group 1 ZEVs at any point prior to 2025, Group 2 ZEVs at any point prior to 2027, and Group 3 ZEVs at any point prior to 2030. Drayage fleets could add ZEVs to the CARB Online System at any point prior to turnover requirements or the 2035 ZEV deadline. Fleets that act early would be more likely to be eligible for incentive programs that may be available to finance costs or lower the upfront cost.

ZEVs are anticipated to lead to other unquantified benefits and operational efficiencies that may provide another incentive for fleets to use ZEVs to better serve customers. For example, ZEV may be able to make deliveries at night where noise ordinances limit deliveries, their quiet operation can also improve safety at a work site, and the ability to plug in power tools or export power at a job site or as back-up power may increase overall productivity.

Staff anticipates growth in industries that manufacture or support ZEVs, including ZEV manufacturer and component suppliers, infrastructure installers, electrical vehicle technicians, and others. This growth would strengthen the ZEV supply chain, foster a ZE market, and promote technology growth sooner than would have otherwise occurred.

h) Competitive Advantage or Disadvantage

The proposed ACF regulation has three primary regulatory components for different fleet types and each component addresses competitive advantage or disadvantage differently.

The public fleet requirement would not be anticipated to create a competitive advantage or disadvantage. Public agencies do not compete against each other, and each agency would be able to identify the strategy that allows them to comply.

The drayage truck requirement would not be anticipated to create a competitive advantage or disadvantage. The proposed ACF regulation applies equally to all drayage trucks that enter seaports and railyards within California.

The high priority and federal fleet requirement would not be anticipated to create a significant change in competitive advantage or disadvantage. First, federal agencies do not compete with other fleets and would not have a competitive advantage or disadvantage. For high priority fleets, the requirements apply to all trucks that operate in California regardless of where the truck or company is headquartered and would be phased in by truck type. This ensures that all vehicles in these fleets would be subject to the same requirements.

Fleets that do not meet the fleet size or revenue threshold would not be initially regulated by this proposed ACF regulation, but the risk of creating a competitive advantage or disadvantage is mitigated as these initially non-regulated fleets would become subject to the regulation if their revenue or fleet size increases above the thresholds established in the regulation, and ultimately, such fleets would be subject to the regulation when the 100 percent ZEV sales component of the proposed ACF regulation is fully implemented. In addition, the fleet size for determining which fleet would be subject to the regulation includes all medium- and heavy-duty vehicles that are operated under common ownership and control. This ensures a level playing field between businesses that compete for the same work regardless of their business model.

The 100 percent manufacturer ZEV sales requirement would not be anticipated to create a significant change in competitive advantage or disadvantage. This manufacturer requirement affects entities that are headquartered both within California and outside the state. However, all of the costs from deploying the number of ZEVs required by the proposed ACF regulation are assumed to be borne in California. This approach shows the full estimated cost to California for deploying the same number of ZEVs required by the regulation. As shown in the cost analysis, these proposed ACF regulation are expected to have a positive economic impact on affected entities. Fleets and California businesses are expected to see a net reduction in costs through reduced spending on fuel costs and vehicle maintenance as shown in the cost examples, Table 55, and Figure 69.

4. Summary and Agency Interpretation of the Assessment Results

The results of the macroeconomic analysis of the proposed ACF regulation are summarized in Table 77. As analyzed here, CARB estimates the proposed ACF regulation would be unlikely to have a significant impact on the California economy. Overall, the change in the growth of jobs, state GDP, and output is projected to not exceed 0.2 percent of the baseline. While the proposed ACF regulation would initially result in decreased growth in the transportation and warehousing sector in California, it trends positively over time diminishing the negative impact. Both the construction and electric power sectors would see large positive growth by providing their services to affected fleets. The diesel and gasoline fuel savings for the fleets represent decreased demand for gasoline and diesel from the industry, implying a decrease in growth for the industry and downstream industries such as gasoline stations and vehicle repair. This analysis also shows the negative impact estimated for State and local government output and employment due to tax revenue decreases, without any offsetting revenues. This foregone revenue, which supports important programs in the state, may eventually be replaced by revenue from other sources, in which case these negative impacts to State and local government would be diminished.

Table 77: Summary of Macroeconomic Impacts of Proposed ACF Regulation

Indicator	Metric	2026	2030	2034	2038	2042	2046	2050
GSP	% Change	0.00%	-0.06%	-0.10%	-0.12%	-0.08%	-0.04%	-0.08%
	Change (2021M$)	-43	-2,420	-4,169	-5,276	-3,796	-2,293	-4,276
Personal Income	% Change	-0.02%	-0.11%	-0.17%	-0.18%	-0.11%	-0.05%	-0.04%
	Change (2021M$)	-764	-3,855	-6,195	-7,140	-4,745	-2,180	-2,071
Employment	% Change	0.00%	-0.07%	-0.13%	-0.16%	-0.13%	-0.09%	-0.15%
	Change in Jobs	21	-18,835	-33,107	-43,138	-34,577	-25,572	-41,990
Output	% Change	0.00%	-0.07%	-0.11%	-0.13%	-0.10%	-0.06%	-0.10%
	Change (2021M$)	-99	-4,256	-7,379	-9,506	-7,440	-5,253	-9,117
Private Investment	% Change	-0.03%	-0.18%	-0.19%	-0.07%	0.17%	0.33%	0.31%
	Change (2021M$)	-172	-1,040	-1,141	-453	1,200	2,436	2,492

IX. Evaluation of Regulatory Alternatives

Government Code section 11346.2, subdivision (b)(4) requires CARB to consider and evaluate reasonable alternatives to the proposed regulatory action and provide reasons for rejecting those alternatives. This section discusses alternatives evaluated and provides reasons why these alternatives were not included in the proposed ACF regulation. As explained below, no alternative proposed was found to be less burdensome and equally effective in achieving the purposes of the regulation in a manner than ensures full compliance with the authorizing law.

The primary objectives of the proposed ACF regulation include the following:

1. Accelerate the deployment of ZEVs that achieve the maximum emissions reductions possible from medium- and heavy-duty vehicles to assist in the attainment of NAAQS for criteria air pollutants (Health & Safety Code sections 43000.5(b), 43018(a)).

2. Reduce the State's dependence on petroleum as an energy resource and support the use of diversified fuels in the State's transportation fleet (Health & Safety Code Section 43000(e), California Public Resources Code (PRC) section 25000.5). In addition, petroleum use as an energy resource contributes substantially to the following public health and environmental problems: air pollution, acid rain, global warming, and the degradation of California's marine environment and fisheries (PRC section 25000.5(a)).

3. Decrease GHG emissions in support of statewide GHG reduction goals by adopting strategies to deploy medium- and heavy-duty ZEV in California to support the Scoping Plan, which was developed to reduce GHG emissions in California, as directed by SB 32.[445] California's 2017 Climate Change Scoping Plan and 2020 Mobile Source Strategy aim to accelerate development and deployment of the cleanest feasible mobile source technologies and to improve access to clean transportation. Implementation of the proposed ACF regulation would also provide further GHG reductions pursuant to Assembly Bill 1493.[446]

4. Develop a regulation that is consistent with and meets the goals of the SIP, providing necessary emissions reductions from vehicular sources for all of California's non-attainment areas to meet NAAQS (Health & Safety Code sections 39002, 39003, 39602.5, 43000, 43000.5, 43013, 43018).

5. Maintain and continue reductions in emissions of GHGs beyond 2020, in accordance with SB 32 (Health & Safety Code sections 38551(b), 38562, 38562.5, 38566); pursue measures that implement reduction strategies covering the State's GHG emissions in furtherance of California's mandate to reduce GHG emissions to the 1990 level by 2020 and 40 percent below the 1990 level by December 31, 2030. In addition, target and achieve carbon neutrality in California no later than 2045, pursuant to SB 100,[447] and maintain net negative emissions thereafter in accordance with Executive Order B-55-18.

6. Lead the transition of California's medium- and heavy-duty transportation sector from internal combustion engines to ZE technology. Promote this development alongside the manufacturer sales requirements established in the ACT regulation to support ZEV sales, CARB Resolution 20-19 and Executive Order N-79-20 setting a course to transition truck and bus fleets to ZE by 2045 with earlier targets for key segments including drayage operations to ZE by 2035.

7. Complement existing programs and plans to ensure, to the extent feasible, that activities undertaken pursuant to the measures complement, and do not interfere with,

[445] SB 32 (Pavley, Stats. 2016, ch. 249).
[446] AB 1493 (Pavley, Stats. 2002, ch. 200).
[447] SB 100 (De León, Stats. 2018 ch. 312).

existing planning efforts to reduce GHG emissions, criteria pollutants, petroleum-based transportation fuels, and toxic air contaminant emissions.

8. Incentivize and support emerging ZE technology that will be needed to achieve CARB's SIP goals.

9. Achieve maximum technologically feasible emissions reductions of GHGs that are real, permanent, quantifiable, verifiable, and enforceable (Health & Safety Code sections 38560, 38562(d)(1)).

10. Provide market certainty for ZE technologies and fueling infrastructure to guide the acceleration of the development of environmentally superior medium- and heavy-duty vehicles that will continue to deliver performance, utility, and safety demanded by the market.

11. Take steps to ensure all Californians can live, work, and play in a healthful environment free from harmful exposure to air pollution. Protect and preserve public health and well-being, and prevent irritation to the senses, interference with visibility, and damage to vegetation and property (Health & Safety Code section 43000(b)) in recognition that the emission of air pollutants from motor vehicles is the primary cause of air pollution in many parts of the state (Health & Safety Code section 43000(a)).

12. Spur economic activity of ZE technologies in the medium- and heavy-duty vehicle sectors. Incentivize innovation that will transition California's economy into greater use of clean and sustainable ZE technologies and promote increased economic and employment benefits that will accompany this transition (AB 1493,[448] section 1(g); Health & Safety Code Section 38501(e)).

A. List of Alternatives

CARB's portfolio of regulations already working to decarbonize the medium-, and heavy-duty transportation sector began with the ICT regulation CARB adopted in 2018, the ASB regulation and the Zero-Emission Powertrain Certification regulation, which CARB adopted in 2019, and the Advanced Clean Trucks regulation which CARB adopted in 2021. This proposed ACF regulation seeks to build an equitable transition for businesses that works towards decarbonizing the transportation sector in California. Staff listened to stakeholder concerns that involved 19 workshops and 366 meetings over the course of 2 years. Staff considered and integrated many stakeholder's concepts into the proposed ACF regulation. However, since the proposed ACF regulation seeks an optimum balance between feasibility and progress, staff rejected some of the of the concepts that were either more burdensome than the proposed ACF regulation and/or that were not as effective as the proposed ACF regulation. Some concepts staff considered but did not perform detailed emissions and cost projections for include various exemptions and narrowed applicability requirements that could create a market imbalance or opportunities to evade ownership models. And other concepts staff did not analyze because they were financially and administratively infeasible. Staff performed a full detailed cost and benefits analysis for a few proposed alternatives as bookends for this regulatory alternatives' analysis, these include: the least stringent

[448] AB 1493 (Pavley, Stats. 2002, ch. 200).

(combustion) and most stringent (acceleration) alternatives which were analyzed as part of the SRIA and CEQA, Appendix C and D, respectively.

Table 78 provides annual criteria emissions reductions benefits of these alternatives and staff's proposed ACF regulation, when compared to Legal Baseline or BAU. Staff's proposed ACF regulation is estimated to achieve 1.7 times the NOx and 16.7 times the PM2.5 emissions reductions benefits as the least stringent alternative. However, when compared to the most stringent alternative, staff's proposed ACF regulation is estimated to achieve 60 percent of the NOx and 63 percent of the PM2.5 benefits. Table 79 shows the valuation of the health benefits attributed to the criteria emissions reductions. The total statewide valuation of health benefits of the less stringent alternative is less than half of the proposed ACF regulation at about $25.6 billion and the more stringent alternative is about $34.3 billion more in health benefits than the proposed ACF regulation at $92.1 billion.

Table 78: Criteria Pollutant Reduction Comparisons to Business-as-Usual for the Staff Proposed ACF regulation, Less (Combustion) and More (Acceleration) Stringent Alternatives

Year	Alt. 1 (Combustion) NOx (tpd)	Proposed ACF regulation NOx (tpd)	Alt. 2 (Acceleration) NOx (tpd)	Alt. 1 (Combustion) PM2.5 (tpd)	Proposed ACF regulation PM2.5 (tpd)	Alt. 2 (Acceleration) PM2.5 (tpd)
2024	0.42	2.39	5.52	0.0002	0.03	0.07
2025	1.41	2.69	7.87	0.0032	0.04	0.12
2026	2.83	3.69	12.75	0.0059	0.05	0.20
2027	5.30	5.96	19.21	0.012	0.08	0.30
2028	8.04	7.78	25.23	0.018	0.11	0.40
2029	10.59	10.91	31.01	0.024	0.16	0.52
2030	13.49	15.24	37.83	0.034	0.24	0.64
2031	16.35	19.99	46.47	0.041	0.33	0.80
2032	19.13	24.42	55.21	0.045	0.41	0.97
2033	21.37	28.23	63.46	0.045	0.48	1.13
2034	23.66	34.05	72.28	0.048	0.60	1.30
2035	26.24	40.67	81.45	0.055	0.72	1.49
2036	27.94	46.12	87.06	0.055	0.83	1.61
2037	29.67	51.99	92.91	0.058	0.95	1.79
2038	31.38	58.15	98.92	0.061	1.07	1.95
2039	33.08	63.94	104.89	0.066	1.20	2.11
2040	34.78	68.59	106.71	0.071	1.31	2.19
2041	36.47	73.78	108.78	0.077	1.48	2.26
2042	38.14	79.56	111.01	0.084	1.64	2.34
2043	39.79	80.51	113.35	0.090	1.70	2.42
2044	41.41	81.65	115.90	0.096	1.77	2.50
2045	43.01	83.89	118.70	0.10	1.86	2.58
2046	44.57	86.30	121.83	0.11	1.94	2.67
2047	46.09	88.91	125.12	0.11	2.03	2.76
2048	47.59	91.66	128.58	0.12	2.12	2.85
2049	49.09	94.44	132.17	0.19	2.21	2.94

2050	50.60	97.24	135.93	0.12	2.29	3.03
Total[449]	**231,637**	**418,938**	**673,970**	**519**	**8,627**	**13,710**

Table 79: Health Benefits Comparisons to Business-as-Usual for the Staff Proposed ACF Regulation, Less (Combustion) and More (Acceleration) Stringent Alternatives (Million 2021$)

Year	Alternative 1 (Combustion)	Proposed ACF regulation	Alternative 2 (Acceleration)
2024	$10.45	$83.75	$188.46
2025	$41.93	$94.20	$272.21
2026	$83.75	$125.68	$450.28
2027	$167.55	$209.43	$691.13
2028	$251.30	$282.73	$921.53
2029	$335.05	$397.90	$1,162.44
2030	$429.37	$575.97	$1,434.77
2031	$523.63	$764.54	$1,790.85
2032	$617.90	$942.55	$2,146.93
2033	$701.70	$1,110.17	$2,503.12
2034	$785.45	$1,351.08	$2,880.22
2035	$879.77	$1,633.92	$3,299.20
2036	$942.67	$1,874.83	$3,550.68
2037	$1,005.51	$2,126.25	$3,854.37
2038	$1,068.35	$2,398.58	$4,147.72
2039	$1,131.19	$2,660.45	$4,441.02
2040	$1,194.03	$2,880.39	$4,556.30
2041	$1,267.38	$3,152.78	$4,692.49
2042	$1,330.22	$3,435.56	$4,828.63
2043	$1,393.07	$3,519.37	$4,964.82
2044	$1,455.91	$3,603.18	$5,111.52
2045	$1,518.80	$3,739.37	$5,268.62
2046	$1,581.64	$3,875.56	$5,425.84
2047	$1,644.48	$4,011.81	$5,603.91
2048	$1,696.87	$4,158.46	$5,782.03
2049	$1,759.77	$4,315.62	$5,960.22
2050	$1,812.15	$4,462.26	$6,148.74
Total*	**$25,629.94**	**$57,786.37**	**$92,078.05**

*Totals may not add up due to rounding.

Table 80 shows the annual CO_2 emissions reductions benefits of these alternatives and staff's proposed ACF regulation, when compared to Legal Baseline or BAU. Staff's proposed ACF regulation is estimated to achieve about 307 MMT CO_2 emissions reductions benefits more

[449] The total cumulative emissions reductions for PM2.5 and NOx are converted from tons per day into years and assumes 312 operational days per year. Due to rounding errors, the 2024-2050 cumulative totals differ very slightly when compared to the sum values listed.

than both BAU and the least stringent alternative. Compared to the most stringent alternative, staff's proposed ACF regulation is estimated to achieve 65 percent of the 472 MMT CO_2 benefits. The avoided cost benefits attributed to these estimated CO_2 emissions reductions are about $9.4 to $36.4 billion through 2050 when compared to the least stringent alternative. However, the more stringent alternative avoided cost benefits attributed to the GHG emissions reductions are about $13.5 to $54.4 billion through 2050. The avoided cost benefits are the SC-CO_2 discussed in detail in GHG Benefits Section.

Table 80: Greenhouse Gas Reduction Comparisons to Business-as-Usual for the Staff Proposed ACF Regulation, Less (Combustion) and More (Acceleration) Stringent Alternatives (Million 2021$)

Year	Alternative 1 (Combustion) CO_2 (MMT/yr.)	Proposed ACF regulation CO_2 (MMT/yr.)	Alternative 2 (Acceleration) CO_2 (MMT/yr.)
2024	0	0.26	0.83
2025	0	0.45	1.57
2026	0	0.81	2.67
2027	0	1.35	4.00
2028	0	1.79	5.22
2029	0	2.53	6.55
2030	0	3.52	7.96
2031	0	4.55	9.72
2032	0	5.54	11.52
2033	0	6.34	13.16
2034	0	7.52	14.89
2035	0	8.84	16.73
2036	0	9.84	17.86
2037	0	10.91	19.42
2038	0	12.04	20.95
2039	0	13.16	22.43
2040	0	14.26	23.11
2041	0	16.00	23.83
2042	0	17.63	24.56
2043	0	18.32	25.29
2044	0	19.02	26.04
2045	0	19.89	26.84
2046	0	20.76	27.68
2047	0	21.65	28.53
2048	0	22.55	29.39
2049	0	23.42	30.26
2050	0	24.27	31.15
Total*	**0**	**307.24**	**472.16**

*Totals may not add up due to rounding.

Table 81 shows the net cost and benefits to California's economy for staff's proposed ACF regulation as well as the least and most stringent alternatives, when compared to Legal Baseline or BAU. The cost to the California economy when assuming all costs occur in

California would be $3.5 billion between 2024 and 2050 in the least stringent alternative versus the Legal Baseline. Staff's proposed ACF regulation and the most stringent alternative have the most cost-savings at $22.1 billion and $22.5 billion, respectively. The benefit-cost ratio is greater than one in all cases suggesting that other metrics need to be considered when evaluating the proposal in comparison to alternatives. The total benefits of the proposal and Alternative 2 compared to Alternative 1 results in twice the health benefits and substantial GHG benefits that are not quantified in Table 80. Finally, the net benefit is the total benefits minus the total costs. This analysis shows that Alternative 2 (Acceleration) has more benefits than costs than both the least stringent Alternative 1 (Combustion) and the proposed ACF regulation. The reasons for rejecting the alternatives are discussed in more detail below.

Table 81: Total Statewide Benefit and Cost Comparison to Business-as-Usual of the Staff Proposed ACF Regulation, Alternative 1 (Combustion) and Alternative 2 (Acceleration)

Scenario	Total Costs	Cost-Savings	Net Costs	Health Benefits	Tax and Fee Revenue	Total Benefit*	Net Benefit**	Benefit: Cost Ratio
Combustion (less)	$6.7	$3.5	$3.2	$25.6	$0.7	$29.8	$23.1	4.5
Proposed ACF regulation	$63.4	$85.5	-$22.1	$57.8	-$33.0	$110.3	$46.9	1.7
Acceleration (more)	$112.5	$135.0	-$22.5	$92.1	-$57.9	$169.2	$56.7	1.5

*Total benefit is the sum of cost savings, health benefits, and tax and fee revenue.
**Net benefit is the total benefit minus the total costs.

1. Cleaner Combustion—Less Stringent

This alternative is less stringent than the proposed ACF regulation. This alternative is based on an alternative concept suggested by the California Council for Environmental and Economic Balance and applies to the same fleets as the proposed ACF regulation. [450] This alternative is characterized as a "cleaner combustion" option that would count engines certified to the Heavy-Duty Omnibus regulation equivalent to a ZEV purchase for the same regulated fleets as the proposed ACF regulation.

Under this alternative, regulated fleets would have the option to meet compliance requirements by purchasing a combination of ZEVs or engines certified to the engine standards established by the Heavy-Duty Omnibus regulation. All medium- and heavy-duty engines sold in California need to be certified to the latter standards, regardless of fuel type. Engines certified in California to the Omnibus regulation starting in 2024 are initially certified to standards 75 percent to 90 percent lower than U.S. EPA certified engines and have

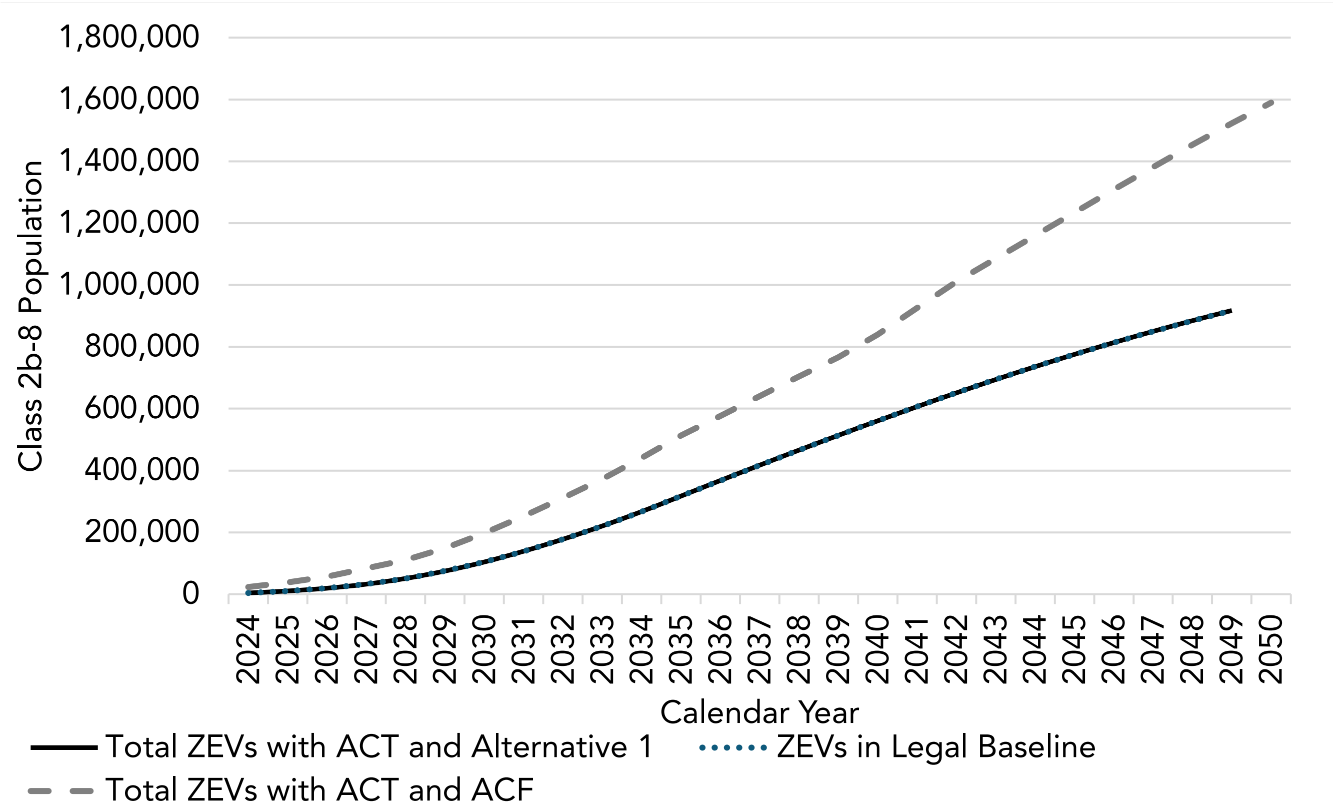
[450] California Council for Economic and Environmental Balance, *Re:Comments on Advanced Clean Fleets Proposed ACF regulation and Alternatives for the Environmental Analysis*, 2021 (web link: https://www.arb.ca.gov/lists/com-attach/29-acf-comments-ws-UDNUMVUxUGZWMlcl.pdf, last accessed August 2022).

additional requirements that ensure real world emissions remain low for a longer period of time in all modes of operation through improved test procedures, lengthened warranty, strengthened durability demonstrations, and other emissions control requirements.[451] We expect real world NOx emissions to be about 90 percent lower during the life of the vehicle than existing engines starting in 2024.

In this alternative, starting in 2024, State and local government fleets and high priority fleets would be required to purchase either ZEVs or engines certified to the California Heavy-Duty Omnibus engine standards. For State and local government fleets, this alternative is not expected to result in any changes because they already buy California certified engines. For high priority and federal fleets, this alternative is projected to result in accelerated emissions benefits and increased costs, as the fleets that would have otherwise normally purchased used federally certified engines in the baseline, would now be required to purchase new California Heavy-Duty Omnibus certified engines. For drayage fleets, pre-2024 MY trucks would be removed from the CARB drayage Online System at the end of their useful life and all vehicles added in the Online System would be either a ZEV or 2024 MY or newer engine certified to the Heavy-Duty Omnibus requirements. Under this alternative, the number of ZEVs would not increase beyond what is projected from the ACT regulation already reflected in the Legal Baseline. The Cleaner Combustion Alternative results in NOx emissions benefits relative to the Legal Baseline from the more stringent NOx standards of California certified engines compared to federal engine standards. This alternative also results in some PM2.5 emissions benefits and negligible GHG benefits. Figure 75 illustrates the ZEV population over time under combustion (Alternative 1) which results in roughly 650,000 ZEVs by 2035 and 950,000 ZEVs by 2050, the same number as in the Legal Baseline. This represents 200,000 fewer ZEVs by 2035 and 650,000 fewer ZEVs by 2050 when compared to the proposed ACF regulation. Because of the identical number of ZEVs between combustion (Alternative 1) and the Legal Baseline, the "ZEVs due to ACT" line overlaps with the "Total ZEVs" line.

[451] California Air Resources Board, *Heavy-Duty Omnibus: Appendix D – Emissions Inventory and Results for the Proposed Amendments*, 2020 (web link: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2020/hdomnibuslownox/appd.pdf, last accessed August 2022).

Figure 75: Statewide Vehicle Population Forecast over Time under Combustion (Alternative 1)



Although (Alternative 1) results in lower NOx, PM2.5, and GHG emissions compared to the Legal Baseline scenario, it is important to note that this alternative results in significantly fewer NOx, PM2.5, and GHG benefits compared to the proposed ACF regulation. Indeed, this result is readily apparent when considering the faulty underlying premise of this alternative – that the exhaust emissions generated by trucks powered by engines that emit low levels of emissions (e.g., 0.02 grams of NOx), are equivalent to emissions generated by trucks that emit zero emissions of criteria pollutants or GHGs.

Alternative 1 produces less criteria emissions reductions than the proposed ACF regulation, is less effective at meeting California's SIP obligations, and does not make progress towards meeting the State's GHG reduction targets. In addition, this alternative is not projected to result in any additional near-term emissions reductions compared to the proposed ACF regulation. Figure 76, Figure 77, and Figure 78 show the difference in GHG, NOx, and PM2.5 emissions between combustion (Alternative 1), the Legal Baseline, and the proposed ACF regulation.

Figure 76: Projected Greenhouse Gas Emissions under Legal Baseline, Proposed ACF Regulation, and Combustion (Alternative 1)

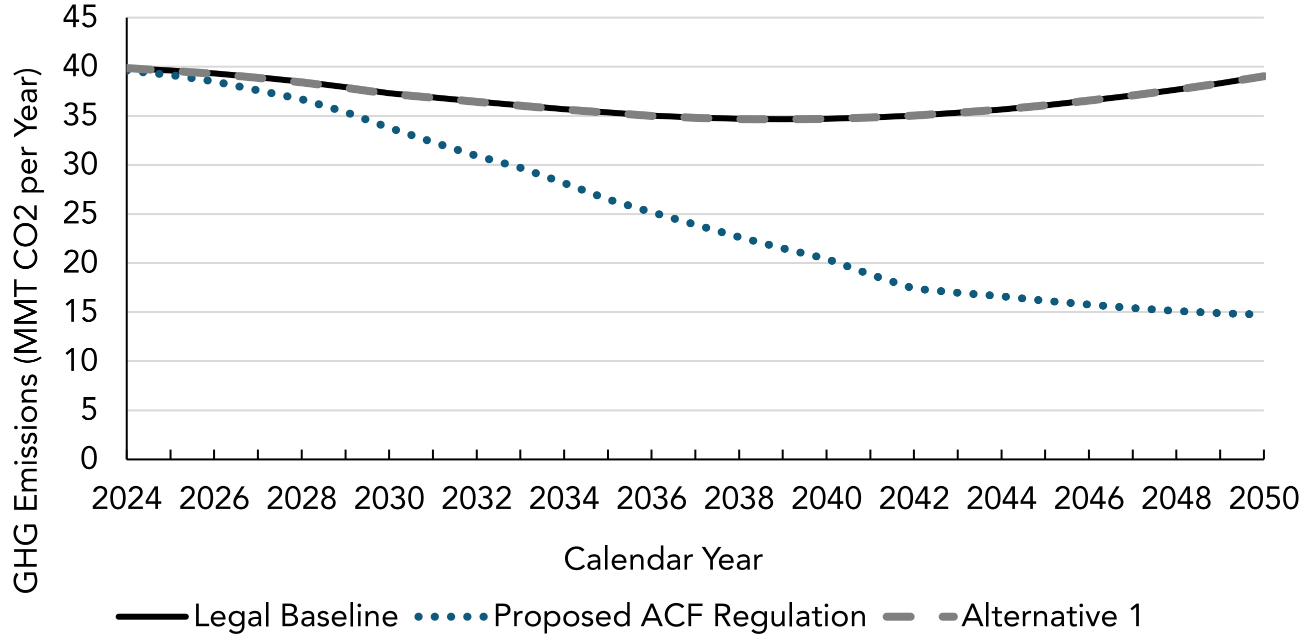


Figure 77: Projected NOx Emissions under Legal Baseline, Proposed ACF Regulation, and Combustion (Alternative 1)

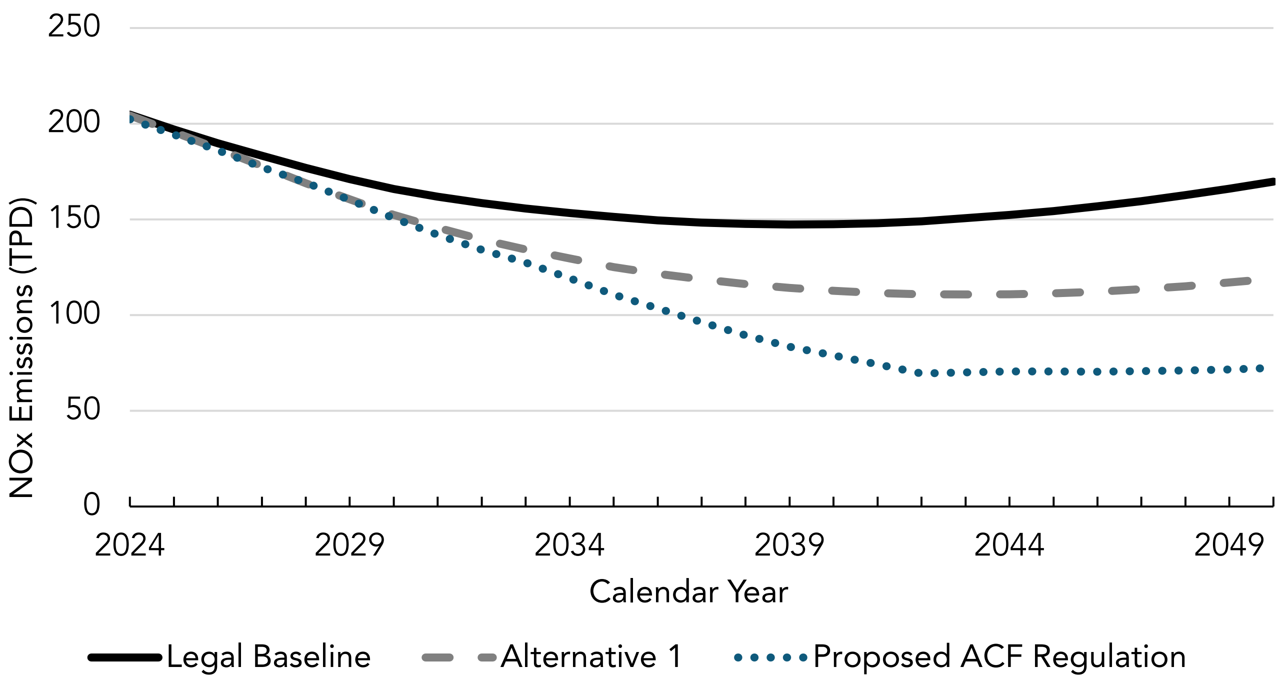
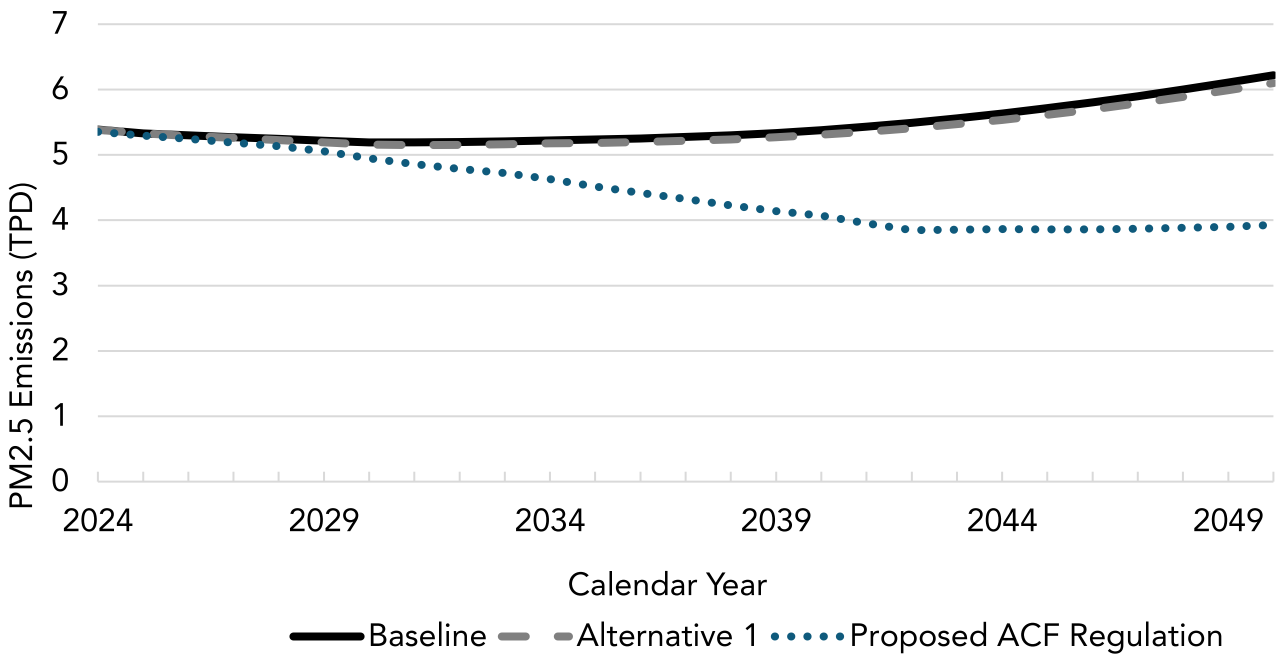


Figure 78: Projected PM2.5 Emissions under Legal Baseline, Proposed ACF Regulation, and Combustion (Alternative 1)



The Cleaner Combustion (Alternative 1) results in emissions reductions relative to the Legal Baseline leading to health benefits as shown in Table 82. The health benefits for this alternative are less than those of the proposed ACF regulation due to less emissions reductions estimated. The total statewide valuation of health benefits of the less stringent alternative is estimated to be $25.6 billion as summarized in Table 82.

Table 82: Statewide Valuation from Avoided Health Outcomes for Combustion Alternative 1 (Million 2021$)

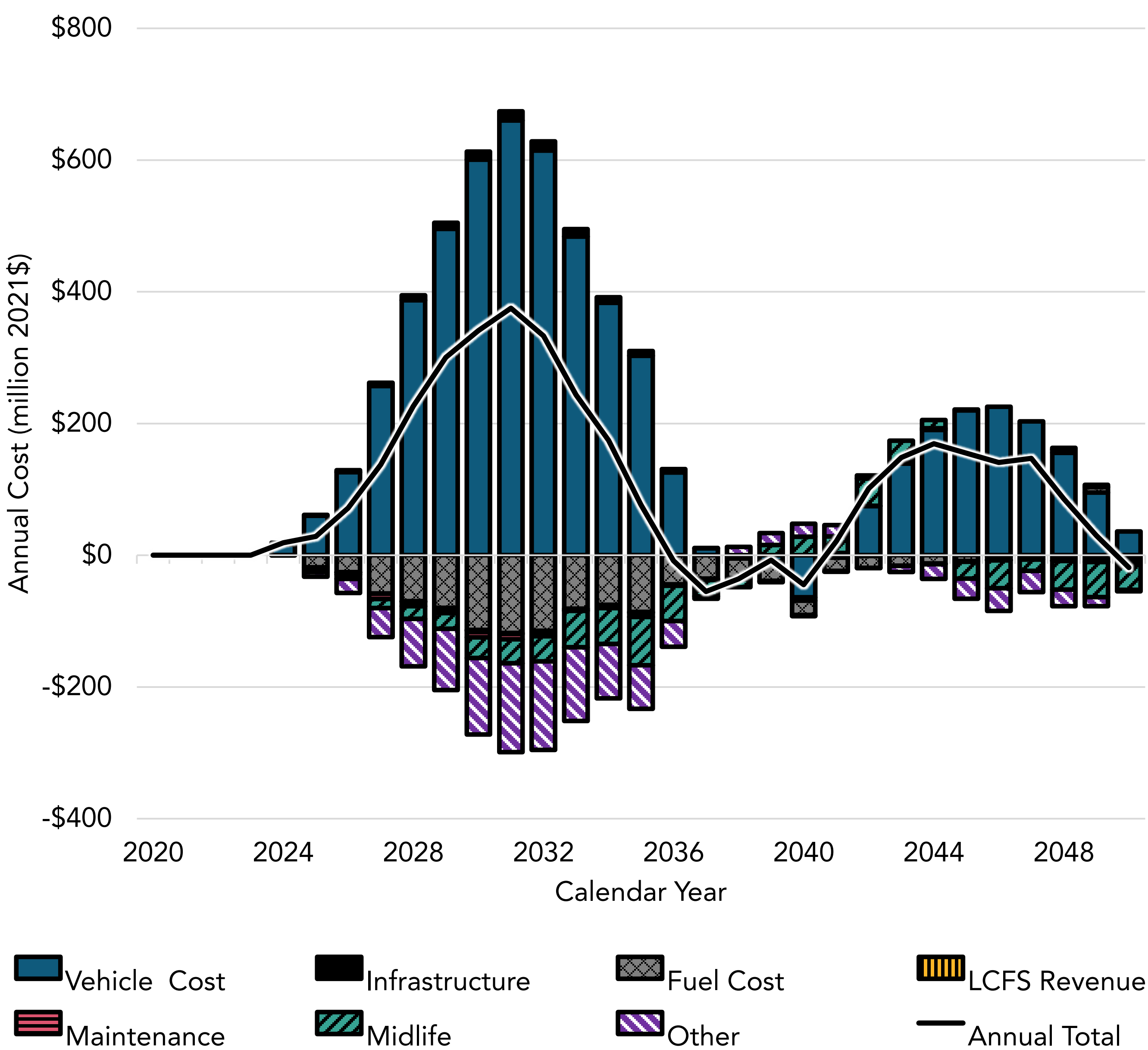
Calendar Year	Avoided Cardiopulmonary Mortality	Avoided Hospitalizations for Cardiovascular Illness	Avoided Hospitalizations for Respiratory Illness	Avoided ER Visits	**Total Avoided Annual Valuation**
2024	1	0	0	1	**$10.5**
2025	4	1	1	2	**$41.9**
2026	8	1	1	4	**$83.8**
2027	16	2	3	8	**$165.6**
2028	24	3	4	12	**$251.3**
2029	32	4	5	15	**$335.1**
2030	41	6	7	20	**$429.4**
2031	50	7	9	24	**$523.6**
2032	59	9	10	28	**$617.9**
2033	67	10	12	32	**$701.7**
2034	75	11	13	35	**$785.5**
2035	84	13	15	39	**$879.8**

Calendar Year	Avoided Cardiopulmonary Mortality	Avoided Hospitalizations for Cardiovascular Illness	Avoided Hospitalizations for Respiratory Illness	Avoided ER Visits	**Total Avoided Annual Valuation**
2036	90	14	17	42	**$942.7**
2037	96	15	18	44	**$1,005.5**
2038	102	16	19	47	**$1,068.4**
2039	108	17	20	50	**$1,131.2**
2040	114	18	21	53	**$1,194.0**
2041	121	19	23	55	**$1,267.4**
2042	127	20	24	58	**$1,330.2**
2043	133	21	25	61	**$1,393.1**
2044	139	22	26	63	**$1,455.9**
2045	145	23	28	66	**$1,518.8**
2046	151	24	29	68	**$1,581.6**
2047	157	25	30	71	**$1,644.5**
2048	162	26	31	73	**$1,698.9**
2049	168	27	33	75	**$1,759.8**
2050	173	28	34	78	**$1,812.2**
Total*	**$22,580.1**	**$23.6**	**$24.7**	**$1.0**	**$25,629.9**

*Note: Totals may differ due to rounding.

This alternative results in incremental costs of California certified engines versus federal certified engines which is partially offset by incremental savings associated with projected improved fuel economy of newer vehicles. The cost to the California economy when assuming all costs occur in California would be $3.5 billion between 2024 and 2050 in combustion (alternative 1) versus the Legal Baseline. Figure 79 illustrates the incremental difference in cost between combustion (Alternative 1) and the Legal Baseline scenario.

Figure 79: Total Estimated Direct Costs of Alternative 1 Relative to the Legal Baseline Scenario (Million 2021$)



a) Reason for Rejecting

Combustion (Alternative 1) is rejected because it is less effective at reducing emissions of criteria pollutants and greenhouse gases as the proposed ACF regulation. As shown in Table 78, Alternative 1 achieves minimal reductions of PM2.5 and greenhouse gases, and achieves significantly less reductions of NOx emissions (approximately 50 short tons less NO_X per day in 2049) than the proposed ACF regulation. This factor is critical because California needs to achieve the greatest degree of emissions reductions from criteria pollutants and greenhouse gases in order to reduce the serious risks to the health and welfare of Californians posed by such pollutants, to attain State and federal ambient air quality standards, and to address climate change-induced harms and carbon neutrality goals. Combustion (Alternative 1) also does not effectively advance the deployment of heavy-duty ZEVs as compared to the proposed ACF regulation, and is accordingly not consistent with the goals established by the Governor in multiple Executive Orders and by the Board. ZEV deployments are a key part of the SIP Strategy, and the Climate Change Scoping Plan as a necessary component needed to both improve California's air quality and to achieve the State's climate protection goals. Therefore, this alternative is rejected because it would not achieve the greatest degree of emissions reductions from criteria pollutants and GHGs that are needed to reduce the serious risks to the health and welfare of Californians posed by such pollutants, to attain State and federal ambient air quality standards, and to address climate change-induced harms and carbon neutrality goals. In addition, the alternative fails to advance the deployment of heavy-duty ZEVs, as expressed in direction by the Governor and the Board, as effectively as the proposed ACF regulation.

2. Accelerated Zero-Emission Vehicle Transition—More Stringent

Proposed by a coalition of 20 environmental, environmental justice, health, science-based advocacy, and labor organizations, this alternative proposes a more aggressive ZEV transition than the proposed ACF regulation. [452] Under this concept, the following modifications would be made to the proposed ACF regulation, all of which increase the stringency:

- Applicability for high priority and federal fleets would be expanded to include to any fleet which has ten tractors or more.
- The 100 percent manufacturer ZEV sales requirement would be accelerated to begin in 2036.
- The requirements for high priority and federal fleets would be accelerated by
    - Setting the ZEV Milestones Option for Group 2 vehicles to be the same as Group 1 which begins at 10 percent in 2025 ramping up to 100 percent in 2035; and
    - Setting the ZEV Milestones Option for sleeper cab tractors in Group 3 to be the same as the proposed Group 2 requirements which begins at 10 percent in 2027 ramping up to 100 percent in 2039.

The Accelerated ZEV Transition Alternative results in more medium- and heavy-duty ZEVs deployed than the Legal Baseline scenario and the proposed ACF regulation, and achieves more emissions benefits than the proposed ACF regulation. Figure 80 displays the alternative versus the Legal Baseline and proposed ACF regulation. The Accelerated ZEV Transition Alternative results in roughly 560,000 ZEVs by 2035 and 1,810,000 ZEVs by 2050. This is an increase of 860,000 ZEVs by 2050 versus the Legal Baseline and 230,000 more ZEVs in 2050 than the proposed ACF regulation. Criteria and GHG pollutant emissions reductions are shown in Figure 80, Figure 81, and Figure 82.

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[452] 20 undersigned environmental, *Environmental justice, health, science-based advocacy, and labor organizations letter to CARB*, September 27, 2021 (web link: https://www.arb.ca.gov/lists/com-attach/64-acf-comments-ws-AGNXPlI+AD4BYgBu.pdf, last accessed August 2022).

Figure 80: Statewide Population Forecast over Time under Accelerated Zero-Emission Vehicle Transition (Alternative 2)

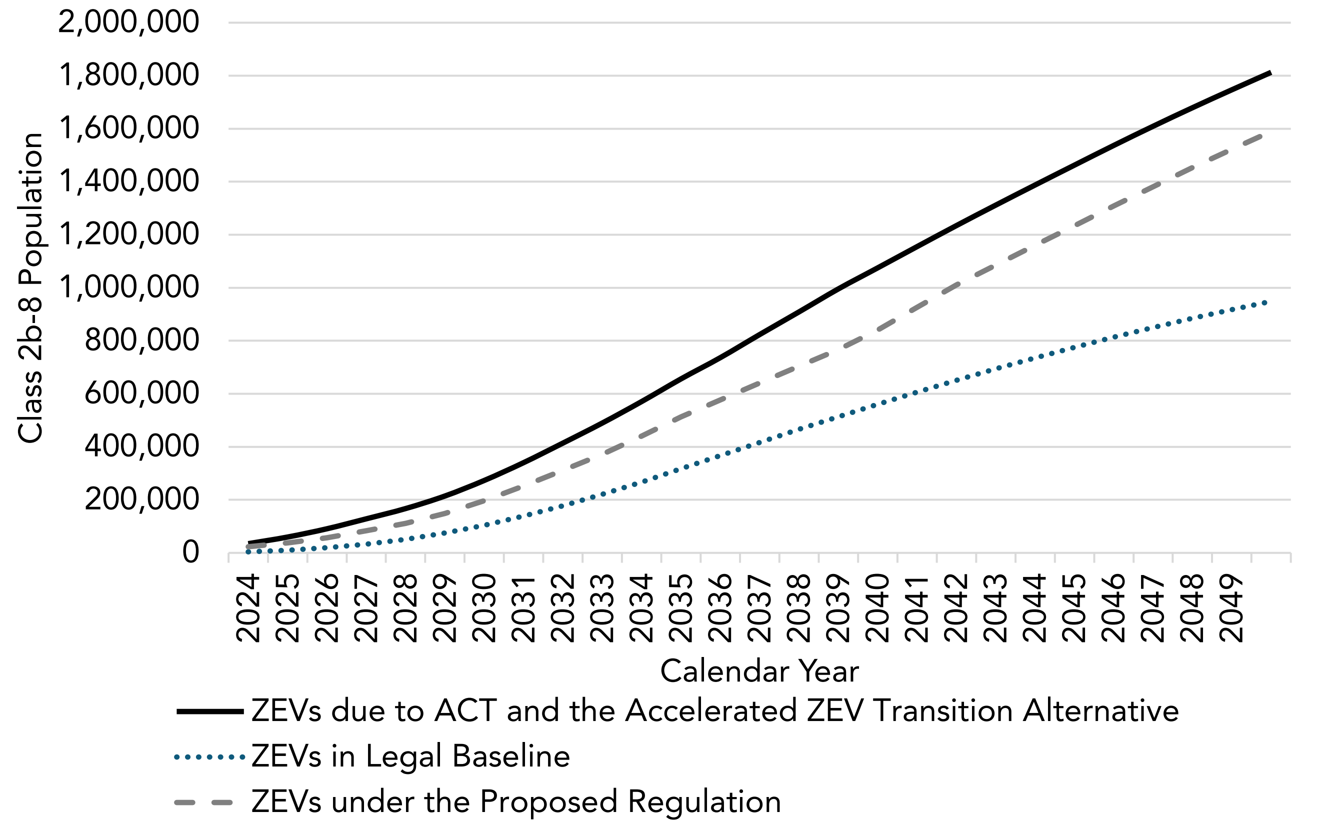


Figure 81: Projected NOx Emissions under Legal Baseline, Proposed ACF Regulation, and Accelerated Zero-Emission Vehicle Transition (Alternative 2)

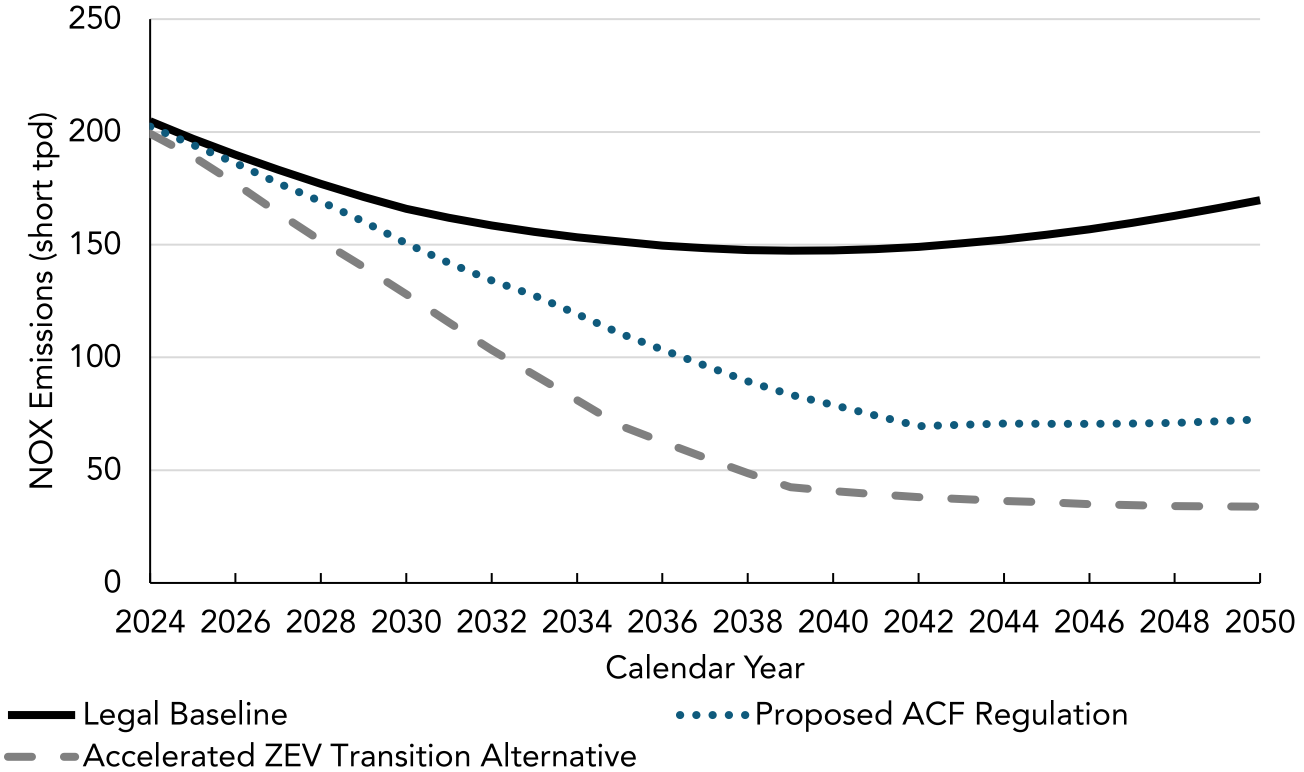


Figure 82: Projected PM2.5 Emissions under Legal Baseline, Proposed ACF Regulation, and Accelerated Zero-Emission Vehicle Transition (Alternative 2)

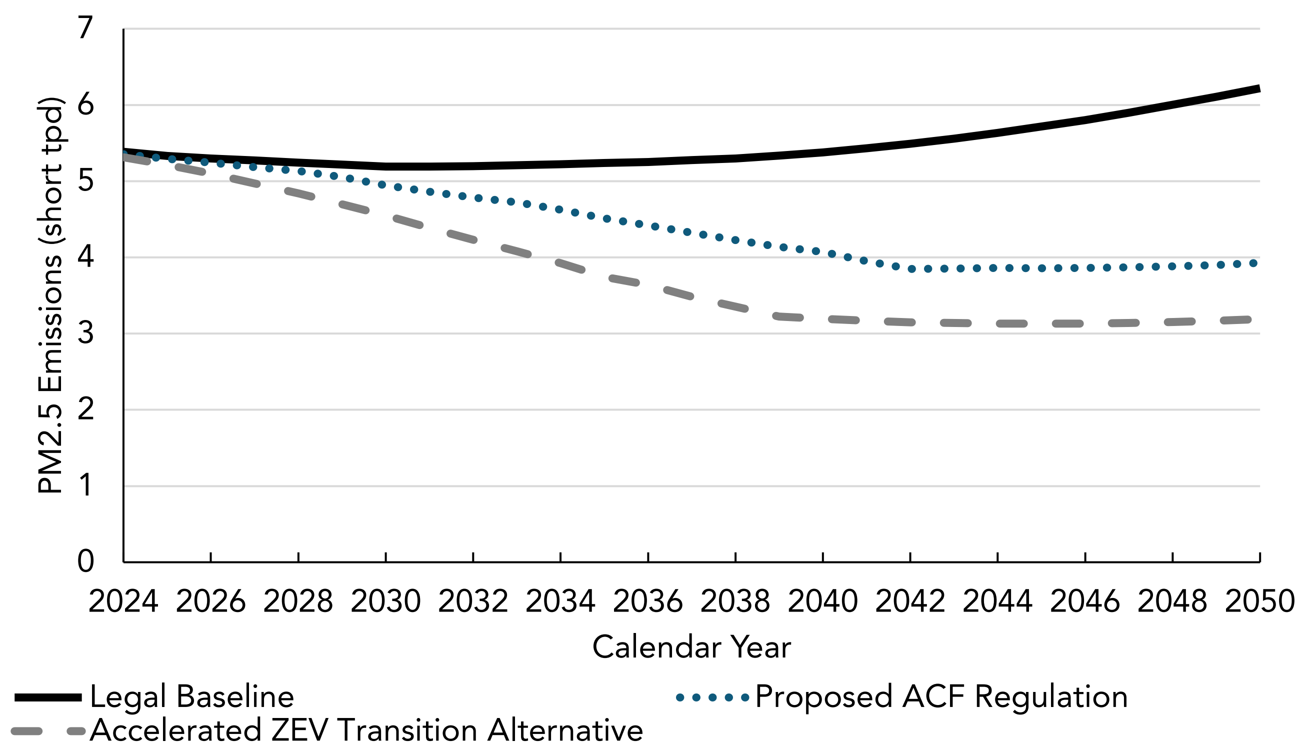
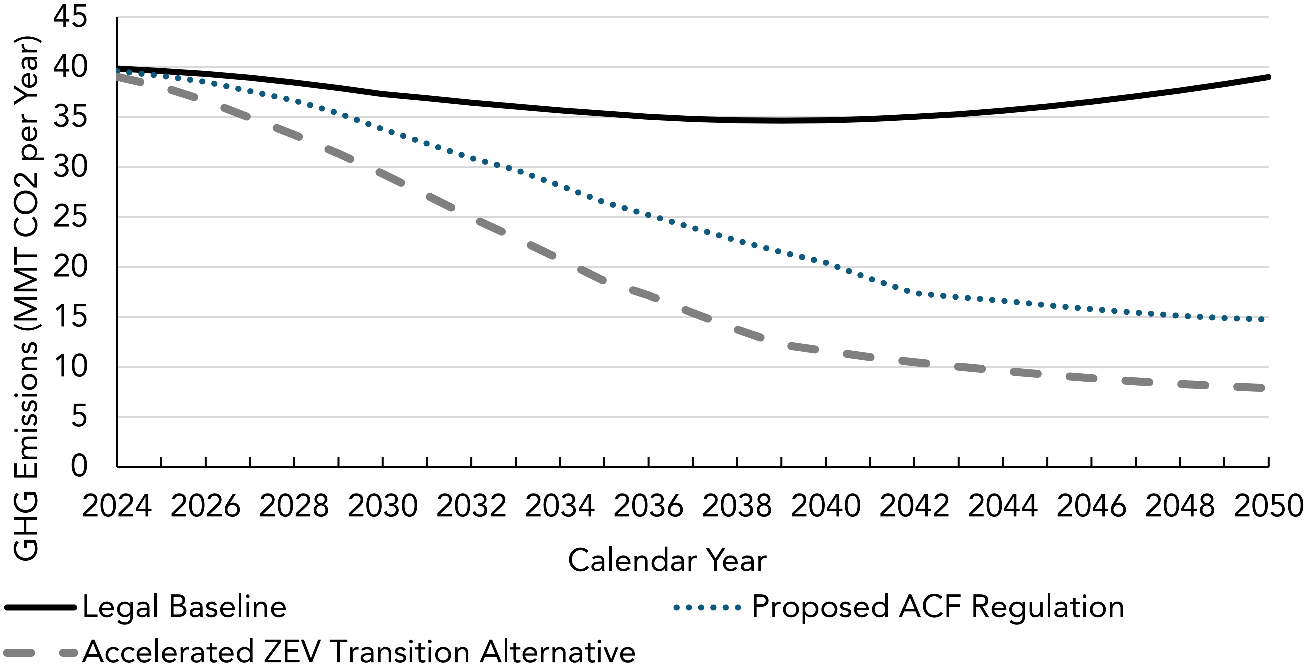


Figure 83: Projected Greenhouse Gas Emissions under Legal Baseline, Proposed ACF Regulation, and Accelerated Zero-Emission Vehicles Transition (Alternative 2)



The Accelerated ZEV Transition Alternative results in emissions reductions relative to the Legal Baseline leading to health benefits. The health benefits for this alternative are more than those of the proposed ACF regulation due to more emissions reductions estimated. The total statewide valuation of health benefits of the more stringent alternative is estimated to be $92 billion as summarized in Table 83. Totals may not add up due to rounding.

Table 83: Statewide Valuation from Avoided Health Outcomes for Accelerated Zero-Emission Vehicle Transition (Alternative 2) (Million 2021$)

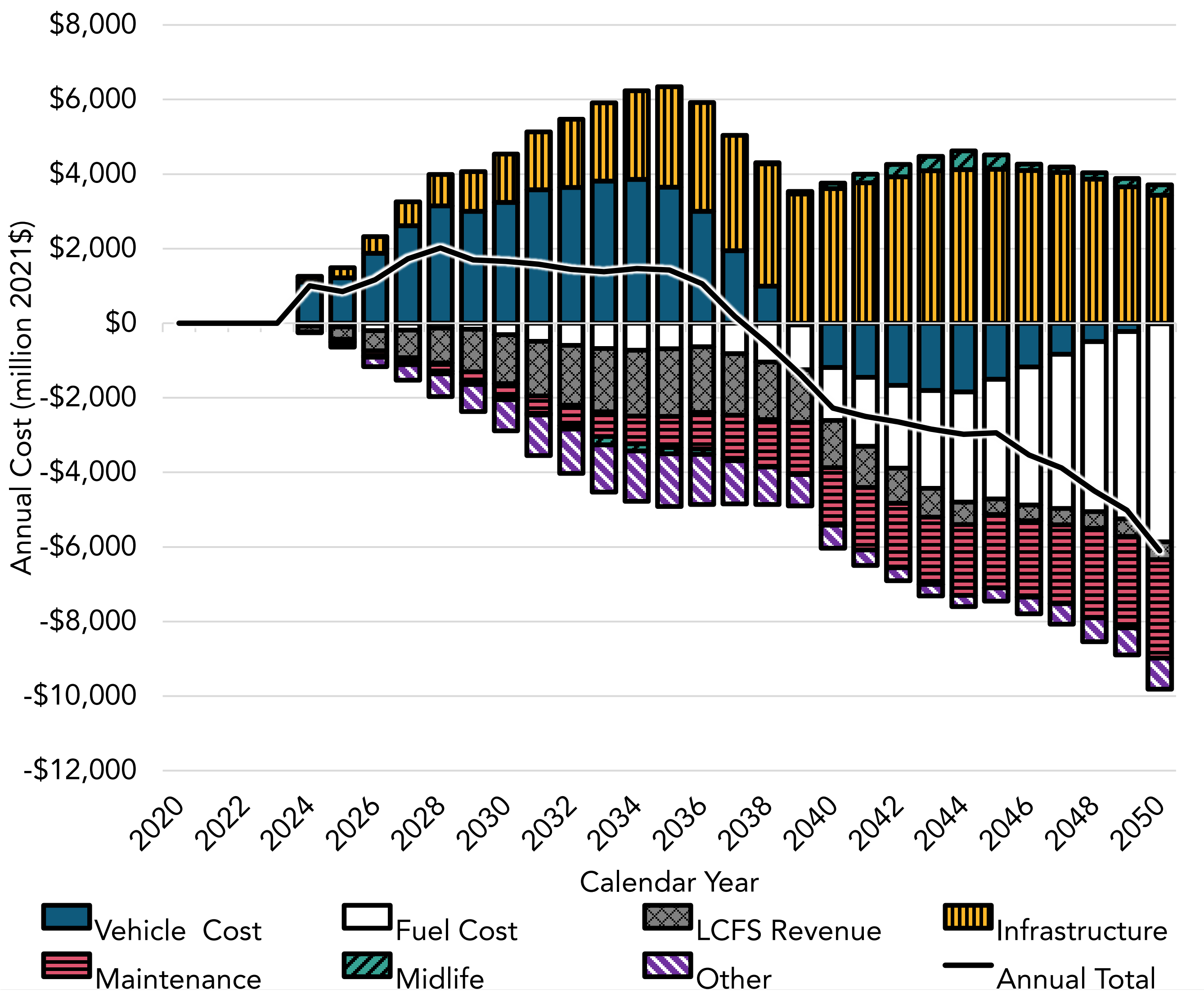
Calendar Year	Avoided Cardiopulmonary Mortality	Avoided Hospitalizations for Cardiovascular Illness	Avoided Hospitalizations for Respiratory Illness	Avoided ER Visits	**Total Avoided Annual Valuation**
2024	18	2	3	9	**$188.46**
2025	26	3	4	13	**$272.21**
2026	43	6	7	21	**$450.28**
2027	66	9	11	32	**$691.13**
2028	88	12	15	43	**$921.53**
2029	111	16	19	53	**$1,162.44**
2030	137	20	24	66	**$1,434.77**
2031	171	25	30	81	**$1,790.85**
2032	205	30	36	98	**$2,146.93**
2033	239	36	43	113	**$2,503.12**
2034	275	42	50	130	**$2,880.22**
2035	315	48	58	148	**$3,299.20**
2036	339	53	63	159	**$3,550.68**

Calendar Year	Avoided Cardiopulmonary Mortality	Avoided Hospitalizations for Cardiovascular Illness	Avoided Hospitalizations for Respiratory Illness	Avoided ER Visits	**Total Avoided Annual Valuation**
2037	368	57	68	172	**$3,854.37**
2038	396	62	74	184	**$4,147.72**
2039	424	67	79	196	**$4,441.02**
2040	435	69	82	201	**$4,556.30**
2041	448	71	85	206	**$4,692.49**
2042	461	73	87	211	**$4,828.63**
2043	474	75	90	217	**$4,964.82**
2044	488	78	93	223	**$5,111.52**
2045	503	80	96	229	**$5,268.62**
2046	518	83	100	236	**$5,425.84**
2047	535	86	103	243	**$5,603.91**
2048	552	89	107	250	**$5,782.03**
2049	569	93	111	257	**$5,960.22**
2050	587	96	114	265	**$6,148.74**
Total*	**$91,900.21**	**$85.28**	**$88.98**	**$3.59**	**$92,078.05**

*Note: Totals may differ due to rounding.

This alternative increases the number of medium- and heavy-duty ZEVs sold in California relative to the Legal Baseline. ZEV sales would also be higher than under the proposed ACF regulation. This results in higher initial costs and lower net costs to California compared to the Legal Baseline. The cost to the California economy when assuming all costs occur in California would be -$22.5 billion between 2024 and 2050 for this alternative versus the Legal Baseline. Figure 84 illustrates the incremental difference in cost between this alternative and the Legal Baseline scenario. The negative costs correspond to a net savings.

Figure 84: Total Estimated Direct Costs of Accelerated Zero-Emission Vehicle Transition Alternative Relative to the Legal Baseline Scenario (Million 2021$)



a) Reason for Rejecting

The Accelerated ZEV Transition Alternative would expand the number of tractor fleets regulated, accelerate requirements for day cabs, sleeper cabs, and work trucks, and bring the 100 percent ZEV sales requirement forward to 2036 MY. This alternative is rejected as the more aggressive timeframe raises questions about feasibility for certain fleets in the near-term while the ZEV market is still developing. Increasing the requirements further by accelerating regulatory deadlines would introduce potential market imbalances between required ZEV sales and purchases. Also, during the transition this alternative would affect more fleets and lessons learned may not be leveraged which could slow progress during early implementation. This alternative would immediately bring in a wide range of smaller businesses that could have less access to capital versus larger fleets and might face difficulty making the needed investments in zero-emission vehicles and infrastructure. Additionally, many of these smaller businesses may not operate in major transportation corridors where retail infrastructure is more likely to be sited in the early years and will need to install infrastructure. Smaller fleets may also be at a disadvantage since these small businesses may not be easily adjust their prices in comparison to high priority fleets that establish market prices. In addition, earlier requirements for work trucks, day cabs tractors, and sleeper cab tractors raise feasibility concerns regarding the availability of publicly available infrastructure as fleets operating these vehicles are more likely to rely on publicly available infrastructure. This alternative also proposes an earlier end date for combustion technologies which increases risks about feasibility for trucks with more challenging use cases, although the 2036 timeframe does provide time for ZE solutions to be identified.

With an accelerated timeframe, smaller tractor fleets would not have the opportunity to learn from the experiences of early adopters and larger fleets. For a smooth transition to ZEV technologies, sufficient time is needed to build-out maintenance, supply, and infrastructure networks to make a full transition to ZEVs. Smaller fleets are more likely to rely on publicly available charging infrastructure and independent maintenance and service technicians that is still in the process of being developed and may not be available where needed in all cases. Additionally, smaller fleets are more likely to purchase used vehicles, which may not be available as ZEVs due to this alternative's accelerated timeframe. This would as a result in more costly vehicle additions as well as an administrative burden for fleets and CARB staff with potential increases in exemption requests as well as other unintended consequences.

Additionally, market forces need to be considered in expanding the early ZEV market. The ACT regulation guarantees a supply of ZEVs in the California market. However, this alternative would result in a fast ramp-up of additional ZEV demand significantly above the expected supply of ZEVs, that may result put upward pressure on vehicle prices. Market dynamics concentrated in the hands of consumer fleets would help maintain downward price pressures and would bring ZEV costs in line with other technologies sooner. Ultimately, this alternative is rejected because it raises additional questions about timing, introduces additional uncertainty associated with the feasibility of successfully deploying ZEVs in the early market, and results in imbalanced market forces that could slow ZEV deployment. Staff will continue to analyze the rapidly evolving technical progress of these vehicle classes to determine if additional stringency or future regulation is warranted. The end date of 2040 for combustion sales in California was selected to complete a full transition to ZEV, and to meet the goals in Executive Order N-79-20. The 2040 end date provides more than ample time for a steady transition to the clean energy economy utilizing the natural rate of attrition and job sector shifts. Additionally, California endorses the Global MOU on Medium- and Heavy-Duty ZEV which established the same target of 100 percent sales by 2040 to enable a full transition.[453] Staff anticipates that critical regional corridor infrastructure will be available and higher incremental upfront cost for ZEV when compared to ICE vehicles will be overcome by 2040. However, staff will continue to investigate the pros and cons of accelerating the 100 percent ZEV date from 2040 to an earlier date.

[453] Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles. (web link: *https://globaldrivetozero.org/site/wp-content/uploads/2021/12/Global-MOU-ZE-MHDVs-signed-20-Dec-21.pdf*, last accessed August 2022).

B. Other Concepts

1. "Legal Baseline" or Business-as-Usual Baseline

Staff examined the BAU, also referred to as the "Legal Baseline" in the CEQA analysis. In this alternative, the proposed ACF regulation is never developed. This alternative results in roughly 650,000 ZEVs by 2035 and 950,000 ZEVs by 2050, which is well below the ZEV targets established by Executive Order N-79-20 and CARB Resolution 20-19. The ACT manufacturer sales mandate jump starts the ZEV market by accelerating the ZE transition—shifting from innovation to commercialization. This proposed ACF regulation builds on ACT by establishing demand for medium– and heavy-duty trucks, and the much-needed build-out of ZE charging and hydrogen fueling infrastructure.

The No Project Alternative is included only to assist in the analysis and consideration of this portion of the proposed ACF regulation and the action alternatives. It is useful to include a "No Project Alternative" in this analysis for the same reasons that this type of alternative is called for in the State CEQA Guidelines. As noted in the CEQA Guidelines, "the purpose of describing and analyzing a no project alternative is to allow decision-makers to compare the impacts of approving the proposed ACF regulation with the impacts of not approving the proposed ACF regulation" (Cal. Code Regs., tit. 14 § 15126.6(e)(1)). The No Project Alternative also provides an important point of comparison to understand the potential environmental benefits and impacts of the other alternatives.

Beneficial impacts resulting from the proposed ACF regulation would not occur under the No Project Alternative. This would include no reduction of criteria pollutants, toxic air contaminants, and GHGs beyond what is required under existing regulations and would not protect public health. The No Project Alternative would fail to support the manufacturer sales requirements of ZEVs in the ACT regulation and other related programs.

Under the No Project Alternative, the proposed ACF regulation would not occur, and existing conditions would continue. Truck sales would continue as they have been and in line with the projected ZEV sales from the existing ACT regulation which is already expected to result in about 280,000 ZEVs by 2035.

2. Match Advanced Clean Trucks and Advanced Clean Fleets Zero-Emission Vehicle Deployments Exactly

Supported by the Truck and Engine Manufacturers Association, this concept would align ZEV deployment criteria between the proposed ACF regulation with the ACT sales requirements. [454] This concept would require fleets to purchase the same types of commercial ZEVs and in the same quantities as produced by the manufacturers in the ACT rule. To match ZEV sales with fleet demand, manufacturers would be responsible to track the usage of trucks under this alternative, which would be difficult to realistically implement, and would ultimately delay the market availability and deployment of ZEVs. Also embedded in this concept is relief for

[454] Truck and Engine Manufacturers Association, *Letter to CARB*, October 29, 2021 (web link: https://www.arb.ca.gov/lists/com-attach/105-acf-comments-ws-V2VUYlBjVjRSC1Bh.pdf, last accessed August 2022).

the manufacturers from the ACT requirements if a fleet is awarded an exemption from the ACF purchase requirements.

This concept also proposes that manufacturers subject to the ACT regulation generate a full credit for the sale of an NZEV because NZEVs and ZEVs are treated equally under the ACF compliance requirements. To put this in context, under the current ACT regulation manufacturers receive partial ZEV credits for producing NZEVs, whereas the proposed ACF regulation would allow fleets to purchase NZEVs to meet their ZEV obligations if a ZEV is not available or if an NZEV best meets their operational needs, and would allow manufacturers to receive full ZEV credit for producing NZEVs qualifying for those exemptions However, to meet California's GHG reduction goals and move to a 100 percent ZE transportation future, a manufacturer sales requirement that assigns maximum credit to the production and sales of ZEVs over NZEVs is necessary to first ensure ZEVs are available and fully supported as fleet purchase requirements and second allow for NZEV production in the early years to be used as a bridging technology until ZEVs can be fully supported through a well-established infrastructure framework. This alternative would still result in NZEV and ZEV deployment, but it does not incentivize manufacturers to produce more ZEVs than NZEVs than what is already required by ACT.

For this concept, the net cost for ZEV deployment would not change; only the allocation of the cost to the fleet or the manufacturer would differ. As a result, the number of ZEVs would not increase compared to the proposed ACF regulation. Therefore, this alternative was rejected at this time because, compared to the proposed ACF regulation, it fails at meeting all project goals mainly due to the lack of medium- and heavy-duty ZEV deployment, delay in development of depot infrastructure, and lack of market certainty.

3. Exempt Group 2 and 3 Vehicles and Extend Timeline Six Years to Purchase Group 1 Zero-Emission Vehicles

Supported by the California Trucking Association (CTA), this alternative is less stringent than the proposed ACF regulation by proposing changes to the ZEV Milestones Option for high priority fleets and in essence would focus ZEV deployments to vehicles currently contained in Group 1 (light-duty package delivery vehicles, box trucks, vans, buses with two axles, and yard tractors). [455] This alternative would delay the ZEV milestones Group 1 purchase schedule by six years and shift the deployment strategy for new ZEVs in Group 2 (work trucks, day cab tractors, and buses with three axles) and Group 3 (sleeper cab tractors and specialty vehicles) to the public using incentive funding.

This alternative would exempt ZEV requirements for most regional or long-haul applications and fails to provide the market certainty and the needed infrastructure investments to develop a charging or hydrogen fueling network for a 100 percent transition to ZEVs. Additionally, the ZEV purchase delay for all Group 1 vehicles would hinder infrastructure build-out and is contrary to current recommended ZEV deployment strategies that show electrification of these vehicles in last mile delivery applications is feasible today.

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[455] California Trucking Association, *Letter to CARB*, October 29, 2021 (web link: https://www.arb.ca.gov/lists/com-attach/126-acf-comments-ws-AGNQIgFhBHoLbFIm.pdf, last accessed August 2022).

This alternative also recommends relying on incentive funding to spur ZEV deployments for Group 2 and 3 vehicles. To date, CARB has administered over $8 billion dollars in funding to support clean transportation. These investments have played a critical role helping advance technologies and bringing us to where we are today. Although incentives are a critical component for the demonstration phase and early adoption of emerging technologies, they are not a sustainable way for a long-term ZEV transition. This can only be accomplished through well-established goals like those in the ZEV Milestones targets for Groups 1, 2, and 3 vehicles of the proposed ACF regulation. Eliminating Group 2 and Group 3 vehicles from purchase requirements would impact California businesses unequally, and high polluters would continue operating in and around overburdened communities.

This alternative additionally has the potential to create a market imbalance and could create an incentive for fleet owners to change their operating characteristics to be excluded from the requirements. Furthermore, this alternative would achieve much fewer air quality benefits than the proposed ACF regulation and would not be as effective at advancing the adoption of medium- and heavy-duty ZE technologies and develop a self-sustaining ZEV market, which is a cornerstone of California's long-term transportation strategy to reduce localized pollution and GHG emissions.

Furthermore, this alternative would not result in any additional ZEV deployments or would result in significantly fewer ZEV deployments than the proposed ACF regulation. Therefore, this alternative is rejected at this time as it fails to meet objective 1, 4, and 10 due to the deceleration of ZEV deployment, a lack of market certainty for ZE technologies and fueling infrastructure, and failing to meet goals of the SIP, while also being less efficient in meeting objectives 2, 3, 5, 6, 8, 11, and 12 compared to the proposed ACF regulation. Additionally, this alternative would delay development of a retail fueling/charging infrastructure network, associated construction expansion, and scalability. Continuing, this alternative would delay development of a retail fueling/charging infrastructure network, associated construction expansion, and scalability and would not be as effective at meeting program objectives.

4. Exempt Small Fleets and Interstate Truckers

Supported by the Owner-Operator Independent Drivers Association (OOIDA), this alternative is less stringent than the proposed ACF regulation because it would exempt small owners of trucks registered and operated in California that are managed by, or dispatched by, a "controlling party" from meeting the ZEV purchase mandate prior to 2045.[456] This alternative would also exempt any interstate truck owner or operator that drives fewer than 7,500 miles in California in any compliance year. Under the proposed ACF regulation, "controlling parties" act like a fleet owner and are held to the same requirements to avoid shifting business practices with the intention of evading ownership models. Under this alternative, fleets managed by "controlling parties" could modify their dispatch practices to prioritize hiring interstate truck owners to circumvent the proposed ACF regulation's ZEV purchase requirements. Exempting small truck owners that are paid to deliver goods by "controlling

[456] Owner-Operator Independent Driver Association, *Comment letter to CARB*, October 29, 2021 (web link: https://www.arb.ca.gov/lists/com-attach/118-acf-comments-ws-BjRVYwY1UTMAKFBh.pdf, last accessed August 2022).

parties" subject to the proposed ACF regulation would impact California businesses unequally, and high polluters would continue operating in California's communities.

This alternative would not apply to long-haul applications and would not provide the market certainty for the needed infrastructure investments to develop a charging or hydrogen fueling network. Furthermore, in addition to potentially creating a market imbalance, this alternative concept would not be as effective at advancing the adoption of medium- and heavy-duty ZE technologies and develop a self-sustaining ZEV market, which is a cornerstone of California's long-term transportation strategy to reduce localized pollution and GHG emissions. Continuing, this alternative would not result in any additional ZEV deployments or would result in significantly fewer ZEV deployments than the proposed ACF regulation.

Therefore, this alternative was rejected because it fails to meet objective 4 and 10 due to a lack of market certainty for ZE technologies and fueling infrastructure as well as failing to meet goals of the SIP, while also being less efficient in meeting objectives 1, 2, 3, 5, 6, 8, 11, and 12 compared to the proposed ACF regulation. Additionally, this alternative would delay development of a retail fueling/charging infrastructure network, associated construction expansion, and scalability.

5. Exempt Refuse Fleets Subject to Senate Bill 1383

This alternative proposes to exempt a solid waste fleet owner until at least 2040 from ZEV requirements if they meet all of the following criteria: the fleet must be located in-state, owned by or contracted with municipalities implementing SB 1383, collecting and processing in-state organic waste into RNG or working in partnership with a facility producing in-state RNG from their organic waste, and using RNG in their own SWCVs. [457] This alternative is based on comments submitted by CR&R Incorporated and Coalition of Waste Management Providers. This alternative is less stringent because it would exempt a small class of fleet owners and qualifying vehicles, resulting in more emissions than the proposed ACF regulation.

Currently, about half of the refuse trucks that operate in California are fueled by natural gas and the other half are fueled by diesel.[458] Based on this distribution, refuse fleets would be impacted unequally under this alternative and refuse fleets that qualify for this exemption would be granted additional time to purchase and deploy ZEVs. However, refuse fleets that operate diesel-fueled vehicles would not be eligible to delay ZEV deployments. Additionally, refuse vehicles operate in and around neighborhoods with a duty cycle and usage pattern conducive to using a ZE powertrain, e.g., low speed, frequent breaking, and returning to base at night. This alternative would delay the transition to a ZE transportation system and would simply prolong the BAU conditions for these fleets.

Natural gas engine NOx emissions are no different than diesel starting in 2024 because of the Heavy-Duty Omnibus regulation as previously described. In addition, natural gas vehicles are not expected to achieve any GHG reductions and generally have a 15 to 20 percent

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[457] SB 1383 (Lara, Stats. 2016, ch. 395).

[458] CARB, *EMFAC*, 2021 (web link: https://ww2.arb.ca.gov/our-work/programs/mobile-source-emissions-inventory/msei-modeling-tools-emfac-software-and, last accessed August 2022).

lower fuel economy than their diesel counterparts[459] and, after factoring in upstream methane emissions, are more harmful to the climate than diesel trucks.[460] Any benefits and costs associated with the use of RNG and other low carbon transportation fuels are already reflected in the baseline due to the LCFS regulation and would not be new reductions.

Supporters of this alternative have stated that transitioning to ZEV technologies and infrastructure would result in stranded assets because the RNG recovered from the SB 1383 mandated conversion of organic waste would diminish their ability to use this RNG in their collection vehicles. However, staff believes that the proposed ACF regulation does not conflict with the organic waste product procurement targets established by enacting SB 1383 since the recovered organic waste product procurement targets for jurisdictions does not require them to purchase RNG directly for use as a transportation fuel. In fact, a recent CPUC decision that implements SB 1440 creates a viable alternative to CARB's LCFS for RNG purchased by utilities and are used in the residential sector. [461,462] Additionally, LCFS credits have a 10-year guarantee after a digester project is operational and CNG trucks have an average vehicle lifetime of 15 years and would not be required to be replaced in less than 18 years. Therefore, staff does not foresee the proposed ACF regulation's ZEV purchase mandate as a barrier for refuse fleets recovering investments in their existing CNG vehicles, or even for new vehicles purchased up until the ZEV mandates take effect. In addition to directing RNG away from the transportation sector, SB 1440 creates RNG procurement targets for the IOUs and prohibits them from procuring biomethane from organic diversion facilities that do not commit to exclusively purchasing and/or leasing Class 8 NZEVs or ZEVs. CPUC's Renewable Gas Standard will be re-evaluated in 2025 and this review includes limiting RNG procurement contracts to facilities that commit to purchasing or leasing exclusively Class 8 ZEVs. This new RNG market created by a Renewable Gas Standard could provide revenue for digesters built to comply with SB 1383.

Finally, California has the potential to produce a limited amount of RNG from dairy, landfill, municipal solid waste, and wastewater treatment facility sources.[463] This alternative would prolong CNG vehicle use that is increasingly competing with other, harder-to-decarbonize sectors than transportation. CARB's AB 32 Scoping Plan scenario number 3 (Figure 85) predicts CNG vehicle growth rate to be relatively flat and insignificant overall, which should

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[459] CEC Energy Almanac, *Transportation Natural Gas in California*, 2019 (web link: https://ww2.energy.ca.gov/almanac/transportation_data/cng-lng.html, last accessed August 2022).

[460] International Council on Clean Transportation, *A comparison of NOx emissions from heavy-duty diesel, natural gas, and electric vehicles*, 2021 (web link: https://theicct.org/sites/default/files/publications/low-nox-hdvs-compared-sept21.pdf, last accessed August 2022).

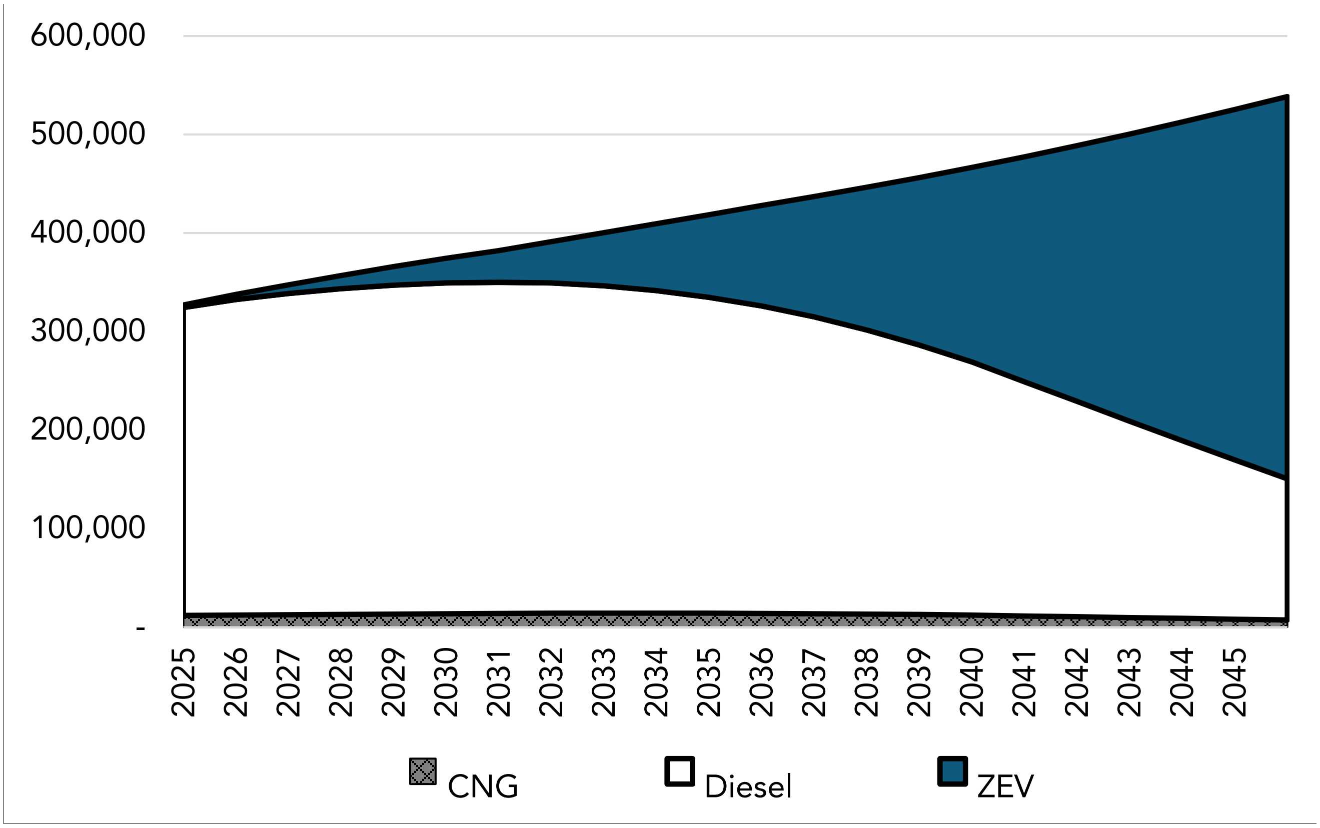
[461] SB 1440 (Hueso, Stats. 2018 ch. 739).

[462] California Public Utilities Commission, *Decision 22-02-025 Implementing SB 1440 Biomethane Procurement Program*, 2022 (web link: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M454/K335/454335009.PDF, last accessed August 2022).

[463] STEPS Program, Institute of Transportation Studies, UC Davis, *The Feasibility of Renewable Natural Gas as a Large-Scale, Low Carbon Substitute*, 2016 (web link: https://ww2.arb.ca.gov/sites/default/files/classic/research/apr/past/13-307.pdf, last accessed August 2022).

be a clear indication of the need to utilize RNG in other, harder-to-decarbonize sectors than transportation, or as a feedstock for energy and materials.[464]

Figure 85: Stacked Area Chart Depicting Heavy-Duty Vehicle Stocks for Compressed Natural Gas, Diesel, and Zero-Emission Vehicles Projected Out from 2025 to 2045 as Predicted by Alternative 3.



Therefore, this alternative is rejected because it would be less effective than the proposed ACF regulation in meeting ZEV-related project objectives 1, 6, 8, 10, and 12 as it would result in fewer ZEVs, less ZEV infrastructure build-out, less ZEV innovation and less ZEV-related economic activity. This alternative also fails to meet 100 percent ZEV targets for refuse trucks by 2040 established in CARB Resolution 20-19.[465] In addition, this alternative is also less effective at meeting GHG-related goals described in project objectives 3, 5, and 9. Furthermore, this alternative would be less effective than the proposed ACF regulation at meeting objectives 2, 4, 7, and 11.

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[464] California Air Recourses Board, *Draft AB 32 Scoping Plan. Data for this chart taken from AB 32 GHG Inventory Sectors Modeling Data Spreadsheet*, 2022 (web link: https://ww2.arb.ca.gov/sites/default/files/2022-05/2022-draft-sp-PATHWAYS-data-E3.xlsx, last accessed August 2022).

[465] CARB, *Public Hearing to Consider The Proposed Advanced Clean Trucks Regulation Resolution 20-19*, 2020 (web link: https://ww2.arb.ca.gov/sites/default/files/barcu/board/res/2020/res20-19.pdf, last accessed August 2022).

6. Focus Zero-Emission Vehicle Requirements on Return to Base Concepts

Proposed by the California Council for Environmental and Economic Balance (CCEEB), this alternative is less stringent than the proposed ACF regulation because it would limit ZEV deployments to fleets that utilize centralized depot charging as the primary BEV charging strategy and would not apply to other fleets. As an example, this alternative would impose ZEV requirements for parcel delivery trucks that operate on regular routes with more than 100 stops per day that return to a depot for charging at the end of the shift. This alternative would result in fewer ZEV purchases than the proposed ACF regulation and therefore would achieve fewer emissions reductions. This alternative also would not apply to most regional or long-haul applications and would not provide the market certainty for the needed infrastructure investments to develop a charging or hydrogen fueling network. Additionally, it would be less effective at reducing emissions from semi-trucks that are a major contributor to medium- and heavy-duty vehicle emissions around warehouses and in our communities.

This alternative has the potential to create a market imbalance as well as an incentive for fleet owners to change their operating characteristics to be excluded from the requirements. Furthermore, this alternative concept would not be as effective at advancing the adoption of medium- and heavy-duty ZE technologies as well as developing a self-sustaining ZEV market, which is a cornerstone of California's long-term transportation strategy to reduce localized pollution and GHG emissions. Therefore, this proposed alternative is rejected because it would not result in any additional ZEV deployments or would result in significantly fewer ZEV deployments than the proposed ACF regulation. This alternative would delay development of a retail fueling/charging infrastructure network, associated construction expansion, and scalability and would not be as effective at meeting program objectives.

This alternative was rejected because it fails to meet objectives 4, 8 and 10 of the proposed ACF regulation as it does not support emerging ZE technology needed to achieve CARB's SIP goals nor does it provide market certainty for ZE technologies and fueling infrastructure. Additionally, the alternative is less efficient in meeting objectives 1, 2, 3, 5, 6, 11, and 12 compared to the proposed ACF regulation.

7. Credit for Zero-Emission or Natural Gas Vehicles

Presented by the Western States Trucking Association, this alternative proposes that early action credit should be granted to early adopters of both ZE trucks and low-NOx trucks, stemming from the adoption of natural gas vehicles that have already been deployed in the construction, utility, and waste collection industries to historically offset diesel emissions. [466]

As discussed under the BACT alternative, while reducing emissions of NOx, low-NOx engines do not achieve any additional GHG reductions and would not reduce PM from tire wear, compared to existing trucks. The potential use of renewable fuels including RNG and RD procured by fleets are already covered under the LCFS program and Heavy-Duty Omnibus

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[466] Western States Trucking Association, *letter to CARB*, September 27, 2021 (web link: https://www.arb.ca.gov/lists/com-attach/63-acf-comments-ws-UiVSJwB1UGIBKgIq.pdf, last accessed August 2022).

regulation while the GHG reductions from these fuels are already attributed to the LCFS and Heavy-Duty Omnibus regulations.

This alternative is rejected as it would not align with California's goal of maximizing TE while resulting in no additional NOx emissions reductions and would potentially result in less PM and GHG reduction. It also fails to meet or is less effective in meeting all program objectives compared with the proposed ACF regulation.

8. Best Available Control Technology Concept

This alternative is a modification to the proposed ACF regulation and would allow for the use of BACT for compliance. The order of BACT would be a ZEV, then NZEV, then the cleanest certified engine. This alternative was suggested by the California Natural Gas Vehicle Coalition and proposes to expand what is considered to be ZEVs that are not available based on costs, availability of reliable infrastructure, and if ZEVs are not able to be a one-to-one replacement for existing ICE vehicles and many of these are undefined or are already included in the proposed ACF regulation. For simplicity this analysis focuses on the core effect of the suggested alternative when ZEVs are not available. This concept builds on the Heavy-Duty Omnibus regulation that sets new NOx engine standards and other emission control requirements. The Heavy-Duty Omnibus regulation also includes optional certification standard and a credit average, banking, and trading system.

For drayage trucks, this alternative would potentially result in fewer ZEVs and more ICE vehicles because the proposed ACF regulation only allows for ZEVs. For high priority and federal fleets, the alternative could result in more NZEVs assuming the fleet owner would otherwise purchase a NZEV when a suitable ZEV was available because this alternative treats ZEVs and NZEVs equally. It could increase the number of cleaner combustion engines if ZEVs and NZEV are not available assuming engines certified to the HD I/M optional standards become available. For State and local government fleets there would be no change except when ZEV and NZEVs are not available because the proposed ACF regulation already requires them to purchase ZEVs before NZEVs. If either is not available, the alternative could increase the number of engines certified to the Heavy-Duty Omnibus optional standards assuming they become available.

The proposed concept could potentially result in cleaner engines in some fleets but would not achieve new NOx reductions overall, because engine manufacturers can average their emissions to comply with the Heavy-Duty Omnibus regulation for all MYs. If CNG engines are certified to the optional standards, this alternative concept could require the purchase of some CNG engines along with ZEVs. This would likely result in the need for CNG infrastructure for small number of vehicles and potentially result in poorly utilized fueling and maintenance infrastructure and concerns about stranded assets for fleets that are not already using CNG.

Overall, this alternative could result in some emission benefits from increasing ZEVs in high priority fleets that would otherwise purchase NZEVs, but could reduce the number of ZEVs in drayage. It would not achieve any new benefits from cleaner combustion engines compared to the proposed ACF regulation because manufacturers can average their emissions to comply in the Heavy-Duty Omnibus regulation.

This alternative is rejected because it adds administrative burden to account for cleaner engines that are already accounted for in the Heavy-Duty Omnibus regulation and would not achieve any new reductions by including them in the proposed ACF regulation.

This alternative also suggests that using renewable fuels such as RNG and RD would achieve additional GHG benefits. However, any requirement to use renewable fuels would not result in additional GHG benefits because low carbon fuels like RNG and RD are accounted for under California's LCFS program and the federal Renewable Fuel Standard.

The number of Class 2b-8 CNG vehicles projected for 2025 is already relatively small at approximately one percent of California's statewide heavy-duty vehicles. Allowing a narrow exemption for an extremely small percentage of California's heavy-duty vehicles could result in unnecessary financial risk and the potential for stranded assets as ZEV technology improves and ZEV infrastructure expands. Staff is also concerned that the cost to operate existing CNG fueling stations and maintenance shops will grow with declining usage. Therefore, this alternative was rejected because it fails to meet or is less effective in meeting all program objectives compared to the proposed ACF regulation.

9. Apply 100 Percent Drayage Zero-Emission Vehicle Timeline to All Regional Goods Movement

Proposed by the ACF Coalition, this alternative would apply a more stringent ZEV purchase requirement by targeting an expansion of the drayage definition to include regional secondary goods movement. The current drayage definition covers the initial movement of goods by trucks that move cargo to and from seaports to intermodal railyard facilities. This alternative would expand the drayage definition to include secondary goods movement where the cargo has been unloaded and repackaged at a local processing, cross-docking, warehouse, or transloading facility before heading to the next or final destination. This alternative would expand the scope to smaller fleets not currently affected by the high priority fleet requirements and could potentially move the 100 percent ZEV purchase timeline for some vehicle types up by 4 years, from 2039 to 2035, for high priority fleets that have opted to use the ZEV Milestones Option.

This alternative would add considerable complexity to the existing high priority fleet definition because it would be difficult to determine and differentiate which vehicles are used in drayage verses regional freight movement verses longer-haul applications. Additionally, this alternative would encourage entities to shift their business models to possess older ICE vehicles for longer than they traditionally would in order to circumvent earlier ZEV transition compared to the proposed ACF regulation, as it lacks the additional ZEV Milestones Option allowed in the proposed ACF regulation. The ZEV Milestones Option increases flexibility for fleets with a higher turnover rate while continuing to maintain a timeframe that coincides with ZEV deployment and air quality goals, as well as other program objectives. Coupled with the Model Year Schedule, the ZEV Milestones Option supports an increased and more cost-effective ZEV transition within fleets that would result in more significant air quality and health benefits, and in an earlier timeframe, than the alternative would, particularly in DACs located near ports and intermodal facilities in relation to drayage ZEV transition. Under this alternative, there would be heavy reliance on public charging that is still in development. In addition, the implementation and enforcement of this alternative presents additional costs and challenges. For example, each facility would need to develop a compliance verification system to determine if a truck meets the regulatory requirements before entering the property. This adds additional costs and complexity that could impede the movement of goods due to the number of potential facilities that would need to implement or update verification or reporting systems.

This alternative would also only provide minimal emission benefits above the currently proposed ACF regulation, as well as require significant expansion of regulatory exemptions and special provisions to achieve proper implementation and enforcement. Furthermore, this alternative conflicts with the timeline for ZEV deployment in the proposed ACF regulation, which was structured to coincide with infrastructure development, and the majority of regional trucks are already subject to the high priority and federal fleet requirements. Therefore, this alternative was rejected at this time as it is less effective in meeting objectives 1, 3, 4, 5, 6, 8, and 11 due to the anticipated decrease in early ZEV deployment within drayage fleets and resulting diminished GHG reductions compared to the proposed ACF regulation.

10. Require 100 Percent Zero-Emission Vehicle Purchases beginning in 2023 for State and Local Government Fleets

Supported by the ACF Coalition, this alternative proposes a more stringent purchase requirement for State and local government fleets. This concept modifies the proposed ACF regulation by increasing the ZEV purchases to 100 percent beginning in 2023 for State and local government fleets instead of 2027. This alternative would increase ZEV purchases by State and local government fleets from 2024 through 2026.

This alternative could be more effective at meeting program objectives; however, it also bears substantial risks. This alternative would start one year earlier than the proposed ACF regulation, move up the 100 percent ZEV purchase requirement 3 years earlier for local government fleets that operate in low-population designated counties, and increase the 50 percent ZEV purchase requirement to 100 percent for all other State and local governments. This alternative removes the additional time for smaller agencies in more remote areas to plan for infrastructure and removes their opportunity to learn from the experiences of other larger State and local government agencies. Furthermore, State and local governments additionally require lead time with a 2-3 year timeframe to approve budgets and secure contracts for infrastructure installation as well as ZEV acquisitions due to their unique funding cycle and competitive procurement practices. This alternative, as a result, would be difficult to realistically implement with the given lead time constraint. Additionally, CARB staff does not expect the rule requirements to be codified and effective until late 2023, which would not provide enough time for State and local governments to plan and implement a purchase schedule to meet the requirements of this alternative.

This alternative would likely increase the number of ZEVs deployed but would also increase administrative burden due to the higher likelihood that certain vehicle configurations may not be available as ZEVs until the market develops further. Therefore, this alternative was rejected at this time as it is financially and administratively infeasible for State and local government fleets due to a lack of lead time for infrastructure development and ZEV acquisition needed for their funding cycles and competitive procurement practices. However, given the greater emissions benefits of this alternative, staff continues to analyze the rapidly evolving technical progress of these categories to determine if additional stringency is warranted.

11. Mandate Retirement at the End of Useful Life

Supported by the South Coast Air Quality Management District, the ACF Coalition, and the California Electric Transportation Coalition, this alternative concept targets the mandatory retirement of the medium- and heavy-duty ICE vehicles subject to the proposed ACF regulation at the end of their useful life, as defined by SB 1.[467] At the end of their useful life, these older trucks are to be replaced with ZEVs under this alternative. The SB 1 useful life provision limits the retirement, replacement, retrofit, or repower of specified commercial vehicles that would have been subject to new regulations or amendments. SB 1 provides truck owners certainty of their investments by allowing truck owners to operate their existing vehicles for specified periods of time before being subject to regulations that require the retirement, replacement, retrofit, or repower of specified commercial motor vehicles. This alternative concept forces the turnover of older trucks to be replaced with ZEVs and would send a signal to the market regarding the residual value of combustion trucks.

In general, this alternative would only advance the timeline for vehicle turnover for State and local government fleets, resulting in greater ZEV purchases and associated benefits; however, it also bears some risks. This alternative would eliminate the flexibility for a State and local government fleet to keep a unique, specialized, or costly vehicle in the fleet longer while purchasing ZEV replacements and could result in higher costs. It also means that State and local government fleets may need to retire a relatively low-use vehicle and would limit their ability to purchase a ZEV that could be highly utilized, which would result in more emissions benefits and have a better TCO. This alternative could also place downward pressure on used truck prices and create additional incentive for unregulated fleets to purchase used trucks and keep them in California. This could reduce the potential air quality benefits and may shift costs from regulated fleets to unregulated fleets. For State and local government fleets, this would increase administrative burdens due to the higher likelihood that certain vehicle configurations may not be available as ZEVs until the market develops. Still, this alternative would likely be more effective at meeting program objectives, reducing criteria pollutant emissions, and reducing climate emissions relative to the proposed ACF regulation.

Therefore, this alternative was rejected at this time as it is financially and administratively infeasible for fleets already subject to the ZEV purchasing requirements of the proposed ACF regulation. However, given the potential for greater emissions benefits of this alternative, staff continues to analyze industry interest and the rapidly evolving technical progress of the ZEV market to determine if additional policies are needed. Preliminary analysis like this alternative is discussed in the 2022 SIP Strategy (draft) as a measure called, "Zero Emission Trucks Measure." The proposed draft SIP measure would use market signal tools, if given authority to implement differentiated registration fees, restrictions or fees for combustion trucks entering low or zero-emission zones, and/or indirect source rules to establish zero-emissions zones by 2035. Without new authority to use such market signal tools, these strategies would need to consider the most economical compliance options available in the secondary markets to upgrade to ZEVs, including used ZEVs, everywhere feasible.

[467] SB 1 (Beall, Stats. 2017, ch. 5).

12. Small Fleet Turnover

Proposed by the ACF Coalition, this alternative builds on the proposed ACF regulation and adds additional requirements for smaller fleets that are initially unaffected by the proposed ACF regulation until the 100 percent ZEV purchase requirement takes effect.[468] Under this alternative, these small fleets would be required to retire all ICE vehicles at the end of their useful life as defined by the criteria in SB 1 and then replace these vehicles with newer ICE vehicles or ZEVs. In considering this alternative, staff modeled that small fleets would most likely replace the vehicles that reach the end of their useful life with used combustion-powered vehicles that are typically three to five years old, which is a common practice today since the upfront costs are lower to purchase used ICE vehicles. As a result, this alternative would delay the number of ZEVs deployed when compared with the proposed ACF regulation. Replacing older trucks at the end of their useful life with newer "used" combustion trucks would produce more NOx and PM reductions in California than staff's proposed ACF regulation as shown in Table 84. The NOx emissions reductions related to accelerated fleet turnover is the most pronounced from 2024 to 2030 as the oldest combustion vehicles are retired from California's fleet.

Table 84: Pollutant Reduction Difference Between the Staff Proposed ACF Regulation and the Small Fleet Turnover Concept

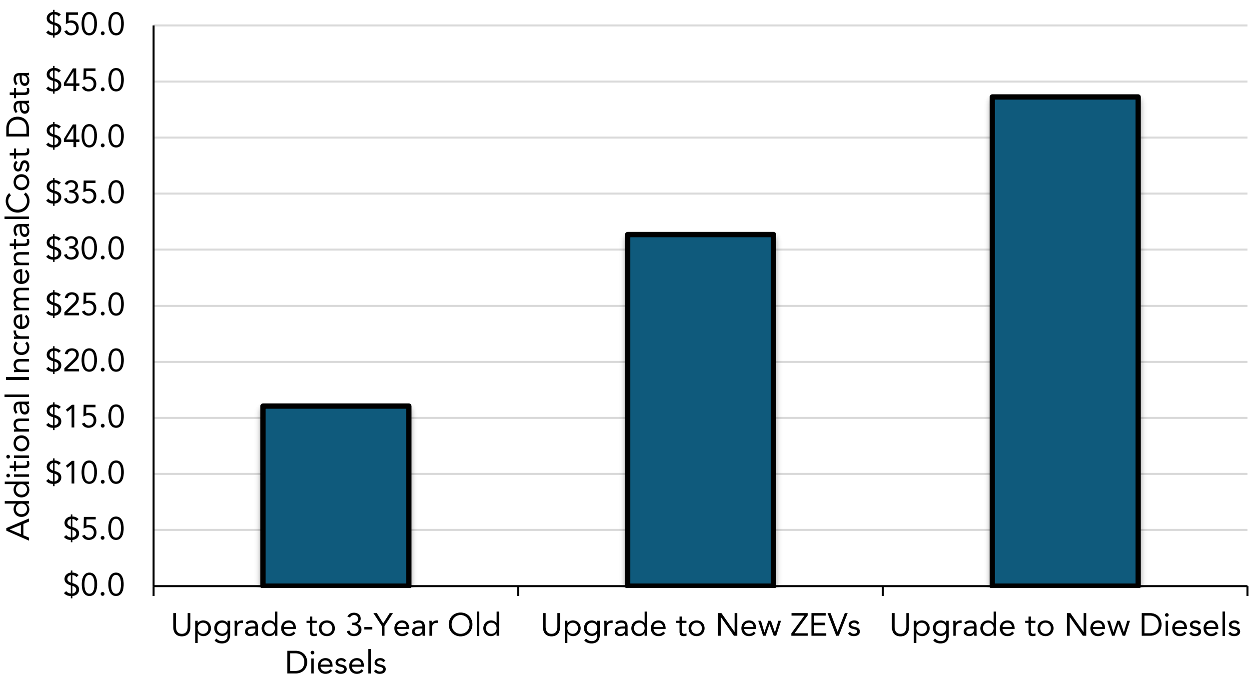
Year	NOx (tpd)	PM2.5 (tpd)	CO_2(MMT/yr)
2024	-32.05	-0.39	0.17
2025	-29.75	-0.37	0.16
2026	-27.90	-0.35	0.15
2027	-25.51	-0.31	0.14
2028	-23.13	-0.27	0.09
2029	-20.88	-0.24	0.05
2030	-19.05	-0.21	0.10
2031	-17.43	-0.17	0.14
2032	-15.59	-0.14	0.13
2033	-14.20	-0.12	0.13
2034	-13.21	-0.10	0.12
2035	-12.87	-0.09	0.15
2036	-12.16	-0.08	0.16
2037	-11.36	-0.06	0.17
2038	-10.34	-0.05	0.12
2039	-9.36	-0.04	0.06
2040	-8.54	-0.03	0.02
2041	-8.01	0.02	0.26
2042	-7.39	0.06	0.31
2043	-6.59	0.07	0.38
2044	-5.69	0.08	0.43

[468]Advanced Clean Fleets Coalition, *letter to CARB*, September 8, 2021 (web link: https://www.arb.ca.gov/lists/com-attach/47-acf-comments-ws-VCBcKAZyBzdQPQJd.pdf, last accessed August 2022).

Year	NOx (tpd)	PM2.5 (tpd)	CO_2(MMT/yr)
2045	-5.05	0.07	0.38
2046	-4.33	0.06	0.20
2047	-3.92	0.03	-0.11
2048	-3.66	0.00	-0.44
2049	-3.43	-0.02	-0.58
2050	-3.01	-0.03	-0.66
Total[469]	**-110,572**	**-840**	**2.22**

This alternative is expected to result in significant costs to affected fleets. Requiring fleets who would typically hold on to their vehicles until they cannot operate to immediately replace them with lightly used or new vehicles bears a significant incremental cost. Figure 86 illustrates a simplified cost analysis for this alternative versus the Legal Baseline as well as examples that require new ZEVs or new diesel-powered vehicles. All three examples show a significant increase in costs to these smaller fleets, with used diesels causing the smallest increase and new diesels providing the largest. Note that this analysis includes cost savings, so while the ZEV example has lower cost than new diesel vehicles, these smaller fleets may not have the capital necessary to make the necessary vehicle and infrastructure investments needed for ZEVs.

Figure 86: Increase in Total Direct Costs for Small Fleet Turnover Alternative Versus Legal Baseline By 2037



This alternative accelerates vehicle turnover for some of the oldest vehicles, resulting in some criteria emission benefits compared to staff's proposed ACF regulation; however, it also bears some risks and would create an increased burden for smaller fleets. This alternative

[469] The total cumulative emissions reductions for PM2.5 and NOx are converted from tons per day into years and assumes 312 operational days per year. Due to rounding errors, the 2024-2050 cumulative totals differ very slightly when compared to the sum values listed.

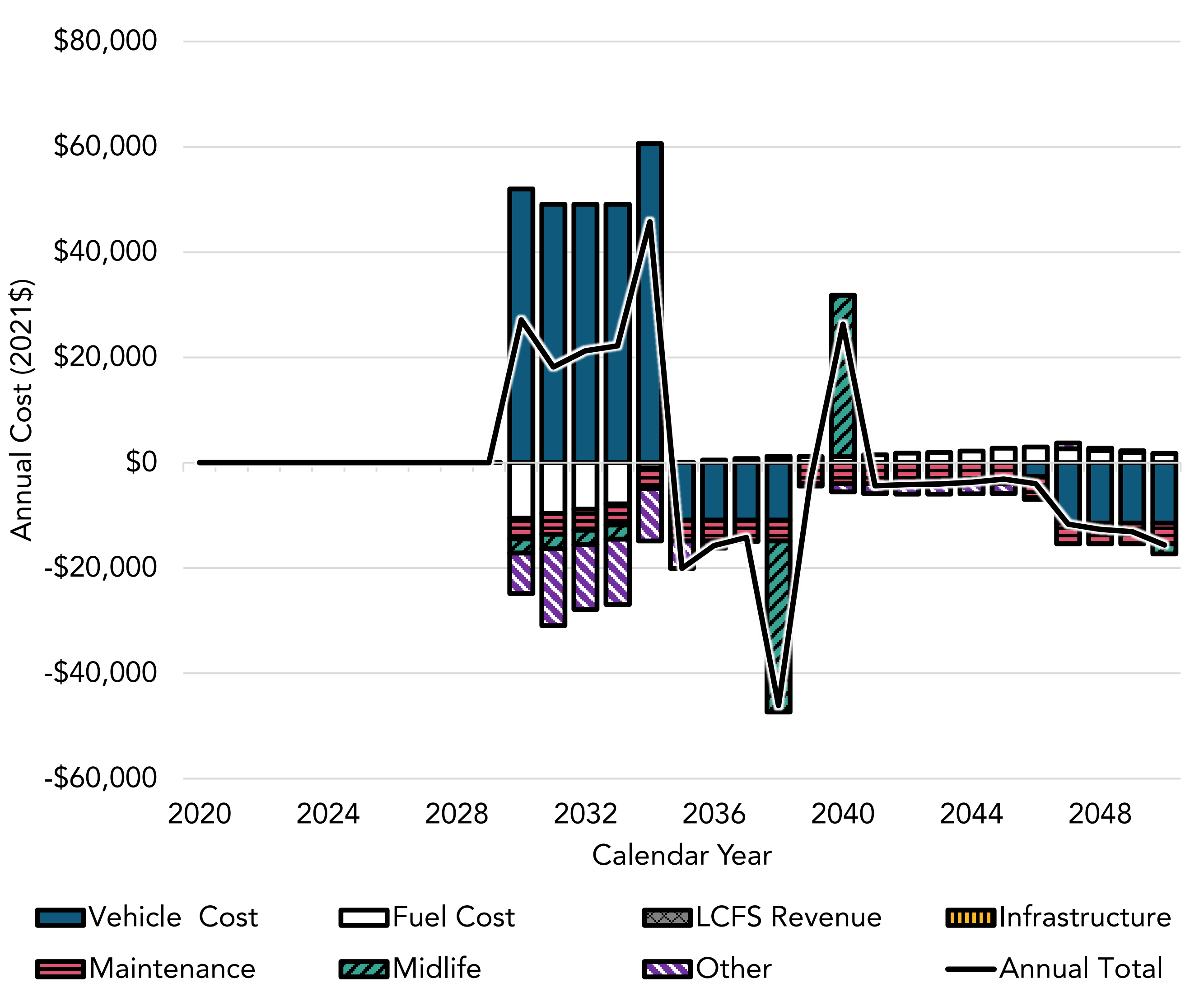
could place downward pressure on used truck prices by shifting market sales of used trucks from the larger regulated fleets to the small unregulated fleets. Under this alternative, there would also be a financial strain on small California businesses with forced turnover requirements in addition to opportunity cost related to delaying ZEV purchase. As shown by Table 84, this alternative would reduce NOx and PM emissions from smaller fleets but would not be more effective at increasing the number of ZEV deployments nor at reducing climate emissions compared to the proposed ACF regulation. Therefore, this alternative was rejected as it is financially infeasible for small fleets currently unaffected by the proposed ACF regulation. However, fleet turnover polices could become an important component of the next-generation portfolio of regulations and fiscal incentives that support our economy's transition to a ZE transportation system.

C. Small Business Alternative

The Board has not identified any reasonable alternatives that would lessen any adverse impact of the proposed ACF regulation on small businesses.

The example small business modeled is a drayage truck owner-operator subject to the drayage truck requirements. For both the "Legal Baseline" and proposed ACF regulation example, the small business owner purchases a used 2014 diesel day cab tractor in 2022. In the "Legal Baseline" scenario, the business owner operates that vehicle for 12 years until 2034. Following that, the operator would continue the pattern of purchasing an 8-year-old used diesel day cab tractor and operate that vehicle for 12 years (purchasing used ICE vehicles in 2034 and 2046). Under this proposed ACF regulation example, the drayage operator would likely turn over their diesel tractor at the end of 2029 when the tractor is 15 years old and has exceeded the useful life. The operator would replace the tractor with a new 2030 battery-electric tractor which it would operate for 20 years. In this example, the small business would buy one less used ICE vehicle than the "Legal Baseline" because they would be purchasing a new ZEV with a longer useful life instead. The drayage operator is assumed to finance its vehicles for 5 years at an interest rate of 15 percent. In the proposed ACF regulation example, the operator will see a net savings starting in 2040 which would continue to grow until 2050. The overall costs to a small business owner throughout the timeframe of this regulation is less than the "Legal Baseline" since its TCO is less for a BEV than for an ICE vehicle. However, the operator would need to make a significant upfront capital expenses in 2030 to purchase a new battery-electric tractor rather than two smaller investments spread out over a longer time. Incentives, financing assistance, and other programs offered will be helpful to support smaller operators with the onetime upfront capital expense. Staff assumed a small business would utilize public charging or fueling infrastructure rather than building depot infrastructure. For retail electricity refueling, staff conservatively assume that most LCFS credit revenue is not be passed on to fleets directly as the credit value is already incorporated into the retail price.

Figure 87: Estimated Costs of Proposed ACF Regulation to the Example Small Business (2021$)



D. Performance Standards in Place of Prescriptive Standards

Government Code section 11346.2(b)(4)(A) requires that when CARB proposes a regulation that would mandate the use of specific technologies or equipment, or prescribe specific actions or procedures, it must consider performance standards as an alternative. The proposed ACF regulation does not prescribe any specific technology or any equipment – rather, it allows regulated entities to acquire affected categories of any medium- and heavy-duty vehicles that have demonstrated that they emit zero emissions of criteria or GHG emissions; the regulation does not specify how such vehicles must comply with these standards. Currently battery-electric vehicle technology (BEV and PHEV) and fuel cell electric vehicle (FCEV) technologies have demonstrated the capability of meeting the proposed performance standards; however, the regulation does not preclude regulated entities from utilizing any other technology that meets the proposed performance standards. If entities elect to utilize BEV or FCEV technologies, the proposed ACF regulation also establishes requirements to ensure that regulated entities actually purchase and use those technologies, rather than vehicles that emit higher levels of emissions. The proposed ACF regulation encourages innovation by allowing manufacturers and fleet owners to determine the most cost-effective means of compliance given their business model or operational needs. Even if the proposed ACF regulation is considered a prescriptive standard, to the extent it establishes specific measurements, actions, or quantifiable means of limiting emissions or purchasing ZEVs, it would still be preferred over other *performance*-based alternatives. Anything less prescriptive than this proposed ACF regulation in terms of emission limits and requirements for ZEV purchases erodes the proposed ACF regulation's ability to secure the emissions reductions needed for meeting California's public health and climate goals and State and federal air quality standards because less prescriptive measures would allow, by omission, additional flexibilities on technology, valuation, fleet mixing, and assurance measures that would not achieve the same magnitude of emissions reductions or support for the nascent ZEV market. More performance-based alternatives would thus undermine the goals of this action. Furthermore, to the extent the proposed ACF regulation is determined to specify a sole means of compliance through specific actions, measures, or other quantifiable means, this means of compliance is necessary to accurately confirm compliance with the requirements to ensure that motor vehicle emissions are permanently reduced.

E. Health and Safety Code Section 57005 Major Regulation Alternatives

CARB estimates the proposed ACF regulation would have an economic impact on the state's business enterprises of more than $10 million in one or more years of implementation. CARB will evaluate alternatives submitted to CARB and consider whether there is a less costly alternative or combination of alternatives that would be equally as effective in achieving increments of environmental protection in full compliance with statutory mandates within the same amount of time as the proposed regulatory requirements, as required by Health and Safety Code section 57005.

X. Justification for Adoption of Regulations Different from Federal Regulations Contained in the Code of Federal Regulations

Currently, there are no comparable federal requirements for fleets to purchase or use ZE technologies for vehicles greater than 8,500 lbs. GVWR, and there are also no federal requirements for 100 percent sales of ZE technologies for Class 2b-8 vehicles beginning in 2040. As shown in this staff report and accompanying analyses, the cost of the State regulations is justified by the substantial benefits to the public health, and welfare, and the environment, as described above and in the accompanying materials, including California's need to achieve the greatest degree of emissions reductions from criteria pollutants and greenhouse gases in order to reduce the serious risks to the health and welfare of Californians posed by such pollutants, to attain State and federal ambient air quality standards, to address climate change-induced harms and carbon neutrality goals, and to effectively advance the deployment of heavy-duty ZEVs as consistent with the goals established by the Governor in multiple Executive Orders and by the Board in California's SIP Strategy and the Climate Change Scoping Plan.

XI. Public Process for Development of the Proposed Action

Consistent with Government Code sections 11346, subdivision (b), and 11346.45, subdivision (a), and with the Board's long-standing practice, CARB staff held public workshops and had other meetings with interested persons during the development of the proposed ACF regulation. These informal pre-regulatory discussions provided staff with useful information that was considered during development of the regulation and is now being proposed for formal public comment.

In February 2020, CARB staff began informing the public of the proposed ACF regulation and development process. Over the past 2 years of rule development, staff hosted over 24 public workgroups and workshops. CARB staff reached out directly to affected stakeholders and conducted 386 meetings with over 170 groups and individuals. CARB staff also sent over 273,000 mailers and numerous emails to the 81,944 recipients from 10 listservs, as well as 84,597 fleet contacts from the TRUCRS reporting database system. CARB staff offered engagement opportunities to receive feedback and solicit for alternatives from a variety of groups and stakeholders, including manufacturers, large fleet owners and single truck owners-operators, environmental advocacy organizations and the communities impacted most heavily by medium- and heavy-duty truck emissions. Numerous workshops, workgroup meetings, forums, and listening sessions were held via webcast. A summary of outreach activities is listed in Table 85 and a full list of meetings related to this proposed ACF regulation can be found in Appendix E Summary of Outreach Table.[470]

Table 85: List of Outreach Activities

Number	Outreach Activity
24	Workshop/Workgroups
3	Listening Sessions
386	Stakeholder Meetings
273,000	Postcard Mailers
166,541	Email Recipients
883	Training Attendees

A webpage was developed to host all information pertaining to the regulatory process. The webpage hosted all public meeting announcements, materials made available for public comment, English and Spanish language factsheets, drafted regulation language and comments, a listserv signup link, and contact information.[471] CARB's TruckStop website also hosted information on the proposed ACF regulation on the ACF webpage and the ZEV TruckStop webpage.[472,473] The ZEV TruckStop webpage includes information about all ZE

[470] California Air Resources Board, *Advanced Clean Fleets Meetings and Events*, 2022 (web link: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets/advanced-clean-fleets-meetings-events, last accessed August 2022).
[471] California Air Resources Board, *Advanced Clean Fleets Regulation*, 2021 (web link: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets, last accessed August 2022).
[472] TruckStop, *Proposed ACF regulations, 2021* (web link: https://ww2.arb.ca.gov/sites/default/files/truckstop/azregs/futureregs.html, last accessed August 2022).
[473] TruckStop, *ZEV TruckStop, 2021* (web link: https://ww2.arb.ca.gov/sites/default/files/truckstop/zev/zevinfo.html, last accessed August 2022).

regulations in development or that are currently being implemented and all available incentive programs. It also contains information on CARB's major partners in the ZE transition and links to resources regarding ZEV market availability.

Workshops were held to discuss a variety of strategies on the potential framework for a ZE truck regulation. In 2021, several comprehensive workshops were held on the proposed ACF regulation as a whole and in September of 2021 a workshop was held to discuss draft regulation language being released to the public. Some workshops were recorded and posted for reference on the ACF website; others were not recorded to allow for frank discussions. Most were held remotely due to the Coronavirus pandemic.

Smaller workgroups were held to better capture stakeholder input from similarly affected fleets.[474] These meetings focused on different topics including drayage fleets and costs, State and local government fleets, high priority and federal fleets, and smaller fleets. This provided a dedicated space for smaller fleets to ask questions, comment on the proposed regulatory requirements and express how those requirements might affect them.[475] The small fleet workgroup meetings included both day and evening sessions to reach and receive input from the largest possible audience. A separate channel for live interpretation was provided once for Punjabi and twice for Spanish with one Spanish session recorded and posted on the ACF website. A workgroup was also held to discuss the emissions reductions associated with the proposed ACF regulation. Staff were available throughout the meetings to answer questions. All workgroups were recorded and posted for reference on the ACF website.

Separate from the workgroups focused on the proposed ACF regulation, CARB staff also hosted a series of workgroup meetings in collaboration with CEC, CPUC, and GO-Biz. Spanning from late 2021 to March 2022, these meetings focused on activities, challenges, and solutions surrounding the build-out of fueling infrastructure needed to support the fleet of ZE trucks and buses that the proposed ACF regulation would bring about. The primary objective was to gain a collective understanding of the status in each topic area, the initiatives underway at each State agency, and the opportunities presented in meeting the demands of infrastructure scale-up. Workgroup meetings were held on four topics including Business Considerations, Hydrogen, Electricity and the Grid, and Costs and Funding.

For every public event staff used notices to announce meeting events, documents, a public comment docket, translation resources, and other associated regulatory materials to encourage participation and attendance at the workgroups and workshops. The materials include staff presentations, the December 2020 Preliminary Draft Cost Data and Methodology Discussion (updated and reposted with new September 2021 data), and the proposed ACF regulation language.[476, 477] Draft regulation text was organized in sections

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[474] California Air Resources Board, *Notice of Public Workshop Meeting to Discuss the Proposed Advanced Clean Fleets Regulation*, 2021 (web link: https://ww2.arb.ca.gov/resources/documents/mailout-msc-21-2103, last accessed August 2022).
[475] California Air Resources Board, *Notice of Public Workshop to Discuss the Proposed Advanced Clean Fleets Regulation*, 2021 (https://content.govdelivery.com/accounts/CARB/bulletins/2f6a894, last accessed August 2022).
[476] California Air Resources Board, *Cost Data and Methodology Discussion Document, 2020* (https://ww2.arb.ca.gov/sites/default/files/2020-12/201207costdisc_ADA.pdf, last accessed August 2022).
[477] California Air Resources Board, *Advanced Clean Fleets Draft Regulation and Comments*, 2021 (https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets/advanced-clean-fleets-draft-regulation-and-comments, last accessed August 2022).

including requirements for high priority and federal fleets, State and local government fleets, drayage truck fleets, and vehicle manufacturers, and was posted publicly 2 weeks prior to the September 2021 workshop. The 30-day informal comment period following this posting was extended to allow ample and additional time for input, feedback, and alternatives to the proposed ACF regulation. Staff released updated draft regulation language that included changes made based on prior comment ahead of the workshops on May 2, 4, and 6 of 2022 including the addition of requirements for light-duty package delivery vehicles.[478] Table 86 lists the number of recipients for each email list used by staff to announce document postings, public events, and other regulatory updates.

Table 86: Distribution to CARB Email Lists

Public Email List	Number of Recipients
Actruck	8,051
Zevfleet	4,098
Porttruck	6,272
Onrdiesel	33,484
Publicfleets	5,619
Swcv	4,114
Sfti	2,869
Aqip	8,931
Hvip	3,017
Hdlownox	5,489
TRUCRS	84,597
Total	166,541

Staff included input from the community beyond directly regulated stakeholders and environmental advocacy organizations. To do this, CARB hosted a community listening session focused on truck activities as well as a two-day listening session focused on freight activities. These events gave attendees a brief overview of CARB's work to reduce air pollution from California trucks and allowed interested community members the opportunity to provide their input and vision for what CARB's priorities should be going forward. In addition, staff directly reached out to over 50 environmental justice groups to offer information and time to discuss the proposed ACF regulation. This work resulted in several informational meetings and 3 webinar presentations for AB 617 Community Steering Committees. Staff also published an article in the CARB Environmental Justice blog spot to reach a wider and more diverse audience of affected parties.[479] This post was highlighted in the November 2021 Environmental Justice newsletter. To inform tribal communities, staff utilized CARB's Tribal Relations website[480] as well as the Tribal Relations email listserv.

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[478] California Air Resources Board, *Updated Draft Regulatory Text for the Advanced Clean Fleets Regulation Now Available for Public Comment*, 2022 (https://content.govdelivery.com/accounts/CARB/bulletins/3142c5f, last accessed August 2022).
[479] California Air Resources Board, *CARB Environmental Justice Blog*, 2021 (web link: http://carbej.blogspot.com/2021/10/new-zero-emission-truck-regulation-will.html, last accessed August 2022).
[480] California Air Resources Board, *CARB Tribal Relations*, 2022 (web link: https://ww2.arb.ca.gov/tribal-relations, last accessed August 2022).

Staff also explored several other avenues to inform and engage fleets who may not be tuned into CARB's workgroups or email lists. An informational postcard mailer was sent to over 273,000 fleets identified to be either directly or indirectly affected by the proposed ACF regulation. Staff also reached out to 14 trade associations and 18 metropolitan planning organizations. Several rural areas were also engaged through outreach efforts and meetings were held with the Otay Mesa Chamber of Commerce and the Imperial County Environmental Justice IVAN committee. Staff reached out by email to the Rural Counties Representatives Council. To reach State and local government fleets, staff sent several invitations to engage directly by email to the Metropolitan Planning Organizations, the San Diego Association of Governments Freight Stakeholders Working Group, Clean Cities Coalitions, and the Institute of Local Governments, who in turn included an overview in several affiliated newsletters and listservs. An overview of the proposed ACF regulation has also been incorporated into a new CARB training course that has hosted over 883 attendees in 5 separate sessions in addition to 586 attendees who received an ACF overview when CARB staff hosted the One-Stop Truck events that occurred in October 2021 and January 2022.

Another round of workgroups were held in May of 2022 when staff presented revised regulation language and encouraged further feedback. Three separate sessions were hosted to best engage with stakeholders on the three sections of the regulation. For a second time staff reached out directly to community-based organizations, industry associations, and local government organizations to encourage participation in the workgroups and offer one-on-one meetings to discuss the proposed ACF regulation. A final public workgroup was held on July 26, 2022 which focused on how to improve draft provisions for allowing exemptions and extensions of the proposed ACF regulation for high priority, federal, and State and local government fleets.

After several years of virtual meetings, staff finally had the chance to attend in-person events. Representatives from CARB attended the Great American Truck Show in Fresno April 15-16, 2022, and the Advanced Clean Transportation Expo held May 9-12, 2022. At both events staff had the opportunity to speak to attendees regarding the proposed ACF regulation and participated in several event workgroups as CARB representatives. Staff also presented the proposed ACF regulation to a national audience on the SIRIUS XM Road Dog Trucking radio program. Staff was interviewed about the regulation and California's plans for ZE transportation in two separate hour segments during the month of April 2022.

Throughout the past two years, CARB worked closely with GO-Biz, CEC, CPUC, and other agencies and utilities in the state to engage the public on upcoming TE efforts. CEC is the State's primary energy policy and planning agency working on the strategic regional planning needed to support adoption of ZEVs. GO-Biz is the State's leader for job growth, economic development, and business assistance efforts and they are leading the way for collaboration on ZE transportation. They are working to cultivate opportunities to accelerate ZEV market growth by offering consultation for incentives, site selection, compliance, and investment assistance. CEC is investing in the charging infrastructure and technologies that are driving the transition to clean ZEVs throughout the state. One example is their new EnergIIZE program which offers funding for ZE truck and bus infrastructure. CPUC and California's six IOUs are working towards accelerating widespread TE and ensuring that electric rates make EV charging cheaper than fueling with gasoline or diesel. In addition to planning and monetary assistance, new educational resources for fleets are being developed every day by several agencies and organizations. Staff is working hard to ensure fleets are finding these helpful resources and getting access to planning resources and trainings when they are being offered. Staff continue to meet with stakeholders and explore ways to inform the public about the proposed ACF regulation. The program webpage and CARB's TruckStop website will be continually updated to offer information on engagement opportunities, existing and future regulations, and the resources that would aid fleets in their transition to ZE technologies.[481]

XII. Next Steps

With implementation of both ACT and the proposed ACF regulation, only about half of the trucks operating in California would be ZE. Shifting the remaining fleet to ZE technology requires additional policy tools. As the Board looks to significantly expand ZEV deployment beyond ACF there must be careful consideration of how to do this in a manner that is economically feasible for the more than 100,000 fleets who rely on the secondary market to purchase trucks. As Senator and Board member Leyva's letter indicated, new market tools may be needed, such as differentiated registration fees, restrictions or fees for polluting trucks entering low or ZE zones, and indirect source rules may be more effective at aggressively targeting emissions reductions in heavily impacted neighborhoods.[482]

The 2022 SIP Strategy (draft), scaffolded from the recent 2020 Mobile Source Strategy, includes a proposed commitment to accelerate the number of medium- and heavy-duty ZEVs beyond ACT by upgrading remaining combustion trucks to new or used ZEVs. The 2022 SIP Strategy includes a Zero-Emission Truck Measure which would use market signal tools, if given authority to implement differentiated registration fees, restrictions or fees for combustion trucks entering low or ZE zones, and/or indirect source rules to establish ZE zones by 2035. Without new authorities, starting in 2030 the measure would require fleets to phase in ZEVs into fleets operating in California that aren't already covered by the proposed ACF regulation. The strategy would consider the most economical compliance options available in the secondary markets to upgrade to ZEVs, including used ZEVs, everywhere feasible. Another measure called out in the 2022 SIP Strategy is the On-Road Heavy-Duty Vehicle Useful Life Regulation that would involve CARB developing a regulation, potentially paired with new incentives or legislative measures, to require on-road heavy-duty vehicles that have reached the end of their useful life as defined in SB1 to retire, replace, retrofit, or repower the on-road heavy-duty vehicle or engine, and upgrade to ZE trucks.

Additional incentive programs are needed to send clear signals to the market and support new scrap and replace regulatory programs, specifically to help ensure that smaller trucking companies have more consistent access to ZE truck incentives. This concept would involve CARB working to develop incentive programs which should include consideration of policies other jurisdictions have employed such as supporting local ZE zones and/or differentiated registration fees so that dirtier trucks pay more and ZE trucks have a consistent source of incentive funding.

[481] California Air Resources Board, *CARB TruckStop Zero-Emission Vehicles*, 2021 (web link: http://ww2.arb.ca.gov/sites/default/files/truckstop/zev/zevinfo.html, last accessed August 2022).
[482] Senator Levya, *letter to CARB*, October 27, 2021 (web link: https://ww2.arb.ca.gov/resources/documents/senator-leyva-letter-regarding-diesel-vehicle-turnover, last accessed August 2022).

Other policy levers cannot be adjusted by Californians alone. Over half of the heavy-duty VMT in California are from federally certified trucks and their NOx emissions will be significantly higher than California engines starting in the 2024 MY. The Clean Air Act requires that federal emissions standards for new heavy-duty engines and vehicles provide manufacturers a minimum of 4 years of lead time, and that such standards be applicable for a period of 3 years. Existing federal truck GHG standards already ratchet up in 2027. Federal truck rules to tighten NOx emissions standards were proposed in March 2022 and must be finalized by the end of the year, or the opportunity will be lost to include emissions reductions associated with the 2027 MY, and would also potentially jeopardize the benefits from the 2028 and 2029 MY standards. It is paramount that the U.S. EPA align the proposed federal future heavy-duty emissions standards and other emissions-related requirements with CARB's Heavy-Duty Omnibus regulation, and to also push for accelerated medium- and heavy-duty ZEV policies nationwide. From our collective experience with promulgating light-duty ZE technologies, regulations, and incentives, we know that manufacturers respond creatively when regulators inside and outside of California send strong, unified, regulatory signals. Advocating for federal adoption of cleaner NOx truck standards as well as an ACT regulation (or its CO_2 regulatory equivalent) will help California communities, but, critically, will also ensure that communities everywhere benefit from a robust clean truck market.

Staff understands more needs to be done, especially to reduce emissions in overburdened communities and to require upgrades to ZEV upon vehicle retirement. Even with the above policies to kick start the early ZEV market for high priority and public fleets, additional tools will provide the best opportunity to promote ZEV for use cases where it is more challenging to make the transition to zero.

XIII. References

The following documents references are shown on Appendix B.

California Air Resources Board

Public Hearing to Consider the Advanced Clean Fleets Regulations

Final Statement of Reasons for Rulemaking, Including Summary of Comments and Agency Response

Public Hearing Date: April 27-28, 2023
Agenda Item No.: 23-4-2.

Table of Contents

List of Acronyms and Abbreviations

100 Percent ZEV Sales – The 100 Percent ZEV Sales by 2036 Regulation

ACF or the Regulation or the ACF Regulation – The Advanced Clean Fleets Regulation

ACF 15-Day Notice - Notice of Public Availability of Modified Text and Availability of Additional Documents, Advanced Clean Fleets Regulation

APA – Administrative Procedures Act

AB – Assembly Bill

AB 5 – Gonzalez, Statutes of 2019, Chapter 296

AB 8 – Perea, Statutes of 2013, Chapter 401

AB 52 – Gatto, Statutes of 2014, Chapter 532

AB 118 – Nunez, Statutes of 2007, Chapter 750

AB 617 – Garcia, Statutes of 2017, Chapter 136

AB 841 – Ting, Statutes of 2020, Chapter 372

AB 1279 – Muratsuchi, Statutes of 2022, Chapter 337

AB 2061 – Frazier, Statutes of 2018, Chapter 580

AB 2127 – Ting, Statutes of 2018, Chapter 365

AB 2565 – Muratsuchi, Statutes of 2014, Chapter 529

AB 2700 – McCarty, Statutes of 2022, Chapter 354

ABT – Averaging, Banking, and Trading

ADAS – Advanced Driver Assist System

ARBER – Air Resources Board Equipment Registration

BEV – Battery-Electric Vehicle

BTU – British Thermal Unit

CA GHG Phase 2 – California's GHG Phase 2 Regulation

CAISO – California Independent System Operator

Caltrans – California Department of Transportation

CARB – California Air Resources Board

CCR – California Code of Regulations

CDFA – California Department of Food and Agriculture

CEC – California Energy Commission

CEQA – California Environmental Quality Act

CI – Carbon Intensity

COVID-19 – Coronavirus Disease 2019

CNG – Compressed Natural Gas

CNRA – California Natural Resources Agency

CPUC – California Public Utilities Commission

CTC – California Transportation Commission

CTP – Clean Truck Program

CVC – California Vehicle Code

DEF – Diesel Exhaust Fluid

DMV – California Department of Motor Vehicles

DOF – California Department of Finance

DTR – Drayage Truck Registry

EA – Environmental Analysis

EMFAC – Emission Factor

EnergIIZE – Energy Infrastructure Incentives for Zero-Emission Commercial Vehicles

EPA – Environmental Protection Agency

ePTO – Electric Power Take-Off

EV – Electric Vehicle

EVITP – Electric Vehicle Infrastructure Training Program

EVSE – Electric Vehicle Supply Equipment

FSOR – Final Statement of Reasons

FCEV – Fuel Cell Electric Vehicle

GHG – Greenhouse Gas

GO-Biz – Governor's Office of Business and Economic Development

HD I/M or Clean Truck Check – Heavy-Duty Inspection and Maintenance Regulation

HD Omnibus – Heavy-Duty Omnibus Regulation

H2ICE – Hydrogen-Fueled Internal Combustion Engine

HPF or HPF Regulation – The High Priority and Federal Fleets Regulation

HVIP – Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project

ICE – Internal Combustion Engine

ICT – Innovative Clean Transit Regulation

IIJA – Infrastructure Investment and Jobs Act

IOU – Investor-Owned Utility

IPAG – Incentive Program Advisory Group

IRA – Inflation Reduction Act of 2022

IRP – International Registration Plan

ISEF – Innovative Small e-Fleets

ISOR or ACF ISOR or Staff Report– Advanced Clean Fleets Initial Statement of Reasons

kW – kilowatt

kWh – kilowatt hour

LBNL – Lawrence Berkeley National Lab

LCFS – Low Carbon Fuel Standard

LER – Large Entity Reporting

LLC – Limited Liability Company

LSI - Large Spark-Ignition Engine Fleet Requirements Regulation

MJ – Megajoule

MW – Megawatt

NAAQS – National Ambient Air Quality Standards

NERC – North American Electric Reliability Corporation

NEVI - National Electric Vehicle Infrastructure Program

NHTSA – National Highway Traffic Safety Administration

OAL – Office of Administrative Law

OEM – Original Equipment Manufacturer

OSHA – Occupational Safety and Health Administration

PG&E – Pacific Gas and Electric

PHEV – Plug-In Hybrid Electric Vehicle

PM – Particulate Matter

POU – Publicly Owned Utility

PSPS – Public Safety Power Shutoff

PTO – Power Take-Off

RD – Renewable Diesel

RNG – Renewable Natural Gas

RTC – Response to Comments

SB – Senate Bill

SB 1 – Beall, Statutes of 2017, Chapter 5

SB 100 – De León, Statutes of 2018, Chapter 312

SB 617 – Calderon, Statutes of 2011, Chapter 496

SB 643 – Archuleta, Statutes of 2021, Chapter 646

SB 671 – Gonzalez, Statutes of 2021, Chapter 769

SB 1020 – Laird, Statutes of 2022, Chapter 361

SB 1339 – Stern, Statutes of 2018, Chapter 566

SB 1383 – Lara, Statues of 2016, Chapter 395

SB 1440 – Hueso, Statutes of 2018, Chapter 739

SCE – Southern California Edison

SDG&E – San Diego Gas and Electric

SLG or SLG Regulation – The State and Local Government Fleets Regulation

SRIA – Standardized Regulatory Impact Analysis

TCO – Total Cost of Ownership

TRAC - Truck Regulations Advisory Committee

TRUCRS - Truck Regulation Upload, Compliance and Reporting System

VIN – Vehicle Identification Number

Volvo LIGHTS – Volvo Low Impact Green Heavy Transport Solutions

ZE – Zero-Emissions

ZEV – Zero-Emissions Vehicle

ZEP Certification – Zero-Emissions Powertrain Certification

I. General

On September 2, 2022, CARB released the 45-Day Notice of Public Hearing and Staff Report: ISOR, titled "Public Hearing to Consider Advanced Clean Fleets Regulation" for public review. The Staff Report contains a detailed description of the problem the Regulation is intended to address; a snapshot of the ZEV market, emissions analysis, health exposure and benefits analysis, cost and cost benefits analysis, environmental analysis, fiscal analysis, alternatives assessment, and rationale for the Regulation. The 45-Day Notice included all references relied upon and identified in the Staff Report.

The Regulation is explained in the Staff Report as critical to meeting California's State and federal air quality standards, protecting public health, and achieving the State's climate goals. The Regulation aims to further curb criteria, toxic, and GHG emissions by transitioning ICE vehicles to ZEVs using a phase-in approach, sets clear targets for regulated fleets to make a full conversion to ZEVs, and creates a catalyst to accelerate development of a heavy-duty public infrastructure network. In addition, it transitions drayage trucks to ZEVs given the suitability of their duty cycles, outsized impact on disproportionately impacted communities, and ability to maximize emissions reductions in heavily impacted communities. This approach gives fleets the flexibility to phase in ZEVs in the most suitable applications first and focuses initial ZEV infrastructure development to support community health around seaports and railyards. The Regulation includes four components. A manufacturer requirement for 100 percent of sales of medium- and heavy-duty vehicles to be ZEVs and fleet requirements to purchase and deploy ZEVs in SLG fleets, drayage truck operations, and HPF fleets.

The Regulation is the result of an extensive public process. In February 2020, CARB staff began informing the public of the likely proposal of the Regulation and development process. Over the past four years of ACF Regulation development, staff hosted 27 public listening sessions, workgroups, and workshops. CARB staff reached out directly to affected stakeholders and conducted more than 475 meetings with over 170 groups and individuals. CARB staff also sent more than 273,000 mailers and numerous emails to the 81,944 recipients from 10 email distribution lists, and 84,597 more fleet contacts from TRUCRS. CARB staff offered engagement opportunities to receive feedback and solicited alternatives from a variety of groups and stakeholders, including manufacturers, large fleet owners, single truck owners-operators, environmental advocacy organizations and the communities most heavily impacted by truck emissions. Through this public process, staff considered all stakeholder feedback and integrated many stakeholder's concepts into the Regulation. CARB received written comments from 344 commenters during the 45-Day Notice comment period. On October 27, 2022, the Board conducted a public hearing where staff informed the Board of the Regulation, and the Board received an additional 32 written and 163 oral comments from the public. At the conclusion of the hearing, the Board directed staff to evaluate providing more time for infrastructure development and for trucks using biomethane to better align with California's organic waste diversion rule, to continue working with transit fleets and utilities to ensure they can do their important work, streamline criteria for exemptions, and assess moving up the end date for sales of new combustion trucks and reducing the HPF fleet size from 50 to 10 tractors; as well as conduct additional stakeholder outreach.

Staff released an emissions analysis which concluded the proposed Regulation already requires more ZEVs to be purchased than manufacturers are required though the ACT Regulation and pushing ahead the tractor purchase requirements by three years could be a concern depending on how the rapidly developing market plays out.[1] The Board approved the ACF Resolution which includes direction to update the ACT manufacturer sales requirements to be consistent with the SIP.

At the direction of the Board and in response to stakeholder concerns, staff proposed updates to the original proposal and solicited stakeholder feedback through a series of two focused public workgroups and one general public workshop. Waste and wastewater provisions were discussed at the December 12, 2022, public workshop, which was attended by 253 remote and more than 23 in-person participants. Infrastructure Construction Delays and ZEV Purchase Exemptions were discussed at the January 13, 2023, public workgroup, which was attended by 717 remote and 49 in-person participants. A final February 13, 2023, public workshop on the draft 15-day revisions to the original proposal was attended by 77 in-person and 1,015 remote participants.

Based on the Board's direction and feedback from the additional public workshops, a number of proposed changes were made. The date for ending new combustion engines sales in California was moved from 2040 to 2036. New ICE vehicle purchases were required to be California certified engines when ZEV purchases are not required. A new provision was added to provide more time to begin phasing in ZEVs for CNG powered trucks that exclusively use biomethane and are operated by waste and wastewater fleets involved in municipal diversion of organic waste. Transit agencies were made exempt until January 1, 2030, to allow them to focus on electrifying their buses. Extensions for ZEV infrastructure were expanded to address circumstances beyond the fleet owner's control when constructing ZEV infrastructure or in obtaining grid power. Other changes were made to streamline criteria for the ZEV Purchase and Daily Usage Exemptions, and some safeguards were added to ensure exemptions are only granted when necessary for compliance. The drayage truck reporting requirements for terminals, seaports, and railyards were also streamlined. More information on the changes is provided in the section, Modifications Made to the Original Proposal

The following section provides a high-level summary of modifications made to the original proposal at the direction of the Board and in response to stakeholder concerns. The summary of changes does not include any definitions, edits made for clarity or those used to restructure. For more detailed information on each change and their purpose and rationale, see the ACF 15-Day Notice on CARB's website: https://ww2.arb.ca.gov/rulemaking/2022/acf2022.

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In accordance with Government Code section 11346.8, the Board may adopt the proposed amendments after making any appropriate conforming modifications, as well as any additional supporting documents and information available to the public for a period of at least 15 days. The Board further provided that the Executive Officer shall consider such written comments as may be submitted during this period and shall make such modifications as may be appropriate

[1] CARB, Executive Officer Memo to Board - Advanced Clean Fleets Regulation High Priority Fleet Size Analysis, 2023 (web link: https://ww2.arb.ca.gov/sites/default/files/2023-02/HPF%20Fleet%20Size%20Board%20Memo_ADA.pdf, last accessed March 2023).

in light of the comments received, then shall present the Regulations to the Board for further consideration if warranted.

After the October 27, 2023, Board Hearing, CARB released a Notice of Public Availability of Modified Text and Availability of Additional Documents and Information on March 23, 2023. The text of the proposed regulatory and Staff Report modifications is posted on CARB's website: https://ww2.arb.ca.gov/rulemaking/2022/acf2022 and was made accessible to all stakeholders and interested parties.

The Final EA and written responses to the Draft EA were posted on April 14, 2023, for public review and tribes requesting notice under AB 52 were provided notice. No requests for tribal consultation were received.

CARB received written comments from 177 commenters during the ACF 15-Day Notice comment period. Staff presented the modified proposal to the Board for further consideration on April 27-28, 2023, at which 34 written comment submissions were received along with 158 individuals who gave oral testimony. At that hearing, the Board considered the Final EA and RTC in accordance with the requirements of CEQA and CARB's certified regulatory program. The Board adopted Resolution 23-13, which adopted the Findings and Statement of Overriding Considerations, approved written responses to the Draft EA, certified the Final EA, and adopted the proposed ACF Regulation. The adopted Regulations reflect the final modifications that were made available for the supplemental comment periods and non-substantial changes that were appropriate to be made, as reflected in the Final Regulation Orders made available for the hearing.

This FSOR updates the Staff Report by identifying and explaining the modifications that were made to the original proposal at the Board's direction and in response to comments. It updates the information in the Staff Report and summarizes and responds to the written and oral comments submitted to CARB on the Regulations or on the process by which they were adopted.

In adopting the ACF Regulations, CARB has added the following sections to title 13, in the CCR: 2013, 2013.1, 2013.2, 2013.3, 2013.4, 2014, 2014.1, 2014.2, 2014.3, 2015, 2015.1, 2015.2, 2015.3, 2015.4, 2015.5, 2015.6, and 2016.

Mandates and Fiscal Impacts to Local Governments and School Districts

Costs incurred by local governments and school districts are not reimbursable pursuant to Section 6 of Article XIII B of the California Constitution and Part 7 (commencing with Section 17500), Division 4 of Title 2 of the Government Code. These costs are not reimbursable because this action neither compels local agencies to provide new governmental functions (i.e., it does not require such agencies to provide additional services to the public), nor imposes requirements that apply only on local agencies or school districts.[2] Instead, this regulatory action establishes requirements that apply to all individuals and entities that own or operate regulated vehicles and facilities. This action also does not compel local agencies to increase the

[2] County of Los Angeles v. State of California (1987) 43 Cal.3d 46, 56.

actual level or quality of services that they already provide the public.[3] For the foregoing reasons, any costs incurred by local agencies to comply with this regulatory action are not reimbursable.[4]

Consideration of Alternatives

For the reasons set forth in the Staff Report, in staff's comments and responses at the hearing, and in this FSOR, the Board determined that no alternative considered by the agency would be more effective in carrying out the purpose for which the regulatory action was proposed, or would be as effective and less burdensome to affected private persons, or would be more cost-effective to affected private persons and equally effective in implementing the statutory policy or other provisions of law than the action taken by the Board.

1. Small Business Alternative

Section 11346.9, subdivision (a)(5), of the Government Code provides that the FSOR shall contain an "explanation setting forth the reasons for rejecting any proposed alternative that would lessen the adverse economic impact on small businesses." The drayage truck portion of the ACF Regulation does apply directly to small businesses. For discussion about small business alternatives, please see Chapter IX.C. of the ACF ISOR. The Board has not identified any reasonable alternatives that would be as effective in carrying out the purposes of the regulatory action and that would lessen any adverse indirect impacts of the ACF Regulations on small business. As explained in Chapter IV.A.7. of the ACF FSOR, as the master response to cost comments, the TCO including incremental ZEV purchase cost predicts that many businesses will experience net benefits from ownership and operation of ZEVs.

II. Modifications Made to the Original Proposal

The following section provides a high-level summary of modifications made to the original proposal at the direction of the Board and in response to stakeholder concerns. The summary of changes does not include any definitions, edits made for clarity or those used to restructure. For more detailed information on each change and their purpose and rationale, see the ACF 15-Day Notice on CARB's website:
https://ww2.arb.ca.gov/rulemaking/2022/acf2022.

Changes to the Regulation include requirements to purchase the lowest emitting combustion engines when ZEVs are not being purchased, expansion of exemptions and extensions, additional flexibility for public fleets, a new provision to address transient vehicles, more time for certain waste and wastewater fleets, and additional limited exemptions, for example, intermittent snow removal vehicles would be exempt until January 1, 2030, and manufacturer test fleet vehicles would be excluded.

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[3] San Diego Unified School Dist. v. Commission on State Mandates (2004) 33 Cal.4th 859, 877.
[4] County of Los Angeles v. State of California, 43 Cal.3d. 46, 58.

Some of the provisions are only applicable to certain fleet requirements. Table 1Table II-1 summarizes the ACF 15-day changes for shared provisions between the three (SLG, HPF, and drayage) fleet requirements. The Backup Vehicle Exemption is not included in the table because no substantive changes were made to that provision.

Table II-1 Summary of 15-Day Changes for Shared Provisions

ACF 15-Day Change	Regulation	Summary of Change
Infrastructure Delay Extension	SLG, Drayage, HPF	The provision was expanded to account for utility delays before construction begins and to provide more time due to construction delays. An additional site electrification delay was added to cover delays for ZEVs that cannot be supported by existing site power due to delays in obtaining grid power from the utility before construction starts. The site electrification delay can extend up to five years from the time a utility and fleet either execute a contract or the utility attests they will proceed with the project; this delay sunsets in 2030. Fleet owners with multiple sites must provide each site’s preliminary infrastructure capacity evaluation from the utility or a third-party licensed professional electrical engineer to qualify. Construction related delays could be approved for up to two years instead of one additional year after construction permit is issued. This would provide for up to three-years from the time a construction permit is obtained due to circumstances outside a fleet owner’s control.
ZEV Purchase Exemption*	SLG, HPF	Allows fleets to purchase a new ICE vehicle when ZEVs are not available in the needed configuration. To accommodate stakeholder requests for clarity on this exemption, the exemption is now separated into two separate paths. The first path requires CARB to maintain a list of vehicle body configurations not available as ZEVs. Fleets may purchase an ICE vehicle type on the list without applying for an exemption. Fleet owners could also apply for an exemption if a needed vehicle configuration was not available to serve the primary function for a particular fleet. Additionally, the provision was expanded to all GVWR.

ACF 15-Day Change	Regulation	Summary of Change
Daily Usage Exemption*	SLG, HPF	Allows fleets to purchase a new ICE vehicle if available ZEVs cannot meet duty cycle for same truck configuration. The fleet must already be composed of 10 percent ZEVs to qualify. Fleets will have up to 180 days to make new ICE purchases when approved. In the ACF 15-day changes, calculations used to determine daily usage needs have been streamlined (including allowing for shorter time periods required by fleets for data collection). Fleets with mutual aid agreements can use a longer period to support their claim. This exemption was expanded to include all vehicle weight classes rather than just the larger trucks.
Mutual Aid Assistance	SLG, HPF	Allows for purchase of ICE vehicles after meeting a minimum threshold of ZEVs in the fleet. Original proposal set this threshold after the fleet had 75 percent ZEVs in the fleet. This has been relaxed. The threshold is a gradual phase-in to 75 percent ZEV over nine years, beginning at 25 percent in 2024 and increasing to 75 percent by 2035.
Waste and Wastewater Fleet Option	HPF Milestones, SLG opt-in	Applies to CNG trucks owned by waste hauler fleets or wastewater agencies that process or handle organic waste. Allows fleets who have opted into ZEV Milestones to shift compliance deadline for Groups 1 and 2 CNG vehicles to Group 3, giving them until 2030 to start their transition.
Vehicle Delivery Delay Extension	HPF, Drayage	Now applies to ZEV orders cancelled by an OEM. This delay gives drayage truck and high priority fleet owners 180 days and government fleet owners one year to secure another ZEV purchase agreement.
Accident/Non-repairable Vehicle Provision	HPF Model Year, Drayage, SLG	In the case of an accident, this provision allows a fleet owner to purchase and make limited use of an ICE vehicle with the same or newer model year engine as the non-repairable vehicle.
Intermittent Snow Removal Vehicle Exemption	SLG, HPF Milestones	A multi-use ICE vehicle that periodically removes snow from roads may be designated as an intermittent snow removal vehicle. They are excluded from the California fleet and exempt from ZEV purchases until 2030.

* Exemption allows the fleet owner to purchase a new California-certified ICE vehicle rather than a ZEV if their application is granted by the Executive Officer.

Section 2013, State and Local Government Fleets

Language was added to exempt transit agencies subject to the ICT Regulation until after January 1, 2030. Language was added to allow SLG fleets to permanently opt into the ZEV Milestones Option and to let a fleet owner know they have until January 1, 2030, to make their choice. Allowing SLG to opt into the ZEV Milestones Option may provide additional time for work trucks and specialty vehicles depending on the fleet composition. Language was added to allow SLG who qualify for the Waste and Wastewater Fleet Option to opt into the ZEV Milestones Option to apply for that provision. Language was added to inform government entities they can comply jointly, but only under the SLG Regulation. Language was added to allow SLG fleets with ten or fewer vehicles, or those whose jurisdiction or service area is split between a designated low population and a non-designated county, more time to start their ZEV transition. Language was modified in the NZEV flexibility provision to expand the use of the provision to any NZEV with a 2035 or earlier model year to be counted as a ZEV for the whole Regulation, except as specified in the Daily Usage and ZEV Purchase Exemptions. Language was added to the late reporting penalty section.

Section 2014, Drayage Truck Requirements

Language was modified to add clarity to definitions for drayage truck requirements. Seaport, railyard, and terminal reporting requirements were modified to reduce burden on reporting parties, add clarity to compliance dates, and account for limited data collection capabilities that some facilities may have.

Section 2015, High Priority and Federal Fleets

Language was added to allow HPF fleet owners, who have vehicles subject to the Zero-Emission Airport Shuttle Bus Regulation, to delay their ZEV transition for those subject vehicles until January 1. 2027. Language was added to inform HPF fleet owners that they may switch between ZEV Milestones and Model Year Schedules until January 1, 2030, and to inform corporations they may comply jointly under the ZEV Milestones Option. Language was added to give HPF fleet owners an annual, 5-Day Pass that excludes any one vehicle from their California fleet for five consecutive days. Language was added to give national rental fleets, complying with the ZEV Milestone Schedule, an option to take an average of four quarterly snapshots of their vehicles operating in California to claim as their California fleet. Language was added on temporary period for late reporting.

Section 2016, 100 Percent ZEV Sales Requirements

Language was modified to reflect a 2036 model year 100 Percent ZEV Sales requirement. This change meets Board direction and is necessary to achieve State air quality and climate goals. Accelerating the 100 Percent ZEV Sales manufacturer requirement sends a stronger market signal indicating the end of combustion-powered sales in California in 2036 rather than in 2040.

Updates to Analysis as a Result of Modifications

Modifications to the Regulation that impact emission estimates include accelerating the 100 Percent ZEV Sales requirement to begin in 2036 instead of 2040. This will accelerate ZEV purchases by all fleets by four years including those not affected by the SLG, drayage, or HPF sections. This change is expected to increase emissions benefits and cost savings associated with the Regulation as ZEVs have lower TCO than ICE vehicles in 2036. Staff have added a new provision affecting CNG powered trucks owned by public or private waste and wastewater fleets involved in municipal diversion of organic waste. Vehicles affected by this provision are moved to the ZEV Milestone Group 3 schedule. This provision provides additional time to these fleets before they must transition these vehicles to ZEVs. Finally, the changes would require California-certified engines when new ICE vehicles are purchased.

Other modifications made to the emissions estimates since the Staff Proposal was released include changes to the Legal Baseline. CARB's HD I/M program became effective on January 1, 2023[5] and the Federal CTP was adopted by the U.S. EPA.[6] Both the HD I/M and CTP decrease projected tailpipe criteria emissions from ICE heavy-duty vehicles and increase their projected costs. These regulatory changes and updates to the Legal Baseline since the Staff Report was released result in smaller criteria pollutant emissions benefits for ACF than originally analyzed.

On August 16th, 2022, President Joe Biden signed the IRA. This landmark piece of federal legislation establishes several provisions which will reduce costs of medium- and heavy-duty ZEVs and accelerate the ZEV market. In the original ACF proposal, staff had attributed IRA cost reductions of $2.0 billion in credits from the IRA in the Legal Baseline. Since the release of the Staff Report, this increased to $4.3 billion in credits due to the increased number of ZEVs and chargers being purchased by fleets subject to the Regulation. This results in a net cost change of -$2.3 billion, representing an increase in savings, due to the IRA.

Furthermore, CEC published updated Transportation Fuel Demand Forecasts on January 5, 2023; these updated values changed the cumulative cost of the Regulation from 2024-2050 by $21.5 billion representing a decrease to the cost of the Regulation. Other, minor corrections were made. Updated costs, emissions and health benefits are presented in Appendix B to the ACF 15-Day Notice. A summary is shown in the table below.

Table IIII-2: Statewide Cumulative Benefits of the Regulation to 2050

Cumulative Benefit to 2050	Value
NOx Reduction	146,872 tons
PM2.5 Reduction	6,875 tons
GHG Reduction	327 MMT CO_2
Avoided Cardiopulmonary Mortalities	2,526
Health Benefits Savings	$26.5 billion

[5] Cal. Code Regs., tit. 13, sections 2193, 2195 through 2199.1

[6] U.S. Environmental Protection Agency, Control of Air Pollution From New Motor Vehicles: Heavy-Duty Engine and Vehicle Standards, 2023 (web link: https://www.federalregister.gov/documents/2023/01/24/2022-27957/control-of-air-pollution-from-new-motor-vehicles-heavy-duty-engine-and-vehicle-standards, last accessed February 2023).

Cumulative Benefit to 2050	Value
Social Cost of Carbon Savings*	$9.8-$38.7 billion
Statewide Direct Cost-Savings	$116.7 billion
Statewide Incremental Total Cost of Ownership Savings	$48.0 billion
Tax and Fee Revenue	-$36.6 billion
Statewide Benefits and Savings**	**$106.6 billion**

* The Social Cost of Carbon savings include global figures and are not included in the total California benefits and savings.

**The total includes the statewide direct cost-savings and health benefits savings minus the tax and fee revenue.

Non-Substantial Modifications

Subsequent to the 15-day public comment periods mentioned above, staff identified the following additional non-substantial changes to the Regulation:

1. Modifications to Section 2013

Section 2013(a)(2)

Added a period after "lbs." that was erroneously excluded.

Section 2013(b)

Removed an extra space in front of "This does not include entities" in the definition for "Manufacturer" that was erroneously included.

Section 2013.1(c)(1)(A)

Removed an extra space after "deadline" that was erroneously included.

Section 2013.2(a)

Removed an extra space after "Fleet" that was erroneously included.

Section 2013.2(i)

Added a space between "extensions" and "requests" that was erroneously omitted.

2. Modifications to Section 2014

Table of Contents

Added period at after "Section 2014" for consistency with other components of the ACF Regulation.

Page 3, before Section 2014

Removed "s" from "Sections" as the pluralization was not needed.

Section 2014(b)

Replaced period at the end of the header for Section 2014(b) with a colon. This change was made to be consistent with the other components of the ACF Regulation.

3. Modifications to Section 2015

Table of Contents

Added period after "Section 2015" for consistency with other components of the ACF Regulation.

Section 2015(b)

Removed an extra space in the "vehicle purchase" definition that was erroneously included.

Section 2015.2

Removed an extra space in front of "By using this option" that was erroneously included.

Section 2015.2(a)

Removed a second period from "Table A: ZEV Fleet Milestones by Milestone Group and Year for their California fleets" that was erroneously included.

Added a space between "31,2027" to now read "December 31, 2027" that was erroneously omitted.

Section 2015.3(e)(2)(D)(1)

Removed an extra space that was erroneously included.

Section 2015.4(k)

Added a space between "extensions" and "requests" that was erroneously omitted.

4. Modifications to Section 2016

Section 2016

Added space/indent between "2016." and "100" in the header which was erroneously omitted.

The above-described modifications constitute non-substantial changes to the regulatory text and do not materially alter the requirements or conditions of the adopted rulemaking action. In addition to these changes, additional non-substantive changes were made to correct numbering, formatting, and grammatical changes throughout the amended and adopted Regulation text.

III. Documents Incorporated by Reference

The Regulation and the incorporated certification procedures, test procedures, and other documents adopted by the Executive Officer incorporate by reference the following documents:

California Air Resources Board, 2014 amended in 2018. Final Phase 2 Greenhouse Gas Amendments to California Greenhouse Gas Exhaust Emission Standards and Test Procedures for 2014 and Subsequent Model Heavy-Duty Vehicles, Attachment B table called, “Phase 2 Plug-in Hybrid Electric Vehicles All-Electric Range Requirements and ATC Multipliers” is used to define “near-zero-emissions vehicle” or “NZEV” and is incorporated by reference in 13 CCR sections 2013 and 2015.

California Air Resources Board, “California Standards and Test Procedures for New 2021 and Subsequent Model Heavy-Duty Zero-Emission Powertrains,” adopted June 27, 2019, is used to define “rated energy capacity” and for Executive Officer determination of ZEV Purchase Exemption criteria and is incorporated by reference in 13 CCR sections 2013, 2013.1, 2015, and 2015.3.

Code of Federal Regulations, Title 40 section 1037.801, as last amended by U.S. EPA on June 17, 2013, is used to define “battery-electric vehicle” or “BEV” and is incorporated by reference in 13 CCR sections 2013 and 2015.

Code of Federal Regulations, Title 49 section 523.2. Title V of the Motor Vehicle Information and Cost Savings Act Vehicle Classification Definitions as it existed on June 3, 2022, is used to define “light-duty package delivery vehicle” and is incorporated by reference in 13 CCR section 2015.

Code of Federal Regulations, Title 49, Chapter V, Parts 565, 566, and 571 is used to define “Vehicle Identification Number” and is incorporated by reference in 13 CCR sections 2013 and 2015.

SAE, Recommended Practice SAE J1667 “Snap-Acceleration Smoke Test Procedure for Heavy-Duty Diesel-Powered Vehicles,” as issued February 1996 is defined for the “smoke opacity test “used for odometer reading documentation and is incorporated by reference in 13 CCR sections 2013, 2013.3, 2014, 2015, and 2015.5.

These documents were incorporated by reference because it would be cumbersome, unduly expensive, and otherwise impractical to publish them in the CCR. In addition, some of the documents are copyrighted, and cannot be reprinted or distributed without violating the licensing agreements. The documents are lengthy and highly technical test methods and engineering documents that would add unnecessary additional volume to the Regulation. Distribution to all recipients of the CCR is not needed because the interested audience for these documents is limited to the technical staff at a portion of reporting facilities, most of whom are already familiar with these methods and documents. Also, the incorporated documents were made available by CARB upon request during the rulemaking action and will continue to be available in the future. The documents are also available from college and public libraries or may be purchased directly from the publishers.

IV. Summary of Comments and Agency Response

Written comments were received during the 45-day comment period from September 2 through October 17, 2022, in response to the public hearing notice, and written and oral comments were presented at the October 27, 2022, Board Hearing. Written comments were received during the 15-day comment period, in response to the second public hearing notice, and written and oral comments were presented at the April 27-28, 2023, Board Hearing. Written comments submitted during comment periods can be viewed at this webpage, https://www.arb.ca.gov/lispub/comm/iframe_bccommlog.php?listname=acf2022. Oral comments can be found at the Board Hearing webcast archive available in English and Spanish at this webpage, https://cal-span.org/. Table IV-1 shows the comment period code for each of the comment periods along with a description.

Table IV-1. Comment Period Code and Description.

Comment Period Code	Comment Period Description
15-1	Written comments submitted during the first 15-days
15-2	Written comments submitted during the second 15-days
45d	Original (45-day) Proposal
OT1	Oral Testimony Comments at the first Board Hearing
OT2	Oral Testimony Comments at the second Board Hearing
WT1	Written comments submitted at first Board Hearing
WT2	Written comments submitted at second Board Hearing

The comment period code is used as a primary identifier followed by a dash then a sequential number in chronological order. The comment codes and sequential numbers are used as primary identifiers that relate comments to individuals or organizations who submitted them. Comment codes are shown below comment summaries and above agency responses in Chapter IV. The following tables can be used as a key to relate comment codes to the organizations and individuals who submitted them.

Table IV-2. Written Comments Received During the 45-Day Comment Period

Comment Code	Commenter's Name	Organization	Date Submitted
001-45d	Mier y Teran, Alejandra	Otay Mesa Chamber of Commerce	9/14/2022
002-45d	Sonnefeld, Joseph	Individual	9/15/2022
003-45d	Mann, Gurwinder	Individual	9/19/2022
004-45d	Borges, Mark	Individual	9/20/2022
005-45d	Jim Hilson	Individual	9/20/2022
006-45d	Jorge Lopez	Individual	9/21/2022
007-45d	Alexander Amort	Cascade Environmental, Limited Liability Company	9/22/2022
008-45d	Josh Grodin	Penske	9/23/2022

Comment Code	Commenter's Name	Organization	Date Submitted
009-45d	Jim G	Individual	9/22/2022
010-45d	Roger Ellis	Individual	9/27/2022
011-45d	Paul Raab	Individual	9/27/2022
012-45d	Jarrett Stoltzfus	Proterra	9/27/2022
013-45d	Jon Zamorano	Big Bear City Community Service District	9/28/2022
014-45d	Tenille Otero	Otay Water District	9/28/2022
015-45d	Elisabeth de Jong	Southern California Public Power Authority	9/29/2022
017-45d	Thomas Gleason	Individual	10/5/2022
018-45d	Jeff Becker	Individual	10/5/2022
019-45d	Mandie Spinelli	Individual	10/5/2022
020-45d	Paul Raab	Individual	10/5/2022
021-45d	Alessandra Magnasco	California Fuels & Convenience Alliance	10/6/2022
022-45d	Tim Cromartie	Environmental Justice League	10/6/2022
023-45d	Cory Peters	Best Drayage	10/6/2022
024-45d	Steven Vilata	Individual	10/6/2022
025-45d	Greg Wright	Best Drayage	10/6/2022
026-45d	Jana W.	Individual	10/6/2022
027-45d	Michael Tooley	Tooley Oil	10/6/2022
028-45d	William Mayo	Golden State Freight	10/6/2022
029-45d	Shane Gusman	California Teamsters	10/6/2022
030-45d	Faustino Arenas	Individual	10/7/2022
031-45d	Dan Maurer	Individual	10/7/2022
032-45d	Marcus Vierra	Individual	10/7/2022
033-45d	Courtney Roche Jr.	Roche Oil	10/7/2022
034-45d	Jeff Cox	Best Drayage	10/7/2022
035-45d	Chris Rodriguez	Individual	10/7/2022
036-45d	Juanita Morones	Individual	10/7/2022
037-45d	Jeremy Vannest	Vannest Trucking, Inc.	10/7/2022
038-45d	Leslee Baird	Individual	10/7/2022
039-45d	Patrick McNeece	McNeece Brothers	10/7/2022
040-45d	Lawrence Garwin	Individual	10/7/2022
041-45d	Jack Guzman	Guzman Enterprises, Incorporated	10/7/2022
042-45d	Tom Bair	Golden State Freight, Incorporated & Garrison Logistics, Incorporated	10/7/2022
043-45d	Mary Leslie	Los Angeles Business Council	10/7/2022
044-45d	Michael Conklin	Individual	10/7/2022
045-45d	Aldo Oviedo	Individual	10/8/2022
046-45d	Kimberly Sulsar	Individual	10/8/2022

Comment Code	Commenter's Name	Organization	Date Submitted
047-45d	Alfonso Campos	Individual	10/8/2022
048-45d	Mary Alyssa Rancier	Associated General Contractors of California	10/10/2022
049-45d	Colin Szehner	Individual	10/10/2022
050-45d	Amy Jo Sihto	El Dorado Almonds, Limited Liability Company	10/10/2022
051-45d	Tej Pahwa	Highway 49 Gas and Food	10/10/2022
052-45d	Stephanie Ferguson	United Pacific	10/10/2022
053-45d	Rajiv Jain	Bridgeport Transportation & Warehousing	10/10/2022
054-45d	Justin Parsons	Individual	10/10/2022
055-45d	Paul Rozenberg	Suburban Propane	10/10/2022
056-45d	David Atwater	Individual	10/10/2022
057-45d	Royd Baik	Individual	10/10/2022
058-45d	Bob Shepherd	California Caterpillar Dealers	10/10/2022
059-45d	JJ Rico	Tiger Lines, Limited Liability Company	10/10/2022
060-45d	Mark Dowsing	Individual	10/10/2022
061-45d	Samuel Belasco	Individual	10/10/2022
062-45d	Vicky Ng	Forward Logistics	10/10/2022
063-45d	Martin Keane	Individual	10/11/2022
064-45d	David VanMuyden	Individual	10/11/2022
065-45d	Trung Nguyen	Individual	10/11/2022
066-45d	Sarah Sachs	Ceres	10/11/2022
067-45d	Gary Rossiter	Don Pedro Pump	10/11/2022
068-45d	Wil Bentz	Best Drayage, Limited Liability Company	10/11/2022
069-45d	Angelyn Tornell	Best Drayage, Limited Liability Company	10/11/2022
070-45d	Nina Solari	Individual	10/11/2022
071-45d	Suzanne Homem	Individual	10/11/2022
072-45d	Kathy Hollis	Individual	10/11/2022
073-45d	Brenda Rightnour	Best Drayage, Limited Liability Company	10/11/2022
074-45d	Jessica Lamke Blasé	Individual	10/11/2022
075-45d	Steve Koretoff	Individual	10/11/2022
076-45d	Chris Camp	Individual	10/11/2022
077-45d	Chuck Greenwood	Individual	10/11/2022
078-45d	Guadalupe Valdovinos	Individual	10/11/2022

Comment Code	Commenter’s Name	Organization	Date Submitted
079-45d	Don Barto	Individual	10/11/2022
080-45d	Fred Montgomery	Almont Orchards, Inc.	10/11/2022
081-45d	Patrick Mason	Individual	10/11/2022
082-45d	Leela Rao	Port of Long Beach	10/11/2022
083-45d	Assemblymember Blanca Rubio	Coalition of California Assemblymembers	10/11/2022
084-45d	Hiko Shimamoto	Individual	10/11/2022
085-45d	Assemblymember Blac Rubio	California State Assembly	10/11/2022
086-45d	Paul Ewing	RPAC, Limited Liability Company	10/11/2022
087-45d	Francisco Madrigal	Individual	10/11/2022
088-45d	Kelly Camp	Individual	10/11/2022
089-45d	Damon Conklin	League of California Cities	10/11/2022
090-45d	Marty Giovanetti	Assured Aggregates Company, Incorporated	10/12/2022
091-45d	Charles McCan	Individual, Lube Locker	10/17/2022
092-45d	Anonymous	California State Fleet	10/12/2022
093-45d	Amy Kay	Kay Construction	10/12/2022
094-45d	John Kay	Kay Construction	10/12/2022
095-45d	Ray Pingle	Sierra Club California	10/12/2022
096-45d	John Doe	California State Fleet	10/12/2022
097-45d	Ray Pingle	Sierra Club California	10/12/2022
098-45d	Deborah Ackerman	Best Drayage, Limited Liability Company	10/12/2022
099-45d	Danielle Neguloua	Individual	10/12/2022
100-45d	Jim Neal	Individual (2,354 form letter submissions)	10/12/2022
101-45d	Bryan Nelson	California Almond Community	10/12/2022
102-45d	Jeff Charter	Almond Alliance & Select Harvest United States of America	10/12/2022
103-45d	Darin Titus	Coalition (Multiple listed)	10/12/2022
104-45d	Mike McManus	Associated General Contractors San Diego	10/12/2022
105-45d	Suleiman Agnes	California Almond Community	10/12/2022
106-45d	Helen Tomao	California Almond Community	10/12/2022
107-45d	Andres Avelar	Almond Alliance & Select Harvest United States of America	10/12/2022
108-45d	Jose Gonzalez	Individual	10/12/2022
109-45d	Kevin Harshberger	Tricon Transportation, Inc.	10/12/2022
110-45d	Manuel Zamora	MC2 Transportation & Zamora Trucking	10/12/2022

Comment Code	Commenter's Name	Organization	Date Submitted
111-45d	Diana Trejo	Green Trucking Limited Liability Company	10/12/2022
112-45d	Evan L	Phoenix PDQ	10/12/2022
113-45d	Alfredo Barajas	PanAnchor	10/12/2022
114-45d	Susan Griffiths	Hyliion	10/12/2022
115-45d	Toby Slayman	Individual	10/12/2022
116-45d	Monica Rivera	Beattie's Trucking Group, Incorporated	10/12/2022
117-45d	Lauren Roberts	Rebel Oil Company, Incorporated	10/12/2022
118-45d	Gabriel Rodriguez	Flying Express, Incorporated	10/12/2022
119-45d	Dave Cortese	California State Senate, District 15	10/12/2022
120-45d	John Marlow	Clean Energy Fuels	10/12/2022
121-45d	Rick Beale	Almond Farmer	10/12/2022
122-45d	Sam Wilson	Union of Concerned Scientists	10/12/2022
123-45d	Sam Wilson	Union of Concerned Scientists	10/12/2022
124-45d	Louie Lopez	Individual	10/12/2022
125-45d	Raja Kumar	Individual	10/12/2022
126-45d	Scott Shimamoto	Mutual Express Company, Oakland	10/12/2022
127-45d	Lakhbir Bhambra	Individual	10/12/2022
128-45d	Paolo Beltran	City of Lakewood	10/12/2022
129-45d	Cathy Moorhead	City of Willits	10/12/2022
130-45d	Herbert Olivares	Individual	10/12/2022
131-45d	Ruben Aronin	ACF Advocacy Coalition	10/12/2022
132-45d	Michael Farmar	Individual	10/12/2022
133-45d	Bhupinder Ojla	Individual	10/12/2022
134-45d	Baron Bigler	Individual	10/13/2022
135-45d	Brandon McDonnell	Individual	10/13/2022
136-45d	Ron Cancilla	Individual	10/13/2022
137-45d	Aaron Shelton	Individual	10/13/2022
138-45d	Trinity Parreira	Individual	10/13/2022
139-45d	Mohammad Khan	Individual	10/13/2022
140-45d	Parmveer Singh	Individual	10/13/2022
141-45d	Lori Coburn	Individual	10/13/2022
142-45d	Parm Shahi	Individual	10/13/2022
143-45d	Chuck Helget	Republic Services	10/13/2022
144-45d	Gina Looney	Select Harvest	10/13/2022
145-45d	Kristy Delgadillo	OKA Logistics	10/13/2022
146-45d	Richard Damilano	Cherokee Freight Lines	10/13/2022
147-45d	Alissa Recker	Daimler Truck North America	10/13/2022
148-45d	Robert Spiegel	California Manufacturers & Technology Association	10/13/2022

Comment Code	Commenter's Name	Organization	Date Submitted
149-45d	Steve Slinkard	Individual	10/13/2022
150-45d	Kenia Zamarripa	San Diego Regional Chamber of Commerce	10/13/2022
151-45d	Margaret Staub	Individual	10/13/2022
152-45d	Erin Graziosi	Robinson Oil	10/13/2022
153-45d	Luis Roa	City of Hawaiian Gardens	10/13/2022
154-45d	Michael Murphy	Bay Area Air Quality Management District	10/13/2022
155-45d	Jason Machado	City of Cypress	10/13/2022
156-45d	Brett Hodgkiss	Vista Irrigation District	10/13/2022
157-45d	Mary Staub	Individual	10/13/2022
158-45d	Mike James	City of El Cajon	10/13/2022
159-45d	Francisco Olivares	Individual	10/13/2022
160-45d	Victor Navarro	Individual	10/13/2022
161-45d	Jeffery Bidwell	Individual	10/14/2022
162-45d	Greg Owen	Individual	10/14/2022
163-45d	James O'Neill	O'Neill Logistics	10/14/2022
164-45d	David Atwater	Individual	10/14/2022
165-45d	Bascomb Grecian	Individual	10/14/2022
166-45d	Dominick Lee	Pacific Coast Container, Incorporated	10/14/2022
167-45d	Mike Mohajer	Los Angeles Department of Public Works	10/14/2022
168-45d	Robert Ackerman	Individual	10/14/2022
169-45d	Mike Joyce	American Automotive Leasing Association	10/14/2022
170-45d	Theresa Romanosky	Association of American Railroads	10/14/2022
171-45d	Ashley Grijalva	Best Drayage	10/14/2022
172-45d	Allen Genetti	Chemical Transfer Co.	10/14/2022
173-45d	Dan Vander Pol	Oak Harbor Freight Lines	10/14/2022
174-45d	Ashley Remillard	Hexagon Agility, Inc.	10/14/2022
175-45d	Alex Oseguera	Waste Management	10/14/2022
176-45d	Rodrigo Saldivar	Individual	10/14/2022
177-45d	Chris McGlothlin	California Cotton Ginners and Growers Association / Western Agricultural Processors Association	10/14/2022
178-45d	Grace Castaneda	Best Drayage	10/14/2022
179-45d	Samantha Argabrite	City of Simi Valley	10/14/2022
180-45d	Staci Heaton	Rural County Representatives of California	10/14/2022

Comment Code	Commenter’s Name	Organization	Date Submitted
181-45d	Macy Neshati	US Hybrid	10/14/2022
182-45d	Ramon Martinez	Individual	10/14/2022
183-45d	Will Barrett	American Lung Association	10/14/2022
184-45d	Edward Wondergem	SC Fuels	10/14/2022
185-45d	Mary Couchman	Individual	10/14/2022
186-45d	Brigitta Van Der Raay	Climate Reality Project, Santa Barbara	10/14/2022
187-45d	Juan Carlos Mariscal	Individual	10/15/2022
188-45d	Jason Cole	Individual	10/15/2022
189-45d	Andrea Cole	Individual	10/15/2022
190-45d	Dan DeWitt	Ed Staub & Sons	10/15/2022
191-45d	Nancy Such	Individual	10/15/2022
192-45d	Jed A. Hendrickson	Individual	10/15/2022
193-45d	Scott Moody	Individual	10/15/2022
194-45d	Brad Staub	Individual	10/15/2022
195-45d	Jatinder Deol	Individual	10/15/2022
196-45d	Hammad Khan	Individual	10/15/2022
197-45d	Mohammad Khan	Individual	10/15/2022
198-45d	David Molina	Individual	10/15/2022
199-45d	Christopher Lish	Individual	10/15/2022
200-45d	Glenn Choe	Toyota Motor North America	10/16/2022
201-45d	Earl Rizzo	Individual	10/16/2022
202-45d	Donald Wortley	Individual	10/16/2022
203-45d	Kulwinder Nagra	None	10/16/2022
204-45d	Dave Johnson	Individual	10/16/2022
205-45d	Frank H	Individual	10/16/2022
206-45d	David Gurrola	One Link Transport Inc.	10/16/2022
207-45d	Christine Wolfe	California Council for Environmental and Economic Balance	10/16/2022
208-45d	Paul Miller	Northeast States for Coordinated Air Use Management	10/17/2022
209-45d	Chris Busch	Energy Innovation: Policy & Technology	10/17/2022
210-45d	William McDonnell	Inland Empire Utilities Agency	10/17/2022
211-45d	Amanda Parsons DeRosier	Global Clean Energy	10/17/2022
212-45d	Tom Van Heeke	Rivian Automotive, Limited Liability Company	10/17/2022
213-45d	GaiParsons	Environmental Entrepreneurs	10/17/2022

Comment Code	Commenter's Name	Organization	Date Submitted
214-45d	Andy Byerly	Allison Transmission	10/17/2022
215-45d	Jerry Davis	Individual	10/17/2022
216-45d	Lucille Cadic	Air Liquide Advanced Technologies	10/17/2022
217-45d	Christina Hartz	Compressed Gas Association	10/17/2022
218-45d	Dana Hamilton	Advance Beverage Company	10/17/2022
219-45d	James Gonzalez	Independent Construction Company	10/17/2022
220-45d	Trevor Gasper	THOR Industries, Incorporated	10/17/2022
221-45d	Doug Allen	Individual	10/17/2022
222-45d	Nicole Collazo	Ventura County Air Pollution Control District	10/17/2022
223-45d	Daniel Hamilton	City of Oakland	10/17/2022
224-45d	Michael Ochs	Recreational Vehicle Industry Association	10/17/2022
225-45d	Pamela De Leo	Doug De Leo Welding, Incorporated	10/17/2022
226-45d	Jennifer Capitolo	California Water Association	10/17/2022
227-45d	Gary Arant	General Manager, Valley Center Metropolitan Water District	10/17/2022
228-45d	Davon Collins	U.S. Postal Service	10/17/2022
229-45d	Melodee Black	Southern California Edison	10/17/2022
230-45d	Rebecca Schenker	Gladstein, Neandross & Associates	10/17/2022
231-45d	William Barrett	American Lung Association	10/17/2022
232-45d	Cindy Muller	Individual	10/17/2022
233-45d	Nicole Looney	Sacramento Municipal Utility District	10/17/2022
234-45d	Alex Boesenberg	Municipal Equipment Maintenance Association	10/17/2022
235-45d	Nicholas Blair	Association of California Water Agencies	10/17/2022
236-45d	Madison Vander Klay	Silicon Valley Leadership Group	10/17/2022
237-45d	Janus Norman	California Cable and Telecommunications Assoc	10/17/2022
238-45d	Jessica Palmer	Navy Region Southwest / Department of Defense	10/17/2022
239-45d	Michael Lewis	Construction Industry Air Quality Coalition	10/17/2022
240-45d	Claire Buysse	International Council on Clean Transportation	10/17/2022
241-45d	David Lax	American Petroleum Institute	10/17/2022
242-45d	Daniel Barad	Sierra Club California	10/17/2022
243-45d	Nicholas Blair	Essential Public Service Providers	10/17/2022
244-45d	Josue Aguilar	Natural Resources Defense Council	10/17/2022
245-45d	Elizabeth Leeper	El Dorado Irrigation District	10/17/2022

Comment Code	Commenter's Name	Organization	Date Submitted
246-45d	Ramorino	Roadstar Trucking Incorporated	10/17/2022
247-45d	Dan Bogard	General Motors	10/17/2022
248-45d	Miles Heller	Air Products	10/17/2022
249-45d	Vincent Sullivan	Sullivan Petroleum Company Limited Liability Company and Sully's Food Stores Limited Liability Company	10/17/2022
250-45d	Tim Hester	Individual	10/17/2022
251-45d	Nick Staub	Ed Staub and Sons Petroleum	10/17/2022
252-45d	Manny Leon	California Alliance for Jobs	10/17/2022
253-45d	Ryan Kenny	Coalition of 42 Stakeholders	10/17/2022
254-45d	Marla Carlson	Individual	10/17/2022
255-45d	Timothy Blubaugh	Truck & Engine Manufacturers Association	10/17/2022
256-45d	Margaret Edwards	National Star Route Mail Contractors Association	10/17/2022
257-45d	Sandra Brown	Individual	10/17/2022
258-45d	Kathleen Hollowell	Boyett Petroleum	10/17/2022
259-45d	Elizabeth Bourbon	Valero	10/17/2022
260-45d	Eva Plajzer	San Diego County Water Authority	10/17/2022
261-45d	Kerry Shapiro	California Construction and Industrial Materials Association	10/17/2022
262-45d	East Peterson-Trujillo	Individual	10/17/2022
263-45d	Steven Poncelet	Truckee Donner Public Utility District	10/17/2022
264-45d	Sourabh Pansare	Phillips 66 Company	10/17/2022
265-45d	Richard Abel	Concerned Citizen & Taxpayer	10/17/2022
266-45d	Sarah Taheri	San Diego Gas and Electric	10/17/2022
267-45d	Kayla Robinson	Coalition of Waste Management Providers	10/17/2022
268-45d	Erin Bednar	Individual	10/17/2022
269-45d	Hannah Davidson	Hidden Valley Lake Community Services District	10/17/2022
270-45d	Tanya DeRivi	Western States Petroleum Association	10/17/2022
271-45d	Andy Schwartz	Tesla, Inc	10/17/2022
272-45d	Ginger Giddings	California Chamber of Commerce	10/17/2022
273-45d	Sam Appel	BlueGreen Alliance	10/17/2022
274-45d	Tracy Fidell	Port of Oakland	10/17/2022
275-45d	David Oliver	Caliber Strategies	10/17/2022
277-45d	Austin Avery	Turlock Irrigation District	10/17/2022
278-45d	Windmera Quintanar	City of Los Alamitos	10/17/2022

Comment Code	Commenter’s Name	Organization	Date Submitted
279-45d	ZeeLaura Page	City of Pleasanton	10/17/2022
280-45d	Jeffrey Clarke	Natural Gas Vehicles for America	10/17/2022
281-45d	Laurel Moorhead	Transfer Flow	10/17/2022
282-45d	Nick Chiappe	California and American Trucking Associations	11/17/2022
283-45d	Katie Byrne	San Diego County Farm Bureau	10/17/2022
284-45d	Ryan Kocher	Knight-Swift Transportation	10/17/2022
285-45d	Brandon Beaudette	City of Santa Barbara	10/17/2022
286-45d	Rick Marshall	Brady Southern California, Inc	10/17/2022
287-45d	Vincet C.	Individual	10/17/2022
288-45d	Jaime Olaiz	Individual	10/17/2022
289-45d	Michael Doggett	MJ Tank Lines	10/17/2022
290-45d	John Kinsey	Wanger Jones Helsley Professional Corporation	10/17/2022
291-45d	Elizabeth de Jong	Southern California Public Power Authority	10/17/2022
292-45d	Priscilla Quiroz	Solid Waste Association of North America	10/17/2022
293-45d	Marina Del Pilar Avila Olmeda	Individual	10/17/2022
294-45d	Hoi-Fei Mok	City of San Leandro	10/17/2022
295-45d	David Roe	Individual	10/17/2022
296-45d	Elizabeth Stears	Advanced Energy Economy	10/17/2022
297-45d	Patrick Oconnor	National Association of Fleet Administrators Fleet Management Association	10/17/2022
299-45d	Michael Pimentel	California Transit Association	10/17/2022
300-45d	James Talavera	Los Angeles Department of Water and Power	10/17/2022
301-45d	Jack Kelly	Humboldt Petroleum	10/17/2022
302-45d	Jack Kelly	Peninsula Petroleum	10/17/2022
303-45d	Peter Dahling	Neste	10/17/2022
304-45d	Charles Darensbourg	Los Angeles County Public Works	10/17/2022
305-45d	Kristian Corby	California Electric Transportation Coalition	10/17/2022
306-45d	Alejandro Rodriguez	DLR AUTOTRANSPORTES Limited Liability Company	10/17/2022
307-45d	Brian Robb	Lion Electric	10/17/2022
308-45d	Ken Dewar	JB Dewar Inc.	10/17/2022
309-45d	Alison Torres	Eastern Municipal Water District	10/17/2022

Comment Code	Commenter’s Name	Organization	Date Submitted
310-45d	Veronica Pardo	Resource Recovery Coalition of California	10/17/2022
311-45d	Tom Boyle	Individual	10/17/2022
313-45d	Joshua Miller	Accion Opportunity Fund	10/17/2022
314-45d	Josiah Young	The California Bus Association	10/17/2022
315-45d	Bobby Hernandez	Individual	10/17/2022
316-45d	Adam Browning	Forum Mobility	10/17/2022
317-45d	Sara Fitzsimon	California Hydrogen Business Council	10/17/2022
318-45d	Jessi Davis	SoCalGas	10/17/2022
319-45d	Todd Campbell	Clean Energy	10/17/2022
320-45d	Marisol Reyes	Individual	10/17/2022
321-45d	Noelle Mattock	City of Roseville	10/17/2022
322-45d	Cara Simag	Stericycle	10/17/2022
323-45d	Kim Mason	Individual	10/17/2022
324-45d	George Ruiz	Individual	10/17/2022
326-45d	Sarah Deslauriers	California Association of Sanitation Agencies	10/17/2022
327-45d	Tigran Agdaian	Breathe Southern California	10/17/2022
328-45d	Chelsea Lee	Advocacy Coalition Framework	10/17/2022
329-45d	Michael Geller	Manufacturers of Emission Controls Association Clean Mobility	10/17/2022
330-45d	Lily Mei	City of Fremont	10/17/2022
331-45d	Jeffrey Roe	Roe Oil Company, Inc.	10/17/2022
332-45d	Ruben Aronin	California Business Alliance for a Clean Economy	10/17/2022
333-45d	Roxana Ramirez	Metropolitan Water District	10/17/2022
334-45d	LEE BROWN	Western States Trucking Association	10/17/2022
335-45d	Quinn Piening	California Tow Truck Association	10/17/2022
336-45d	Saini Inderjit	Individual	10/17/2022
337-45d	Sean Edgar	CleanFleets.net	10/17/2022
338-45d	Brandon Garcia	California State Legislature	10/17/2022
339-45d	Justin Boman	California State Assembly – Mathis	10/17/2022
340-45d	Jose Aviles	Francisco Trucking	10/17/2022
341-45d	Matt Schrap	Harbor Trucking Association	10/17/2022
342-45d	Ali Fariya	Pacific Gas and Electric	10/17/2022
343-45d	Lisa McGhee	GreenPower Motors	10/17/2022
344-45d	Matt Klenske	Dalton Trucking Inc.	10/17/2022
345-45d	Annie Guzman	Valley Pacific Petroleum Services, Inc	10/17/2022
346-45d	Andress Alegre	Frank C. Alegre Trucking Inc	10/17/2022
347-45d	Tamara Ross	Individual	10/17/2022

Comment Code	Commenter's Name	Organization	Date Submitted
348-45d	Kimberly McCoy	Central California Asthma Collaborative	10/17/2022
349-45d	Lee Janger	Alliance for Vehicle Efficiency	10/17/2022
350-45d	Timothy Lipman	Union of Concerned Scientists	10/16/2022

Table IV-3. Oral Comments Presented at the October 27, 2022, Board Hearing

Comment Code	Commenter's Name	Organization
001-OT1	David Asti	Southern California Edison
002-OT1	Suzanne Seivright-Sutherland	California Construction and Industrial Materials Association
003-OT1	Nicholas Blair	Association of California Water Agencies.
004-OT1	Frank Harris	California Municipal Utilities Association
005-OT1	Emily Lemei	Northern California Power Agency
006-OT1	Elisabeth de Jong	Southern California Public Power Authority
007-OT1	Steven Poncelet	Truckee Donner Public Utility District
008-OT1	Ray Pingle	Sierra Club California
009-OT1	David Renschler	Municipal Equipment Maintenance Association
010-OT1	Katharine Larson	Sacramento Municipal Utility District
011-OT1	Tanya DeRivi	Western States Petroleum Association
012-OT1	John X. Mataka	Valley Improvement Projects & the Grayson Neighborhood Council
013-OT1	Jon Costantino	California Council for Economic and Environmental Balance
014-OT1	Jamie Angus	Griffith Company
015-OT1	Brian Van Hook	Griffith Company
016-OT1	Mike Tunnell	The American Trucking Associations
017-OT1	Josiah Young	The California Bus Association
018-OT1	Brad Meyer	NevCal Trucking
019-OT1	Sarah Deslauriers	The California Association of Sanitation Agencies
020-OT1	Staci Heaton	Rural County Representatives of California
021-OT1	Teresa Cooke	California Hydrogen Coalition
022-OT1	Mikhael Skvarla	City of Roseville
023-OT1	Tom Bair	Golden State Freight
024-OT1	Michael Caprio	Republic Services
025-OT1	Sara Flocks	California Labor Federation
026-OT1	Chris Shimoda	California Trucking Association
027-OT1	Sam Wilson	Union of Concerned Scientists

Comment Code	Commenter’s Name	Organization
028-OT1	Mary Alyssa Rancier	Associated General Contractors of California
029-OT1	Sarah Taheri	San Diego Gas and Electric
030-OT1	Manny Leon	California Alliance for Jobs
031-OT1	Matt Broad	California Teamsters Public Affairs Council
032-OT1	Mariela Ruacho	American Lung Association
033-OT1	Elena Pieri	CR&R
034-OT1	Andrew Autwih	Western Propane Gas Association
035-OT1	Fariya Ali	Pacific Gas and Electric
036-OT1	LAURA PLASCENCIA	Valley improvement projects
037-OT1	Meli Morales	Environmental Health Coalition
038-OT1	Madison Vander Klay	Silicon Valley Leadership Group
039-OT1	Bill Magavern	Coalition for Clean Air
040-OT1	Veronica Pardo	Resource Recovery Coalition of California
041-OT1	Adam Browning	Forum Mobility
043-OT1	Maria Carmen Gonzalez	Peoples collective of environmental justice
044-OT1	JOCELYN DEL REAL	East Yard Communities for Environmental Justice
045-OT1	Andrea Vidaurre	People’s Collective for Environmental Justice
046-OT1	Brenda Soto	People’s Collective for environmental justice
047-OT1	Jose Avalos	Justice Collective
048-OT1	Daisy Lopez	Warehouse Worker Resource Center
049-OT1	Kevin Torres	Warehouse Worker Resource Center
050-OT1	Juliet Fuentes	Center for Resources of Warehouse Worker
051-OT1	CECILIA GARIBAY	Moving Forward Network
052-OT1	Lucia Aguilar	People’s Collective for Environmental Justice
053-OT1	KRISTIAN CORBY	California Electric Transportation Coalition
054-OT1	JEANNINE PEARCE	Individual
055-OT1	Yasmine Agelidis	EarthJustice
056-OT1	Tania Gonzalez	People’s Collective for Environmental Justice
057-OT1	Gregory Stevens	California Interfaith Power and Light
058-OT1	YASSI KAVEZADE	Sierra Club National
059-OT1	Alejandra Ruedas	East Yard Communities for Environmental Justice

Comment Code	Commenter’s Name	Organization
060-OT1	Ruben Aronin	California Business Alliance for a Clean Economy and better world group
061-OT1	Orville Thomas	CALSTART
062-OT1	Taylor Thomas	East Yard Communities for Environmental Justice
063-OT1	Damon Conklin	League of California Cities
064-OT1	Alicia Aguayo	Environmental Justice Groups from SoCal
065-OT1	Angie Balderas	Sierra Club
066-OT1	Kathy Huang	Powerswitch Action
067-OT1	Jennifer Cardenas	Sierra Club
068-OT1	Sasan Saadat	Earthjustice
069-OT1	Paul Cort	Earthjustice
070-OT1	Doug Bloch	Teamsters Joint Council 7
071-OT1	Will Barrett	American Lung Association
072-OT1	Nicole Rice	California Natural Gas Vehicle Coalition
073-OT1	Janice Wong	Climate Reality Sacramento Chapter
074-OT1	Sam Appel	BlueGreen Alliance
075-OT1	Beverly Yu	State Building and Construction Trades Council of California
076-OT1	Dwight Hanson	U.S. Hybrid
077-OT1	Alex Oseguera	Waste Management
078-OT1	Priscilla Quiroz	Solid Waste Association of North America’s Legislative Task Force
079-OT1	David Rothbart	Los Angeles County Sanitation Districts
080-OT1	Bob Shepherd	California Caterpillar dealers
081-OT1	Steve Jepsen	Southern California Alliance of Publicly Owned Treatment Works
082-OT1	Andy Schwartz	Tesla
083-OT1	Randy Lee	Inland Empire Utilities Agency’s Board of Directors and General Manager
084-OT1	Robert Ferrante	Los Angeles County Sanitation Districts
085-OT1	Randa Abushaban	Orange County Sanitation District
086-OT1	Alison Torres	Eastern Municipal Water District
087-OT1	Curtis Paxton	Las Gallinas Valley Sanitary District in San Rafael
088-OT1	Craig Murray	Las Gallinas Valley Sanitary District in San Rafael
089-OT1	Leela Rao	Port of Long Beach
090-OT1	Todd Campbell	Clean Energy
091-OT1	Carol Kaufman	Metropolitan Water District of Southern California
092-OT1	Alejandra Mier y Teran	Otay Mesa Chamber of Commerce

Comment Code	Commenter's Name	Organization
093-OT1	Rex Hime	California Business Properties Association, Building Owners and Managers Association of California, NAIOP
094-OT1	Greg Zlotnick	San Juan Water District
095-OT1	Andrea Villarain	Los Angeles Department of Water and Power
096-OT1	Lisa McGhee	GreenPower Motors
097-OT1	Avi Mersky	American Council for an Energy-Efficient Economy
098-OT1	John Kinsey	Wanger Jones Helsley
099-OT1	Amber Coluso	Port of Los Angeles
100-OT1	Dan Potter	Daimler Truck North America
101-OT1	Austin Avery	Turlock Irrigation District
102-OT1	Omar Gonzales	Nikola Corporation
103-OT1	Alison Kerstetter	City of Sacramento
104-OT1	Ileagh MacIvers	Interfaith Power and Light
105-OT1	Margret Edwards	National Star Route Mail Contractors Association
106-OT1	Claire Buysse	International Council on Clean Transportation
107-OT1	East Peterson-Trujillo	Public Citizen
108-OT1	Sam Sukaton	California Environmental Voters based in San Bernardino, California
109-OT1	Alicia Appel	Encina Wastewater Authority in Carlsbad
110-OT1	Victoria Leistman	Clean Mobility Collective
111-OT1	Pearl McLeod	E2 Environmental Entrepreneurs
112-OT1	Camilla Getz	Center for Biological Diversity
113-OT1	Katie Patterson	San Joaquin Irrigation District
114-OT1	Olivia Seideman	Leadership Counsel for Justice and Accountability
115-OT1	Michael Geller	Manufacturers of Emission Controls Association Clean Mobility
116-OT1	Joe Rajkovacz	Western States Trucking Association
117-OT1	John Shears	Center for Energy Efficiency and Renewable
118-OT1	David Prescott	Hazard Construction Company
119-OT1	Derrick Robinson	Center on Policy Initiatives in San Diego
120-OT1	James Fahy	Mercedes-Benz Research and Development North America
121-OT1	Julia Levin	Bioenergy Association of California
122-OT1	Maurissa Brown	Greenlining Institute
123-OT1	Sofia Magallon	CAUSE

Comment Code	Commenter’s Name	Organization
124-OT1	Jessica Cleaver	San Diego County Water Authority
125-OT1	Tim Sasseen	Ballard Power Systems for North America
126-OT1	Odette Moran	CAUSE
127-OT1	Ashley Remillard	Hexagon Agility
128-OT1	Cynthia Pinto-Cabrera	Central Valley Air Quality Coalition
129-OT1	Jim Korkosz	Las Virgenes Municipal Water District
130-OT1	Ryan Kenny	Clean Energy
131-OT1	Christina Angelides	Elemental Excelerator
132-OT1	Jose Luis De La Fuente	ATS Transportation Company
133-OT1	Kyle Heiskala	Environmental Health Coalition
134-OT1	Tyrone Thompson	Clean Star Products
135-OT1	Richard Skaggs	Omstar Environmental
136-OT1	Tim Cromartie	Environmental Justice League
137-OT1	Michael Munoz	Port Campaign for the Los Angeles Alliance for a new Economy
138-OT1	Elfonso Esquer	Multimodal Esquer Trucking
139-OT1	Robert Spiegal	California Manufacturers and Technology Association
140-OT1	Katie Litter	California Farm Bureau
141-OT1	Beverly Des Chaux	Electric Vehicle Association of the Central Coast
142-OT1	Melanie Beikman	Arizona Interfaith Power and Light
143-OT1	LaDonna Williams	All Positives Possible
144-OT1	Matt Zerega	Individual (Transportation Electrification Consultant)
145-OT1	Rebecca Schenker	Gladstein, Neandross, and Associates
146-OT1	Jack Symington	Los Angeles Cleantech Incubator
147-OT1	Chris McGlothlin	California Cotton Ginners and Growers Association and Western Agricultural Processors Association
148-OT1	Alessandra Magnasco	California Fuels and Convenience Alliance
149-OT1	Christina Marquez	International Brotherhood of Electrical Workers Local 569
150-OT1	Thomas Greene	Rancho California Water District
151-OT1	Jennifer Goodsell	Imperial Irrigation District
152-OT1	Jordan Brinn	Natural Resources Defense Council
153-OT1	Marissa Florez-Acosta	The City of San Bernardino Municipal Water Department
154-OT1	Joel Ervice	Regional Asthma Management and Prevention
155-OT1	Patricio Portillo	The Natural Resources Defense Council
156-OT1	Matthew Schrap	Harbor Trucking Association
157-OT1	Sean Edgar	Clean Fleets

Comment Code	Commenter's Name	Organization
158-OT1	Anthony Budicin	Western Municipal Water District
159-OT1	Dana Cervantes (Calling in for Laura Brown)	JG Boswell Company
160-OT1	Lauren Navarro	Environmental Defense Fund
161-OT1	Tim Blubaugh	Truck and Engine Manufacturers Association
162-OT1	Muhammed Patel	Individual
163-OT1	Faraz Rizvi	Asian Pacific Environmental Network
164-OT1	Halim Choucair	Individual

Table IV-4. Written Comment Received During the First Board Hearing

Comment Code	Commenter's Name	Organization
001-WT1	Walied Mohamed	Individual
002-WT1	Victoria Rodriguez	Enterprise Inc.
003-WT1	Frank Harris	California Municipal Utilities Association
004-WT1	Nicole Waxman	Airlines for America
005-WT1	Kye Whitmore	Union of Concerned Scientists
006-WT1	Will Garner	Placer County Department of Public Works
007-WT1	Allen Schaeffer	Diesel Technology Forum
008-WT1	Ileagh MacIvers	Interfaith Power and Light
009-WT1	Cassandra Carmichael	National Religious Partnership for Environment
010-WT1	Jeremy Smith	State Building & Construction Trades Council of California
011-WT1	Ann Amato	Sac Climate Coalition
012-WT1	Mikhael Skvarla	California Hydrogen Coalition
013-WT1	Sam Wilson	Union of Concerned Scientists
015-WT1	Suzanne Seivright-Sutherland	California Construction and Industrial Materials Association
016-WT1	East Peterson-Trujillo	Individual
017-WT1	Derrick Robinson	Individual
018-WT1	Jordan Brinn	Individual
019-WT1	Andrea Marpillero Colomina	GreenLatinos
020-WT1	Maneh Berenji	Individual
021-WT1	Jennifer Goodsell	Imperial Irrigation District
022-WT1	Rebecca Baskins	California Advanced Biofuels Alliance
023-WT1	Marc Narkus-Kramer	San Diego 350
024-WT1	Bob 08-45d	California Caterpillar Dealers
025-WT1	Margaret Edwards	National Star Route Mail Contractors Association
026-WT1	Heidi Harmon	Let's Green CA!
027-WT1	Colin Wilhelm	Lightning eMotors

Comment Code	Commenter’s Name	Organization
028-WT1	Steven King	Environment California
029-WT1	Alfonso Esquer	Multimodal Esquer Inc.
030-WT1	James Fahy	Mercedes-Benz
031-WT1	Ryan Gallentine	Advanced Energy Economy
032-WT1	Alison Kerstetter	City of Sacramento
033-WT1	Muriel Strand	Individual
034-WT1	Nahndi Chiumya	United States Catholic Bishops
035-WT1	Richard J Jackson	University of California, Los Angeles
036-WT1	Judith Borcz	Climate Action California
037-WT1	Tom Greene	Rancho California Water District
038-WT1	Patricio Portillo	National Resource Defense Council
039-WT1	Rogelio Fernandez	Individual
040-WT1	Megan Whitman	Physicians for Social Responsibility
041-WT1	Eric White	National Association of Clean Air Agencies

Table IV-5. Written Comment Received During the 15-Day Comment Period

Comment Code	Commenter’s Name	Organization	Date Submitted
001-15d	Jed Hendrickson	Individual	3/23/2023
002-15d	Dustin Dodds	California Business Affiliate	3/24/2023
003-15d	Darrell Zentner	Henner Tank Lines	3/24/2023
004-15d	Gil Oceguera	RPU	3/27/2023
005-15d	Michael Lewis	Individual	3/28/2023
006-15d	Michael Lewis	Individual	3/28/2023
007-15d	Michael Lewis	Individual	3/28/2023
008-15d	Michael Lewis	Individual	3/28/2023
009-15d	Jessica Clabaugh	Individual	3/28/2023
010-15d	Emily Long	Tuolumne Utilities District	3/29/2023
011-15d	Andrew Cuzman	Individual	3/30/2023
012-15d	Shannon Orellana	con Logistics Group, Inc.	3/30/2023
013-15d	Anne McQueen	Individual	3/31/2023
014-15d	TAHA SALEH	Individual	3/31/2023
015-15d	Rick Thomas	Individual	4/1/2023
016-15d	Beatrice L	Individual	4/3/2023
017-15d	Stephen White	Individual	4/3/2023
018-15d	Diane Williams	City of Brentwood	4/3/2023
019-15d	Kathy Laderman	Individual	4/3/2023
020-15d	Kirk Wasson	Individual	4/3/2023
021-15d	Alissa Recker	Daimler Truck North America	4/4/2023
022-15d	Hernan Molina	City of West Hollywood	4/4/2023
023-15d	Rebecca Simonion	City of Clovis	4/4/2023
024-15d	Hugh Rafferty	Individual	4/4/2023

Comment Code	Commenter’s Name	Organization	Date Submitted
025-15d	Mike Sims	Bonita Sunnyside Fire Protection District	4/4/2023
026-15d	Diane Piccioli	Truckee Sanitary District	4/4/2023
027-15d	Ryan McNeil	Fresno Mosquito and Vector Control District	4/4/2023
028-15d	Michelle Brown	West Valley Mosquito and Vector Control	4/4/2023
029-15d	Matthew Schragge	Twentynine Palms Water District	4/5/2023
030-15d	Becky Hopkins	City of Pleasanton	4/5/2023
031-15d	Damon Wyckoff	Calaveras County Water District	4/5/2023
032-15d	Jonathan Olson	County of Del Norte	4/5/2023
033-15d	Bob Sheppard	California Caterpillar Dealers	4/5/2023
034-15d	Bert Rapp	Ventura River Water District	4/5/2023
035-15d	Nancy Bartlett	Individual	4/5/2023
036-15d	Rhea Varley	City of Arcata	4/5/2023
037-15d	Will Gardner	County of Placer	4/5/2023
038-15d	Bryan White	Individual	4/5/2023
039-15d	Christopher Lish	Individual	4/5/2023
040-15d	Herb Niederberger	South Placer Municipal Utility District	4/6/2023
041-15d	Don Zdeba	Indian Wells Valley Water District	4/6/2023
042-15d	John McNamara	CR&R Environmental Services	4/6/2023
043-15d	Ken Broadway	City of Rocklin	4/6/2023
044-15d	Eric Grubb	Cucamonga Valley Water District	4/6/2023
045-15d	Jon Zamorano	Big Bear City Community Service District	4/6/2023
046-15d	Craig Baker	California Tow Truck Association	4/6/2023
047-15d	Frank Wolinski	Vista Irrigation District	4/6/2023
048-15d	Erin Graziosi	Robinson Oil Corp	4/6/2023
049-15d	Sarah Holyhead	County of Nevada Board of Supervisors	4/6/2023
050-15d	Michael Evans	Working people of California against over Regulation	4/6/2023
051-15d	Stacy Taylor	Mesa Water District	4/6/2023
052-15d	Mitch Crosby	Modoc County	4/6/2023
053-15d	Alessandra Magnasco	California Fuels & Convenience Alliance	4/6/2023
054-15d	Aaron Lagasse	Fleet Services County of Humboldt	4/6/2023
055-15d	Bradley Johnson	North Tahoe Public Utility District	4/6/2023
056-15d	Johanna Wojciak	Lion Electric	4/6/2023
057-15d	Edward McGlone	Einride	4/6/2023
058-15d	Robert Grantham	Rancho California Water District	4/6/2023

Comment Code	Commenter's Name	Organization	Date Submitted
059-15d	Jim Friedl	Conejo Recreation & Park District	4/6/2023
060-15d	Elizabeth Leeper	El Dorado Irrigation District	4/6/2023
061-15d	Patrick Ostly	North of River Sanitary District	4/6/2023
062-15d	David Huey	Contra Costa Water District	4/6/2023
063-15d	Morgan Caswell	Port of Long Beach and Port of Los Angeles	4/6/2023
064-15d	Michael O'Kelly	City of Bell Gardens	4/6/2023
065-15d	Ray Pingle	Sierra Club California	4/6/2023
066-15d	Katie Salciccioli	Ford	4/6/2023
067-15d	Brian McCarthy	Goleta West Sanitary District	4/6/2023
068-15d	Jennifer Goodsell	Imperial Irrigation District	4/7/2023
069-15d	Michael Ochs	Recreational Vehicle Industry Association	4/7/2023
070-15d	Michael Nguyen	Individual	4/7/2023
071-15d	Ka-Wing Poon	Southern California Edison	4/7/2023
072-15d	Austin Avery	Turlock Irrigation District	4/7/2023
073-15d	Andrew Schwartz	Tesla	4/7/2023
074-15d	Bert Kaufman	Range Energy	4/7/2023
075-15d	Bascomb Grecian	Individual	4/7/2023
076-15d	Kyle Berquist	Earthjustice	4/7/2023
077-15d	Paul Miller	Northeast States for Coordinated Air Use Management	4/7/2023
078-15d	Geoff Crook	Ceres, Inc.	4/7/2023
079-15d	Ellis Chiu	Los Angeles Department of Water & Power	4/7/2023
080-15d	Kent Swisher	North American Renderers Association	4/7/2023
081-15d	Danny Weldon	Individual	4/7/2023
082-15d	Harriett Leff	Individual	4/7/2023
083-15d	Bruce Mitchell	Individual	4/7/2023
084-15d	Brenda Lee	Individual	4/7/2023
085-15d	Tom Hazelleaf	Individual	4/7/2023
086-15d	Lana Touchstone	Individual	4/7/2023
087-15d	Paul Wermer	Individual	4/7/2023
088-15d	Samantha Macleod	Individual	4/7/2023
089-15d	Alan Solomon	Individual	4/7/2023
090-15d	Robert Cooper	Individual	4/7/2023
091-15d	Vic DeAngelo	Individual	4/7/2023
092-15d	Scott Underhill	Individual	4/7/2023
093-15d	Susan Walp	Individual	4/7/2023
094-15d	Nancy Garret	Individual	4/7/2023
095-15d	David Bezanson	Individual	4/7/2023

Comment Code	Commenter's Name	Organization	Date Submitted
096-15d	Darrell Brown	Individual	4/7/2023
097-15d	Nancy Schimmel	Individual	4/7/2023
098-15d	Judy Lukasiewicz	Individual	4/7/2023
099-15d	David Smith	Individual	4/7/2023
100-15d	Manny Leon	California Alliance for Jobs	4/7/2023
101-15d	Mike Rohrer	Individual	4/7/2023
102-15d	William Barrett	American Lung Association	4/7/2023
103-15d	Elizabeth Bourbon	Valero	4/7/2023
104-15d	Tenille Otero	Otay Water District	4/7/2023
105-15d	Prentiss Searles	American Petroleum Institute	4/7/2023
106-15d	Veronica Pardo	Resource Recovery Coalition of California	4/7/2023
107-15d	Noelle Mattock	City of Roseville	4/7/2023
108-15d	Larry Rennacker	ArrowTek	4/7/2023
109-15d	Rasto Brezny	Manufacturers of Emission Controls Association Clean Mobility	4/7/2023
110-15d	Roxana Ramirez	Metropolitan Water District	4/7/2023
111-15d	Robert Hassebrock	Weatherford	4/7/2023
112-15d	Kristian Corby	California Electric Transportation Coalition	4/7/2023
113-15d	Michael Taylor	National Association of Fleet Administrators Fleet Management Association	4/7/2023
115-15d	James Ciampa	Public Water Agencies Group	4/7/2023
116-15d	Jessica Palmer	Navy Region Southwest, Department of Defense	4/7/2023
117-15d	DeRivi, Tanya	Western States Petroleum Association	4/7/2023
118-15d	Dan Ferons	Santa Margarita Water District	4/7/2023
119-15d	James Johnston	Autocar, Limited Liability Company	4/7/2023
120-15d	Chris McGlothlin	California Cotton Ginners & Growers Assoc	4/7/2023
121-15d	Kenley Farmer	Airlines for America	4/7/2023
122-15d	Cara Simaga	SteriCycle	4/7/2023
123-15d	Timothy Blubaugh	Engine Manufacturers Association	4/7/2023
124-15d	Nick Blair	Association of California Water Agencies	4/7/2023
125-15d	Steven Poncelet	Truckee Donner Public Utility District	4/7/2023
126-15d	Vincent Sullivan	Individual	4/7/2023
127-15d	Thomas Boylan	Zero Emission Transportation Association	4/7/2023

Comment Code	Commenter’s Name	Organization	Date Submitted
128-15d	Damon Conklin	Cal Cities	4/7/2023
129-15d	Benjamin Palmer	Enterprise Holdings	4/7/2023
130-15d	Jesus Martinez Ramirez	Santa Clarita Valley Water Agency	4/7/2023
131-15d	Dan Dunmoyer	California Building Industry Association	4/7/2023
132-15d	Ryan Kocher	Knight-Swift Transportation	4/7/2023
133-15d	Elisabeth de Jong	Southern California Public Power Authority	4/7/2023
134-15d	Robert Crawford	County of Ventura General Services Administration Fleet Services	4/7/2023
135-15d	Seivright-Sutherland, Suzanne	California Construction and Industrial Materials Association	4/7/2023
136-15d	James Takehara	City of Shasta Lake	4/7/2023
137-15d	Becky Bucar	Town of Truckee	4/7/2023
138-15d	Chris Shimoda	California Trucking Association	4/7/2023
139-15d	Sarah Taheri	San Diego Gas and Electric	4/7/2023
140-15d	Karen Goh	Mayor, City of Bakersfield	4/7/2023
141-15d	Tom Trott	Twain Harte Community Services District	4/7/2023
142-15d	Mike Heller	Rio Linda Elverta Recreation and Park District	4/7/2023
143-15d	Ed Ward	Individual	4/7/2023
144-15d	Pacal Cornejo-Reynoso	Eastern Municipal Water District	4/7/2023
145-15d	Tim Vander Pol	Peninsula Truck Lines, Inc.	4/7/2023
146-15d	Sarah Deslauriers	California Association of Sanitation Agencies	4/7/2023
147-15d	Michael Downs	Individual	4/7/2023
148-15d	Leslie Bryan	City of Redding	4/7/2023
149-15d	Matt Schrap	Harbor Trucking Association	4/7/2023
150-15d	Dominique Bertrand	Marina Coast Water District	4/7/2023
151-15d	Rebecca Baskins	California Advanced Biofuels Alliance	4/7/2023
152-15d	Orville Thomas	CALSTART	4/7/2023
153-15d	Anna Maubach	13 Joint Agricultural Industry Groups	4/7/2023
154-15d	Adam Browning	Electric Vehicle Realty, Terawatt Infrastructure, Forum Mobility	4/7/2023
155-15d	Nicole Looney	Sacramento Municipal Utility District	4/7/2023
156-15d	Jessica Cleaver	San Diego County Water Authority	4/7/2023
157-15d	Salpy Kabaklian-Slentz	City of Norwalk	4/7/2023

Comment Code	Commenter’s Name	Organization	Date Submitted
158-15d	Mary Alyssa Rancier	Associated General Contractors of California	4/7/2023
159-15d	Samuel Bayless	Nikola	4/7/2023
160-15d	Lee Brown	Western States Trucking Association	4/7/2023
161-15d	Jim McCaslin	Individual	4/7/2023
162-15d	Chelsea Lee	ACF Advocacy Coalition Framework	4/7/2023
163-15d	Marisa Olguin	Vernon Chamber of Commerce	4/7/2023
164-15d	Marianna Contact	Individual	4/7/2023
165-15d	Carolina Herrera	County of Riverside	4/7/2023
166-15d	Yazmin Arellano	City of El Cajon	4/7/2023
167-15d	David Pérez Tejada	State Government of Baja California	4/7/2023
169-15d	Christine Wolfe	California Council for Economic and Environmental Balance	4/7/2023
170-15d	Madison Vander Klay	Silicon Valley Leadership Group	4/7/2023
171-15d	Jake Jacoby	Truck Renting & Leasing Association	4/7/2023
172-15d	Joe Dalum	Odyne Systems, Limited Liability Company	4/7/2023
173-15d	Fariya Ali	Pacific Gas and Electric	4/7/2023
174-15d	Todd Campbell	Clean Energy	4/7/2023
175-15d	Garen Kazanjian	Recology, Inc.	4/7/2023
176-15d	Nicole Rice	California Renewable Transportation Alliance	4/7/2023
177-15d	Laurel Moorhead	Transfer Flow, Inc.	4/7/2023

Table IVIV-6. Oral Comments Presented During the April 27-28, 2023, Board Hearing

Commenter Code	Commenter’s Name	Affiliation
001-OT2	David Asti	Southern Cal Edison
002-OT2	Frank Harris	California Municipal Utilities Association
003-OT2	Yasmine Agelidis	Earthjustice
004-OT2	Manny Leon	California Alliance for Jobs
005-OT2	Suzanne Seivright-Sutherland	California Construction and Industrial Materials Association
006-OT2	David Renschler	Certified Public Fleet Professional, Municipal Equipment Manufacturers Association
007-OT2	Michael D. Taylor	National Association of Fleet Administrators Fleet Management Association
008-OT2	Jennifer Goodsell	Imperial Irrigation District

Commenter Code	Commenter’s Name	Affiliation
009-OT2	Elisabeth de Jong	Southern California Public Power Authority
010-OT2	Noelle Mattock	City of Roseville
011-OT2	Nicholas Schneider	Georgetown Divide Public Utility District
012-OT2	Nick Blair	Association of California Water Agencies
013-OT2	Corey Peters	Best Drayage
014-OT2	Tom Bair	Golden State Freight
015-OT2	Chris McGlothlin	California Cotton Ginners Growers; Western Agricultural Processors Association
016-OT2	Cecilia Garibay	Moving Forward Network
017-OT2	Lucia Aguilar	People’s Collective for Environmental Justice
018-OT2	Cindy Donis	East Yard Communities for Environmental Justice
019-OT2	Jocelyn Del Real	East Yard Communities for Environmental Justice
020-OT2	Emily Lemei	Northern California Power Agency
021-OT2	Sarah Deslauriers	California Association of Sanitation Agencies
022-OT2	Jan Victor Andasan	East Yard Communities for Environmental Justice
023-OT2	Whitney Amaya	East Yard Communities for Environmental Justice
024-OT2	Mark Neuburger	California Association of Counties
025-OT2	Adriana Gopar	Warehouse Worker Resource Center
026-OT2	Julieta Fuentes	Warehouse Worker Resource Center
027-OT2	Jose Avalos	PCES
028-OT2	Gem Montes	The Air I Breathe
029-OT2	Andrea Vidaurre	People’s Collective for Environmental Justice
030-OT2	Jamila Cervantes	East Yard Communities for Environmental Justice
031-OT2	Fariya Ali	Pacific Gas and Electric
032-OT2	Delia Guzman	Warehouse Worker Resources Center
033-OT2	Kevin Torres	Warehouse Worker Resources Center
034-OT2	Daisy Lopez	Warehouse Worker Resources Center
035-OT2	Sinai Pantoja	People’s Collective for Environmental Justice
036-OT2	Ada Trujillo	People’s Collective for Environmental Justice
037-OT2	Elba Cordoba	People’s Collective for Environmental Justice
038-OT2	Tania Gonzalez	People’s Collective for Environmental Justice
039-OT2	Ivette Torres	People’s Collective for Environmental Justice
040-OT2	Alondra Mateo	People’s Collective for Environmental Justice
041-OT2	Katelyn Roedner Sutter	Environmental Defense Fund
042-OT2	Enrique Arroyo	Warehouse Worker Resources Center
043-OT2	Brenda Soto	People’s Collective for Environmental Justice
044-OT2	Alberto Leon	People’s Collective for Environmental Justice
045-OT2	Benjamin Luna	Individual
046-OT2	Heather Kryczka	National Resource Defense Council
047-OT2	Ben Palmer	Enterprise Holdings
048-OT2	Christina Scaringe	Center for Biological Diversity
049-OT2	Katharine Larson	Sacramento Municipal Utility District

Commenter Code	Commenter's Name	Affiliation
050-OT2	Orville Thomas	CALSTART
051-OT2	Saira Ramirez	People's Collective for Environmental Justice
052-OT2	Madison Vander Klay	Silicon Valley Leadership Group
053-OT2	Ray Pringle	Sierra Club California
054-OT2	Will Barrett	American Lung Association
055-OT2	Heidi Hannaman	California Special Districts Association
056-OT2	Sam Wilson	Union of Concerned Scientists
057-OT2	David Isen	Denali Water Solutions, Imperial Western Products
058-OT2	Staci Heaton	Rural County Representatives of California
059-OT2	Michael Tunnell	American Trucking Association
060-OT2	Lynnette Robb	Can the Ban
061-OT2	Michael Cuprio	Republic Services
062-OT2	Damon Conklin	League of California Cities
063-OT2	Jon Costantino	California Council for Economic and Environmental Balance
064-OT2	Susan Olavarria	Stericycle
065-OT2	Bill Magavern	Coalition for Clean Air
066-OT2	Jacob DeFant	Agricultural Council of California
067-OT2	Aravind Kailas	Volvo Group North America
068-OT2	Kristian Corby	California Electric Transportation Coalition
069-OT2	Chris Shimoda	California Trucking Association
070-OT2	Julia Levin	Bioenergy Association of California
071-OT2	Elaine Shen	South Coast Air Quality Management District
072-OT2	Ruben Aronin	Better World Group
073-OT2	Veronica Pardo	Reserve Recovery Coalition of California
074-OT2	Kelsey Genesi	Environmental Health Coalition
075-OT2	Ashley Gonzalez	Environmental Health Coalition
076-OT2	Adam Browning	Forum Mobility
077-OT2	Silvia Calzada	Environmental Health Coalition
078-OT2	Margarita Moreno	Environmental Health Coalition
079-OT2	Alicia Sanchez	Environmental Health Coalition
080-OT2	Monserrat Hernandez	Environmental Health Coalition
081-OT2	Meli Morales	Enviro
082-OT2	John McNamara	CR&R Environmental
083-OT2	Andy Schwartz	Tesla
084-OT2	Mike Monagan	Building Trades
085-OT2	Brian A. Giron Flores	Youth vs. Apocalypse
086-OT2	Dana Ignacio Lorenzo	Youth vs. Apocalypse
087-OT2	Teresa Bui	Pacific Environment
088-OT2	Michelle Gonzalez	Youth vs. Apocalypse
089-OT2	Amando Juarez Quintero	Youth vs. Apocalypse

Commenter Code	Commenter's Name	Affiliation
090-OT2	Sanaiya	Youth vs. Apocalypse
091-OT2	Susan Pham	Youth vs. Apocalypse
092-OT2	Michelle Gonzalez	Youth vs. Apocalypse
093-OT2	Ryan Kenny	Clean Energy
094-OT2	Lisa McGhee	Green Power Motor Company
095-OT2	Sheila M	Youth vs. Apocalypse
096-OT2	Mariah	Youth vs. Apocalypse
097-OT2	De'Avieus Hughes	Youth vs. Apocalypse
098-OT2	RaMauri Cash	Youth vs. Apocalypse
099-OT2	Julian Cluster	Youth vs. Apocalypse
100-OT2	Myla Grayson	Youth vs. Apocalypse
101-OT2	Carolyn Norv	Youth vs. Apocalypse
102-OT2	Linda Hutchins-Knowles	Mothers Out Front and Electric Vehicle Charging for All
103-OT2	Angeles Garcia	CAUSE
104-OT2	Kea Andrales	CAUSE
105-OT2	Oliver Martinez	CAUSE
106-OT2	Kristian Nunez	CAUSE
107-OT2	Sofi Magallon,	CAUSE
108-OT2	Lizbeth Gonzalez	CAUSE
109-OT2	Yoana Ibanez	CAUSE
110-OT2	Hedy Juarez	CAUSE
111-OT2	Odettte Moran	CAUSE
112-OT2	Asn Ndiaye	Powerswitch Action
113-OT2	Derrick Robinson	Center on Policy Initiatives
114-OT2	Nicole Rice	California Renewable Transportation Alliance
115-OT2	Monica Embrey	Sierra Club
116-OT2	Yassi Kavezade	Individual
117-OT2	Evan Edgar	Compost Coalition
118-OT2	Curtis Paxton	Las Galinas Water District
119-OT2	Kevin Brown	Manufacturers of Emission Controls Association Clean Mobility
120-OT2	Michael Lopes	Lopes Trucking Service
121-OT2	Steven Poncelet	Truckee Donner Public Utility District
122-OT2	Steve Jepsen	Clean Water Southern California
123-OT2	Greg Kester	California Association of Sanitation Agencies
124-OT2	Carol Kaufman	Metropolitan Water District of Southern California
125-OT2	Joel Ervice	Regional Asthma Management and Prevention
126-OT2	Taylor Roschen	California Rice Commission
127-OT2	Ruy Laredo	Otay Water District
128-OT2	Marissa Flores-Acosta	San Bernardino Municipal Water District
129-OT2	Rebecca Baskins	California Advanced Biofuels Alliance

Commenter Code	Commenter's Name	Affiliation
130-OT2	Alessandra Magnasco	California Fuels and Convenience Alliance
131-OT2	Don Ngyen	Orange County Sanitation District
132-OT2	Thomas Boylan	ZETA
133-OT2	Michael Lewis	Construction Industry Air Quality Coalition
134-OT2	Steven King	Environment California
135-OT2	Samuel Sukaton	California Environmental Voters
136-OT2	Terry Wigglesworth	The Wigglesworth Company
137-OT2	Dave Robba	Ceres
138-OT2	John Lorman	Charter Communications
139-OT2	Jim Verburg	Western States Petroleum Association
140-OT2	John Shears	Center for Energy Efficiency and Renewable Technologies
141-OT2	Sasan Saadat	Earthjustice
142-OT2	Matthew Meyer	Cal Portland
143-OT2	Christina Marques	California State Association of Electrical Workers
144-OT2	Joani Woelfel	Far West Equipment Dealers Association
145-OT2	Maurissa Brown	The Greenlining Institute
146-OT2	David Rothbart	Los Angeles County Sanitation District
147-OT2	Woody Hastings	The Climate Center
148-OT2	Olivia Seideman	Leadership Council for Justice and Accountability
149-OT2	Craig Murray	Las Gallinas Valley Sanitary District
150-OT2	Nicholas Cardel	Wagner Jones Helsey Professional Corporation for Western States Trucking Association
151-OT2	Rebecca Schenker	Gladstein, Neandross & Associates
152-OT2	James Leach	Santa Margarita Water District
153-OT2	Suzanne Caflisch	BlueGreen Alliance
154-OT2	Katie Little	California Farm Bureau
155-OT2	David Fink	Los Angeles Business Council
156-OT2	Todd Campbell	Clean Energy
157-OT2	Enrique Rivas	Individual
201-OT2	Kurt Honold	Baja California's Secretary of Economy

Table IVIV-7. Written Comments Received During the April 27-28, 2023, Board Hearing

Commenter Code	Commenter's Name	Affiliation
001-WT2	Linda Hutchins-Knowles	Mothers Out Front California
002-WT2	Linda Hutchins-Knowles	Electric Vehicle Charging for All Coalition
003-WT2	William Barrett	American Lung Association
004-WT2	Elisabeth De Jong	Southern California Public Power Authority
005-WT2	Robert Ennis	Riverside Public Utility
006-WT2	Frank Harris	California Municipal Utilities Association

Commenter Code	Commenter's Name	Affiliation
007-WT2	Emily Navarro	Individual
008-WT2	Todd Clark	Individual
009-WT2	Manuel Cunha Jr.	Nisei Farmers League
010-WT2	Marcos Luna	Clean Energy Fuels
011-WT2	Jessica Fleming	Individual
012-WT2	Marcos Luna	Clean Energy Fuels
013-WT2	Steve Wopschall	Individual
014-WT2	Cittalli Islas	Individual
015-WT2	Alexa Moran	Individual
016-WT2	Kristie Eglsauer	Individual
017-WT2	Linda Hutchins-Knowles	Mothers Out Front California
018-WT2	John Lormon	Procopio
019-WT2	Ed Ward	Individual
020-WT2	Derrick Robinson	Center on Policy Initiatives
021-WT2	Ti Nguyen	Individual
022-WT2	Alejandro Amador	Casa Familiar
023-WT2	Andrea Marpillero-Colomina	Individual
024-WT2	Josue Aguilar	Natural Resources Defense Council
025-WT2	Brady Borcherding	FuelCell Energy Inc.
026-WT2	Chelsea Lee	ACF Advocacy Coalition
027-WT2	Lesly Gallegos	Casa Familiar
028-WT2	Alana Langdon	Nikola
029-WT2	Phillip Streif	Vandalia Bus Lines
030-WT2	Ashley Remillard	Hexagon Agility
031-WT2	Cassandra Carmichael	National Religious Partnership for Environment
032-WT2	Michael Lewis	Construction Industry Air Quality Coalition
033-WT2	Kathy Dervin	350 Bay Area
034-WT2	Sara Flocks	California Labor Federation
035-WT2	David Yow	Port of San Diego

CEQA and Environmental Analysis Issues

All comments related to the ACF EA or comments raising CEQA concerns are addressed in the ACF Final EA (https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/acf22/acffinalea.docx) and associated RTC (https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/acf22/acfrtc.pdf) documents.

Legal Issues

All legal related comments are addressed in Appendix A - Legal Comments and Responses.

45-Day Comment Period and First Board Hearing Public Comments with Agency Responses

1. Zero-Emissions Vehicle Technology Issues

a) Zero-Emissions Technology – General

Comment Summary: The commenters express concerns regarding ZEV's technological capabilities, emphasizing the need for a greater than replacement rate to meet operational needs compared to conventional trucks. They argue that heavy-duty ZEVs are not yet able to serve the transportation industry effectively and raise questions about their reliability and development progress. The commenters request that CARB assess the feasibility of manufacturing ZEVs with equal capacity and power to conventional vehicles, which would enable one-to-one replacements. Several commenters point out specific cases, such as garbage trucks, where ZEV technology is not ready for large-scale adoption. Some commenters state there is lack of evidence supporting the notion that ZEV development can achieve the necessary variety of vehicle configurations, sizes, and uses for fleets to comply with ACF within the proposed timelines.

Commenter: [005-45d, 010-45d, 018-45d, 018-OT1, 025-WT1, 029-WT1, 030-WT1, 048-45d, 054-45d, 055-45d, 059-45d, 063-45d, 065-45d, 087-OT1, 091-45d, 103-OT1, 105-OT1, 120-45d, 128-45d, 129-45d, 135-45d, 136-45d, 137-45d, 138-OT1, 141-OT1, 158-45d, 167-45d, 172-45d, 173-45d, 175-45d, 179-45d, 196-45d, 207-45d, 227-45d, 246-45d, 253-45d, 256-45d, 259-45d, 263-45d, 270-45d, 282-45d, 291-45d, 299-45d, 304-45d, 310-45d, 322-45d, 334-45d, 335-45d]

Agency Response: Changes were made in response to these comments. The ACF Regulation is phased in over two decades, includes flexibility options to comply and has extensions and exemptions. The ZEV Milestones Option schedule reflects that long range and specialized ZEVs are expected to take longer to come to market. Therefore, fleets do not have to replace their entire fleet all at once, they simply need to begin their transition to ZEVs if they are available and can meet their operational needs. The Regulation also includes many provisions to allow the continued use of ICE vehicles, such as the Non-repairable Vehicle Provision. In the case of an accident, fleets can purchase a used ICE vehicle with the same or newer model year engine as the non-repairable vehicle. Furthermore, a backup vehicle provision allows a fleet to utilize existing and to purchase used ICE vehicles to designate as backup vehicles. These backup vehicles can also be used for mutual aid.

An optional pathway for HPF and SLG is the ZEV Milestones Option which allows fleet owners to phase-in portions of their fleet as ZEVs regardless of vehicle age or mileage. The ZEV Milestones Option was designed to give a longer phase-in for Group 2 vehicles: work trucks, day cab tractors, pickup trucks, buses with three axles; and Group 3 vehicles: Sleeper cab tractors and specialty vehicles as shown on the table below.

Table IV-8 ZEV Milestones Option

Percentage of vehicles that must be ZEVs	10%	25%	50%	75%	100%
Milestone Group 1: Box trucks, vans, buses with two axles, yard tractors, light-duty package delivery vehicles	2025	2028	2031	2033	2035 and beyond
Milestone Group 2: Work trucks, day cab tractors, pickup trucks, buses with three axles	2027	2030	2033	2036	2039 and beyond
Milestone Group 3: Sleeper cab tractors and specialty vehicles	2030	2033	2036	2039	2042 and beyond

For both Milestone Group 2 and 3 ICE vehicles, the phase-in to a 100 percent ZEV fleet extends well beyond the 2036 end date for new combustion sales in California.

Exemptions address situations where a ZEV or NZEV is not available or if the available ZEV's duty cycle could not meet the daily mileage or hours of operation of another ICE vehicle in the fleet. Fleets subject to either the HPF or SLG Regulations can use the ZEV Purchase or the Daily Usage Exemptions to satisfy compliance requirements. The ZEV Purchase Exemption allows fleets to purchase a new ICE vehicle when ZEVs are not available in the needed configuration. If an OEM is not taking orders for a particular ZEV, the vehicle is not considered to be available. If the configuration is available as a BEV to purchase, but the range is unable to meet the fleet's operational needs, then the fleet can apply for the Daily Usage Exemption to purchase an ICE vehicle as a compliant replacement vehicle. If a ZEV is ordered one year ahead of the compliance date and the OEM cannot deliver an ordered ZEV to the fleet on-time, then the Vehicle Delivery Delay Extension allows a fleet owner to continue to use the ICE vehicle and remain in compliance until the ZEV intended to replace that ICE vehicle is delivered.

CARB disagrees that BEVs are not a one-to-one replacement for ICE vehicles because of weight or technological capability. BEVs designed with 100-mile range are about the same weight as a conventional diesel truck. Over time, ZEV performance will continue to improve while the weight of the ZEVs decreases and reaches parity with conventional trucks. As described in Chapter I.H.5. of the ACF ISOR, several data sources show most trucks operating in California average less than 100 miles per day[7,8] except for semi-trucks where most average less than 200 miles per day. Medium- and heavy-duty vehicles travel relatively short distances each day and have operations that are suitable for depot charging overnight as demonstrated by LER data and discussed in Chapter I.D.2. of the ACF ISOR. The Group 1 ZEV truck types in the Milestone Schedule have the capability of serving the operational functions of fleets today, without the need to replace their current trucks at a greater than one-to-one ratio.

As described earlier, the flexibilities provided by the Regulation, as well as the optional ZEV Milestone Schedule means that fleet owners have the flexibility to prioritize which ICE vehicle to replace with a ZEV. As an example, Ford's E-Transit van has a targeted range designed to fulfill a fleet's needs based on insight from 30 million miles of customer telematics data and has an available targeted range of 126 miles in the low-roof cargo van configuration.[9] BEVs built today are capable of driving a wide range of up to 500-miles[10] on one charge which meets the average needs of most local and regional trucking operations for a variety of vocational uses. Furthermore, NZEVs count as ZEVs up until the 2035 model year and there is at least one Class 8 NZEV that has a driving range of up to 1,000 miles — 75 miles is pure electric.[11] However, there may be some situations and edge use cases where a one-to-one replacement is not possible in the early years of ACF, likely because the vehicle is highly specialized or for weight sensitive applications. If currently available ZEVs are unable to fulfill the mileage requirements or primary functions of a fleet's operations, the ACF Regulation provides the Daily Usage Exemption which allows fleets to purchase an ICE vehicle as a compliant replacement vehicle. In addition, the Regulation delays the ZEV Milestones compliance date for trucks with a heavy front axle until 2030. The flexibility, provisions, and long ZEV phase-in schedule were carefully incorporated into the Regulation to ensure that fleets can continue to perform the primary functions of their operations and comply with the transition to a cleaner truck fleet. For additional information about vehicle weight concerns, please see responses in section "Zero-Emissions Technology – Vehicle Weight" in "Zero-Emissions Vehicle Technology Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

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7 California Air Resources Board, LER statewide aggregated data, 2022 (web link: https://ww2.arb.ca.gov/sites/default/files/2022-02/Large_Entity_Reporting_Aggregated_Data_ADA.pdf, last accessed March 2022).

8 NACFE, Guidance Report: Medium-Duty Electric Trucks Cost of Ownership, 2018 (web link: https://nacfe.org/wp-content/uploads/2018/10/medium-duty-electric-trucks-cost-of-ownership.pdf, last accessed August 2022).

9 Ford Press Release. November 12, 2020. Leading The Charge: All-Electric Ford E-Transit Powers The Future Of Business With Next-Level Software, Services And Capability (web link: https://media.ford.com/content/fordmedia/fna/us/en/news/2020/11/12/all-electric-ford-e-transit.html, last accessed February 24, 2023).

10 Trucks.com, Everything We Know About the Tesla Semi Truck, 2019 (web link: https://www.trucks.com/2019/09/05/everything-we-know-about-the-tesla-semitruck/, last accessed August 2022)

11 Freightwaves. Hyliion plans bigger battery to stay relevant in electric truck race. August 5, 2021. (web link: https://www.freightwaves.com/news/hyliion-plansbigger-battery-to-stay-relevant-in-electric-truck-race, last accessed March 2023).

b) Zero-Emissions Technology – Limited Supply

Comment Summary: The commenters express concerns about the limited supply and long order times of many ZEVs, making them challenging to obtain.

Commenter: [009-WT2, 127-45d, 285-45d, 326-45d]

Agency Response: Changes were made in response to these comments. CARB incorporated extensions and exemptions into the ACF Regulation to alleviate any concerns about limited ZEV supply or lengthy delivery times. For example, the Vehicle Delivery Delay Extension provides fleets the flexibility to count an ICE as a ZEV for circumstances involving manufacturer delays of ZEV deliveries to the fleet owner. For example, the Vehicle Delivery Delay Extension provides fleets the flexibility to count an ICE as a ZEV for circumstances involving manufacturer delays of ZEV deliveries to the fleet owner. The Regulation also provides for the ZEV Purchase Exemption that allows fleets to purchase a new ICE vehicle instead of a ZEV, if a ZEV or NZEV configuration is not available due to supply constraints. The ZEV Purchase Exemption also allows fleets to purchase a newer ZEV or NZEV with a model year that differs by up to 18 months from the time the fleet owner submitted an exemption request. In other words, the fleet owner can purchase a 2026 model year ZEV if a ZEV Purchase Exemption request was submitted in July of 2024.

As described in Chapter I.B.10. of the ACF ISOR, California adopted the ACT Regulation to ensure that manufacturers sell ZEVs as an increasing part of their total truck sales in California starting with the 2024 model year. The ACT Regulation will ensure an abundant supply of ZEVs in California, with required sales expected to be about 320,000 by 2035, 780,000 by 2045, and 950,000 by 2050.

c) Zero-Emissions Technology – Availability

Comment Summary: The commenters argue that specific types of vehicles are not available to suit their operational needs and that many vehicles listed in Appendix J of the ACF ISOR may be open for order but not delivered in the ordered quantities. They claim that CARB's assertion of many commercially available ZEV trucks is incorrect, and that ZE truck production will not meet the demand when the ACF mandates begin. They emphasize concerns about vehicle availability at scale and the uncertainty of obtaining ZEVs in various classifications to remain compliant.

Commenter: [003-OT1, 004-WT1, 009-WT2, 025-WT1, 030-45d, 038-45d, 054-45d, 063-45d, 065-45d, 067-45d, 069-45d, 080-OT1, 089-45d, 103-45d, 104-45d, 105-OT1, 116-OT1, 120-OT1, 129-OT1, 134-45d, 137-45d, 148-45d, 152-45d, 179-45d, 194-45d, 220-45d, 232-45d, 234-45d, 237-45d, 243-45d, 252-45d, 253-45d, 256-45d, 259-45d, 260-45d, 278-45d, 279-45d, 281-45d, 282-45d, 283-45d, 290-45d, 292-45d, 294-45d, 295-45d, 308-45d, 322-45d, 323-45d, 330-45d, 333-45d, 347-45d]

Agency Response: Changes were made in response to these comments. The ACF Regulation includes several flexibilities in the form of extensions and exemptions that are designed to help a fleet comply in situations where certain vehicle types are not available to meet the primary functions or operational needs of a fleet. Specifically, the Daily Usage Exemption allows fleets to purchase a new ICE vehicle if currently available BEVs cannot meet the mileage or operational requirements of the original vehicle. In addition, the ACF Regulation includes a ZEV Purchase Exemption which allows fleets to purchase a new ICE vehicle if a ZEV or NZEV is not available in the configuration needed to meet the primary intended function of the fleet. The ACF Regulation is structured such that SLG and HPF fleets would transition to a greater percentage of ZEVs well into the future (2042). The compliance schedule of the ACF Regulation gives fleets the flexibility in how ZEVs, particularly for high mileage and specialty vehicles, would be deployed.

CARB disagrees with the assertion that ZE truck production will not meet the demand of fleets subject to the ACF Regulation. As discussed in Chapter I.F. of the ACF ISOR, technology developments as well as the number of participating manufacturers, for BEVs and FCEVs have rapidly progressed over the last decade, which has led to the market introduction of ZEVs in every weight class. Within these weight classes, a wide range of vehicle configurations exist that can perform a variety of functions. As described in Chapter I.F.1. of the ACF ISOR, there are 148 models in North America where manufacturers are accepting orders or pre-orders; 135 models are actively being produced and are being delivered to the customer. For heavy-duty Class 7 and 8 ZEVs, there are 28 models currently available, eight of which are tractors and five more expected by the end of 2023. If manufacturers are unable to produce enough ZEVs at scale needed to meet market demand or produce ZEVs that can meet the operational needs of fleets, the provisions embedded in the Regulation will ensure that fleets can comply.

However, recent announcements by manufacturers support CARB's position that there will be a sufficient ZEV supply available for fleets to purchase. In 2020, major multinational truck manufacturers acknowledged the science-based need to decarbonize their products fully by 2040 and have individually asserted substantial midterm targets in 2030 to reach their 2040 targets. For example, Navistar committed to 50 percent by 2030 and 100 percent by 2040.[12] GM and Stellantis have each announced or released electric pickups and vans.[13,14,15] Furthermore, Ford has announced that their entire commercial vehicle lineup in Europe will be ZE capable—all-electric or PHEV—by 2024, and entirely battery-electric by 2030.[16,17,18]

Multinational OEMs and specialty upfitters are demonstrating and offering ZE and PHEVs across many specialized configurations beyond simple box and flatbed applications including

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[12] Navistar, Vision And Strategy (web link: https://www.navistar.com/about-us/vision-strategy, last accessed February 2023).

[13] GMC, Sierra Ev Denali Edition 1, 2023 (web link: https://www.gmc.com/future-vehicles/sierra-ev-denali, last accessed February 2023).

[14] General Motors, BrightDrop-Electric first to last mile delivery products, 2023 (web link: https://www.gobrightdrop.com/, last accessed February 2023).

[15] The Detroit News, 2023 Ram ProMaster commercial van preps for next year's battery-electric model, March 2022 (web link: https://www.detroitnews.com/story/business/autos/chrysler/2022/03/09/2023-ram-promaster-van-preps-next-years-battery-electric-model/9430263002/, last accessed February 2023)

[16] Ford, F-150® Lightning™, 2023 (web link: https://www.ford.com/trucks/f150/f150-lightning/2022/, last accessed February 2023).

[17] Ford, E-transit, 2023 (web link: https://media.ford.com/content/fordmedia/fna/us/en/products/evs/e-transit/2022-ford-e-transit.html, last accessed February 2023)

[18] Ford, Ford's new science-based, Interim Carbon-Neutral Targets Highlight First Integrated Sustainability, Financial Report, March 31, 2021 (web link: https://media.ford.com/content/fordmedia/fna/us/en/news/2021/03/31/ford-integrated-sustainability-financial-report.html, last accessed January 2023).

armored cash-in-transit,[19] arborist and utility bucket trucks,[20,21,22] frame mounted and custom chassis truck cranes,[23,24,25,26] front, side, rear and roll-off type refuse,[27,28,29] vehicle

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[19] Loomis, Loomis orders 150 electric armored vehicles from Xos for the US market, 2023 (web link: https://www.loomis.us/resources/press-releases-news/Loomis-orders-150-electric-armored-vehicles, last accessed 2023).

[20] Terex, Terex Utilities Debuts Industry's First All Electric Bucket Truck, 2023 (web link: https://www.terex.com/utilities/en/about/news/terex-utilities-debuts-industry-s-first-all-electric-bucket-truck, last accessed February 2023).

[21] WorkTruck, Con Edison, Lion Electric, and Posi-Plus Developing Electric Bucket Truck, 2021 (web link: https://www.worktruckonline.com/10139523/electric-utility-bucket-truck-makes-clean-energy-breakthrough, last accessed February 2023).

[22] Trib Live, Pittsburgh's green fleet bolstered by 9 electric vehicles, including bucket truck, May 15, 2021 (web link: (web link: https://triblive.com/local/electric-bucket-truck-coming-to-pittsburgh-thanks-to-electric-vehicles-grant-money/, last accessed March 2023).

[23] International Cranes, New fully electric Böcker truck crane and work platform, September 7, 2022 (web link: https://www.internationalcranes.media/news/New-fully-electric-Bocker-truck-crane-and-work-platform/8023128.article, last accessed March 2023).

[24] PR Newswire, Zoomlion Produces the World's First Pure Electric Truck Crane, Takes the Lead in Environmental Protection Construction in Machinery Industry, May 2020 (web link: https://www.prnewswire.com/in/news-releases/zoomlion-produces-the-world-s-first-pure-electric-truck-crane-takes-the-lead-in-environmental-protection-construction-in-machinery-industry-838304210.html, last accessed March 2023).

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[26] Heavy Lift News, The XCT25_EV Plug-In, Double Drive Hybrid Crane from XCMG, December 6, 2021 (web link: https://www.heavyliftnews.com/the-xct25_ev-plug-in-double-drive-hybrid-crane-from-xcmg/, last accessed March 2023).

[27] Scania, Scania at IFAT 2022 in Munich, May 31, 2021 (web link: https://www.scania.com/group/en/home/newsroom/press-releases/press-release-detail-page.html/4278090-, last accessed March 2023).

[28] Scania, First fully electric crane truck for waste collection in Denmark, January 18, 2023 (web link: https://www.scania.com/group/en/home/newsroom/news/2023/first_fully_electric_crane_truck_for_waste_collection_in_denmark.html, last accessed March 2023).

[29] Motor Transport, Volvo to showcase FE-Electric 6×2 hook-lift rigid at Freight in the City Expo on 6 November, October 29, 2019 (web link: https://motortransport.co.uk/blog/2019/10/29/volvo-to-showcase-fe-electric-6x2-hook-lift-rigid-at-freight-in-the-city-expo-on-6-november/, last accessed March 2023).

recovery/towing,[30,31] construction vocational dump and ready-mix concrete,[32,33,34,35,36,37,38,39,40,41] heavy haul logging and mining transport,[42,43,44] snow plows,[45] and work trucks with ePTO.[46] ZE and increasingly ZE-capable NZEVs are being used in emergency municipal fire and airport

[30] Hyzon Press Release. Hyzon Motors to Establish Australian Headquarters, 2022 (web link: https://www.racv.com.au/content/dam/racv/documents/about-racv/our-business/newsroom/racv-press-release-hyzon-motors-jan-22.pdf, last accessed March 2023).

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[32] UK Haulier, Fox Group first in the UK for Volvo FE Electric Tippers, November 16, 2021 (web link: https://www.ukhaulier.co.uk/news/road-transport/fleet/fox-group-first-in-the-uk-for-volvo-fe-electric-tippers/, last accessed March 2023).

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[40] Spanos, ENERGYA K42E: The new battery electric driven truck pump from CIFA, November 1, 2022 (web link: http://www.spanos-group.com/energya-k42e-new-battery-electric-driven-concrete-truck-pump-cifa/, last accessed March 2023).

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[42] Electrek, Tesla Semi electric trucks to power log-hauling program in Canada, April 8, 2021 (web link: https://electrek.co/2021/04/08/tesla-semi-electric-trucks-power-log-hauling-program-canada/, last accessed March 2023).

[43] TU Automotive, Scania Goes Logging with New 80-ton BEV Truck, November 11, 2021 (web link: https://www.tu-auto.com/scania-goes-logging-with-new-80-ton-bev-truck/, last accessed March 2023).

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crash response,[47,48,49,50,51] ZE ambulance as well as smaller ZE public safety and municipal vehicles[52,53,54,55,56,57,58,59,60,61,62,63,64,65,66] and police cars.[67,68,69,70] ZE Class 8 tractors and straight

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trucks are being deployed into bulk applications including milk and related products.[71] Even with the vast availability for ZEVs and NZEVs, portions of the Regulation exclude certain vehicles with two-engines, military tactical vehicles, historical vehicles, heavy cranes, emergency vehicles, dedicated snow removal vehicles, and test fleet vehicles.

Not only are ZEVs available in many models, but the ACT Regulation also requires manufacturers to sell ZEVs as a percent of total sales in California and covers everything from heavy-duty pickups to work trucks to the semi-trucks used in drayage and long-haul applications. Starting with the 2024 model year, truck manufacturers will be required to produce and sell ZEVs into California's market in growing numbers. The estimated number of medium- and heavy-duty ZEVs in California would increase beyond the ACT-only scenario from about 320,000 to about 510,000 in 2035, from about 780,000 to about 1,350,000 ZEVs by 2045, and from about 950,000 to about 1,690,000 ZEVs by 2050. In addition, ACF allows fleets to purchase an NZEV to meet their ZEV obligations, up until 2035. Finally, as previously noted, if a ZEV or NZEV is not available in a given configuration the fleet owner can receive an exemption to purchase an ICE vehicle.

Finally, NZEVs or PHEVs are an established and proven technology that many vehicles use and can be seen driving on our roadways daily. Medium- and heavy-duty NZEVs are also proven. A Department of Energy funded a project in 2015, called the Plug-In Hybrid Medium-Duty Truck Demonstration and Evaluation which designed, developed, validated,

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[64] Rosenbauer, Revolutionary Technology - Electric municipal vehicles, 2023 (web link: https://www.rosenbauer.com/en/int/rosenbauer-world/vehicles/municipal-vehicles/rt, last accessed March 2023).

[65] New York City. Climate Week: City Announces $75 Million in new Investments for Electric Vehicles and Electric Vehicle Charging Infrastructure, September 2021 (web link: https://www1.nyc.gov/office-of-the-mayor/news/639-21/climate-week-city-75-million-new-investments-electric-vehicles-electric, last accessed March 2023).

[66] PRWeb Press Release. ROUSH CleanTech and First Priority Group Collaborate to Create Electric Emergency Response Vehicles, April 2021 (web link: https://www.prweb.com/releases/roush_cleantech_and_first_priority_group_collaborate_to_create_electric_emergency_response_vehicles/prweb17873992.htm, last accessed March 2023).

[67] GM Authority. 2022 Chevy Bolt EUV And Bolt EV Get Police Package, June 2021 (web link: https://gmauthority.com/blog/2021/06/2022-chevy-bolt-euv-and-bolt-ev-get-police-package/#:~:text=The%20new%20police%20packages%20for,the%20interior%20and%20exterior%20lights, last accessed March 2023).

[68] Electrek. Ford Mustang Mach-E passes Michigan State Police test, September 2021 (web link: https://electrek.co/2021/09/24/ford-mustang-mach-e-passes-michigan-state-police-test/, last accessed March 2023).

[69] CleanTechnica. Tesla Police Vehicle Brings Huge Monetary Savings To Westport, Connecticut, June 2021 (web link: https://cleantechnica.com/2021/06/02/tesla-police-vehicle-brings-huge-monetary-savings-to-westport-connecticut/, last accessed March 2023).

[70] Electrek. Police chief explains how Tesla Model Y patrol car will save them $80,000, February 2023 (web link: https://electrek.co/2023/02/06/police-chief-explains-tesla-model-y-patrol-car-will-save/, last accessed March 2023).

[71] Driven, New Zealand set to get first electric milk tanker after government funding boost, February 24, 2022 (web link: https://www.driven.co.nz/news/new-zealand-set-to-get-first-electric-milk-tanker-after-government-funding-boost/, last accessed March 2023).

produced, and deployed 296 PHEVs: 119 Class 6 through 8 trucks; 52 three-quarter-ton vans; and 125 half-ton pickup trucks all with positive results.[72] Furthermore, Hyliion Holdings plans to sell a natural gas generator-powered hybrid powertrain with 75 miles of electric range and a driving range of up to 1,000 miles in California.[73]

d) Zero-Emissions Technology – Battery Recycling

Comment Summary: The commenters state that investments in battery recycling will be necessary due to the ACF Regulation, questioning how the State will handle battery recycling from the influx of ZEVs. They request CARB to inform them of plans for managing hazardous waste disposal of ZEV batteries in coordination with the Department of Toxic Substances Control and EPA and that batteries must be replaced regularly.

Commenter: [048-45d, 054-45d, 059-45d, 060-45d, 063-45d, 083-45d, 085-45d, 093-45d, 094-45d, 137-45d, 164-45d, 180-45d, 286-45d, 334-45d]

Agency Response: No changes were made in response to these comments. As discussed in Chapter VIII.B.6. of the ACF ISOR, BEV manufacturers are currently offering vehicles with warranties of eight or more years and up to 500,000 miles on their products. CARB estimates that a battery will require replacement when battery capacity is not sufficient for meeting daily range needs for a truck or bus, which is likely at the end of the vehicle's useful life with the exception for long haul tractors. Regulatory requirements for battery disposal, reuse, and recycling are outside the scope of this rulemaking, but are discussed at length in the EA RTC document, see Master Response 2 and responses to Comment Letter 83.

CARB expects that there will be a second life for used vehicle batteries, either again for EVs or for less demanding operations such as stationary storage. Some forecasts show the second-life EV battery market will reach $7 billion in value by 2033 as a growing number of repurposed and battery diagnostician start-ups are starting to establish robust supply chains with automotive OEMs.[74] When second-life batteries degrade to the point that they can no longer provide a functional purpose, recyclable materials will be recycled and non-recyclable materials would be disposed of, both in accordance with applicable policies and standards.

e) Zero-Emissions Technology – Battery Technology Not Ready

Comment Summary: The commenters argue that BEV technology is not ready for fleet applications, requiring more time before implementing Regulations. They claim that using BEVs would necessitate more trucks to provide the same level of service.

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[72] Plug-In Hybrid Medium Duty Truck Demonstration and Evaluation. EPRI, Palo Alto, CA: 2015. 3002006566. (web link: https://www.energy.ca.gov/sites/default/files/2021-05/CEC-600-2020-010.pdf, last accessed March 2023).

[73] Freightwaves, Hyliion plans bigger battery to stay relevant in electric truck race. August 5, 2021. (web link: https://www.freightwaves.com/news/hyliion-plans-bigger-battery-to-stay-relevant-in-electric-truck-race, last accessed March 2023).

[74] Green Car Congress. IDTechEx forecasts second-life EV battery market to reach US$7B by 2033, March 2023 (web link: https://www.greencarcongress.com/2023/03/20230314-idtechex.html, last accessed March 2023).

Commenter: [005-45d, 010-45d, 018-45d, 018-OT1, 030-WT1, 048-45d, 059-45d, 091-45d, 141-OT1, 173-45d, 175-45d, 196-45d, 227-45d, 256-45d]

Agency Response: No changes were made in response to these comments. The ACF Regulation has a technology-neutral approach for transitioning conventional vehicles to zero tailpipe emissions and does not specifically require either BEVs or FCEVs as compliance options. However, CARB disagrees with the claim that currently-available BEVs are not ready for fleet applications and would necessitate more trucks to provide the same level of service. As described in Chapter I.H.5. of the ACF ISOR, operational truck data shows that most Class 3 through 8 vocational trucks travel less than 100 miles per day. In addition, most of these vocational trucks have operations characterized by stable routes and home base locations that work well with the current state of battery technology. Today's BEVs are capable of ranges more than 100 miles to about 400 miles depending on the model as demonstrated by the BEVs currently available in the marketplace. As a signal to the capability of today's BEVs, several major delivery companies have already begun the process of incorporating battery-electric light-duty package delivery vehicles into their fleets, such as 100,000 ordered by Amazon, 10,000 ordered by UPS, 4,500 ordered by Walmart, 500 ordered by FedEx, and over 10,000 ordered by the U.S. Postal Service for placement throughout the United States.[75,76,77,78,79]

CARB also disagrees with the assertion that more time is needed before implementing the ACF Regulation. The Regulation is structured such that fleets have the flexibility in how ZEVs will be deployed in their fleets. These flexibilities include extensions, exemptions, and vehicle useful life considerations that are designed to help a fleet comply. For example, if currently available ZEVs are unable to fulfill the mileage requirements or primary functions of a fleet's operations, the ACF Regulation provides the Daily Usage Exemption which allows fleets to purchase an ICE vehicle as a compliant replacement vehicle. The Regulation also includes a ZEV Purchase Exemption which allows fleets to purchase a new ICE vehicle if a ZEV or NZEV is not available in the configuration needed. In addition, the Regulation gradually phases in

[75] Amazon, Amazon's custom electric delivery vehicles are starting to hit the road, February 3, 2021 (web link: https://www.aboutamazon.com/news/transportation/amazons-custom-electric-delivery-vehicles-are-starting-to-hit-the-road, last accessed August 2022).

[76] United Parcel Service, UPS invests in Arrival, accelerates fleet electrification with a commitment to purchase up to 10,000 electric vehicles, January 29, 2020 (web link: https://about.ups.com/ca/en/newsroom/press-releases/sustainable-services/ups-invests-in-arrival-accelerates-fleet-electrification-with-order-of-10-000-electric-delivery-vehicles.html, last accessed August 2022).

[77] Walmart, Walmart To Purchase 4,500 Canoo Electric Delivery Vehicles To Be Used for Last Mile Deliveries in Support of Its Growing eCommerce Business, July 12, 2022 (web link: https://corporate.walmart.com/newsroom/2022/07/12/walmart-to-purchase-4-500-canoo-electric-delivery-vehicles-to-be-used-for-last-mile-deliveries-in-support-of-its-growing-ecommerce-business, last accessed August 2022).

[78] FedEx, Charging Ahead: FedEx Receives First All-Electric, Zero-Tailpipe Emissions Delivery Vehicles from BrightDrop, December 17, 2021, (web link: https://newsroom.fedex.com/newsroom/brightdropev600/, last accessed August 2022).

[79] United States Postal Service, USPS Places Order for 50,000 Next Generation Delivery Vehicles; 10,019 To Be Electric, March 24, 2022 (web link: https://about.usps.com/newsroom/national-releases/2022/0324-usps-places-order-for-next-gen-delivery-vehicles-to-be-electric.htm, last accessed August 2022).

the ZEV fleet requirements over several years with the optional Milestone pathway which allows fleet owners to choose the mix of vehicles that are best suited for BEV technology.

f) Zero-Emissions Technology – Battery Capacity

Comment Summary: The commenters assert that electric big rigs lack the battery capacity and charging efficiency to meet the needs of today's trucking industry.

Commenter: [339-45d]

Agency Response: No changes were made in response to these comments. CARB's LER survey data show most trucks operating in California average less than 100 miles per day and most day cabs average less than 200 miles per day. Battery-electric day cabs are already widely available and achieve TCO savings. The HPF Regulation also gives fleets the option to use NZEVs to meet ZEV compliance until 2035. Furthermore, if there are no BEVs that can fulfill the operational needs of a fleet, the ACF Regulation provides the Daily Usage Exemption that allows fleets to purchase a new ICE vehicle provided they can demonstrate their needs cannot be met.

Lastly, flexibilities built into the ZEV Milestones Option for HPF defers requirements for sleeper cab tractors until 2030 to allow more time for technology to advance and for costs to come down for higher mileage or weight sensitive applications. Worth noting, the ACF Regulation does not mandate any specific ZE technology over another. If fleets do not believe that battery-electric tractors can fulfill their operational needs, they can transition to FCEVs which have similar fueling times and range as conventional vehicles.

g) Zero-Emissions Technology – Charging Times

Comment Summary: The commenters state that electric trucks take too long to charge, which impacts driver productivity and results in the need for more truck drivers and additional trips. They also state that long charging times can have impacts on perishable agricultural commodities.

Commenter: [004-WT1, 083-45d, 085-45d, 092-OT1, 140-OT1, 153-45d, 164-45d, 256-45d, 279-45d, 282-45d, 290-45d, 335-45d]

Agency Response: No changes were made in response to these comments. The Regulation is structured such that fleets have the flexibility in how ZEVs will be deployed in their fleets. Specifically, the Daily Usage Exemption allows fleet owners to purchase a new ICE vehicle as a compliant replacement vehicle, if available BEVs cannot meet the daily usage requirements of any vehicle in the fleet.

The ACF Regulation does not mandate any specific ZE technology over another. If fleets do not believe that battery-electric trucks can fulfill the operational needs of their market segment, fleet owners are free to transition to FCEVs which have similar fueling times and range as conventional vehicles. For BEV technology, fleet owners have the choice to size their fleets' batteries to meet their needs either for a full day's work or they may opt for a smaller size battery then deploy opportunity charging at strategic locations and times. There is also a promising new MW charging standard that will provide charge rates of up to 3.75

MW that potentially enable charging of a 500-mile range battery pack in 20-30 minutes, with an active funded one MW demonstration project in progress.

Furthermore, charging breaks can be planned for and synced up with a drivers rest breaks. Caltrans's ongoing parking study will inform and assist funding programs to identify priority locations for new charger investments that will support publicly accessible charging and increase operator safety. In addition, improving signage to help drivers locate charging facilities is also being addressed.

h) Zero-Emissions Technology – Cold Weather

Comment Summary: The commenters claim that ZEVs are not practical in extreme cold weather, highlighting potential limitations of the technology.

Commenter: [234-45d]

Agency Response: No changes were made in response to these comments. While it is accurate that the current performance of ZEVs degrades under extreme cold conditions, the majority of California's population reside in moderate climates where the effects of extreme cold weather are less impactful. If fleet owners have concerns about operating BEVs in certain conditions, and a FCEV is unavailable, then the fleet owner can apply for a Daily Usage Exemption provided the vehicle is not a Class 7 or 8 BEV tractor or three-axle bus with a rated energy capacity of at least 1,000 kilowatt-hours or a Class 7 or 8 BEV that is not a tractor or three-axle bus with a rated energy capacity of at least 450 kilowatt-hours; or a Class 4 through 6 BEV with a rated energy capacity of at least 325 kilowatt-hours.

i) Zero-Emissions Technology – Commercial Vehicles

Comment Summary: The commenters indicate that some commercial vehicle segments will be more challenging to electrify than passenger cars, suggesting that different approaches may be needed.

Commenter: [329-45d]

Agency Response: No changes were made in response to these comments. The Regulation is structured in a way that provides flexibility for fleet owners to meet the ZEV phase-in requirements based on a fleet's mix of vehicle types and extends the compliance timeframe for vehicles that may take longer to electrify or are high mileage vehicles. The Regulation also has a number of exemptions, flexibilities, and vehicle useful life considerations which are designed to help a fleet comply.

j) Zero-Emissions Technology – Materials Mining

Comment Summary: The commenters express concerns about battery minerals and components being imported from China, impacting national security, and involving environmental impacts, child labor, and slave labor. They also mention concerns about the required mining and associated energy for battery production.

Commenter: [010-45d, 028-45d, 059-45d, 120-45d, 138-45d, 164-45d, 259-45d, 270-45d, 281-45d, 334-45d]

Agency Response: No changes were made in response to these comments. CARB evaluated impacts associated with mining for battery materials in the CEQA EA and these concerns are addressed in the EA RTC document, see Master Response 2.

k) Zero-Emissions Technology – Demonstrations

Comment Summary: The commenters state that claims of ZEV manufacturers do not meet reality when tested, particularly in refuse and utility fleets, where there is little experience with PTO and related equipment powered by current fleets. The commenters request that CARB conduct real-world demonstrations of commercially available Class 2b through 8 vehicles to identify challenge points and inform potential ACF adjustments.

Commenter: [321-45d, 342-45d]

Agency Response: No changes were made in response to these comments. The ACF Regulation has included several flexibilities in the form of extensions and exemptions that are designed to help a fleet comply in situations where certain vehicle types are not available to meet the primary functions or operational needs of a fleet. Specifically, the Daily Usage Exemption allows fleets to purchase a new ICE vehicle if currently available BEVs cannot meet the mileage or operational requirements of the original vehicle. In addition, the ACF Regulation includes a ZEV Purchase Exemption which allows fleets to purchase a new ICE vehicle if a ZEV or NZEV is not available in the configuration needed to meet the primary intended function of the fleet.

CARB cannot accommodate the request to conduct real-world demonstrations of commercially available vehicles, as it would be unfeasible for CARB to individually test all Class 2b through 8 ZEVs in a timely manner. However, CARB has provided a significant amount of funding, as part of the Low Carbon Transportation Investments, for advanced technology demonstration and pilot projects to help accelerate the next generation of advanced technology vehicles, equipment, or emission controls which are not yet commercialized. In addition, fleet owners have the option to use data logging devices and software to obtain real-world vehicle data about the energy usage that powers the trucks and PTO equipment. There are also optional ZEP Certification standards that manufacturers can use, but are required for ACT Regulation credits, which will help fleet owners make informed purchase decisions.

ZEV technology is advancing and will continue to improve over the decades-long phase-in of the Regulation. The ACF Regulation introduces ZEVs to a fleet gradually over a long period of time. For the Milestone Group 2 and Group 3 trucks that use specialty equipment, the first ZEV compliance requirements don’t begin until 2027 and 2030, respectively.

l) Zero-Emissions Technology – Offroad Terrain

Comment Summary: The commenters argue that ZEVs cannot operate in difficult or offroad terrain and that unique duty cycles, far distances, PTO requirements, and payloads may be hindered by battery weight and in-field provisions not met by commercially available ZEV models.

Commenter: [014-45d]

Agency Response: No changes were made in response to these comments. While it is true that ZEVs may not be a good fit for some duty cycles today, ZEVs generally have superior torque to ICE vehicles. As the market matures over the long period of ACF Regulation phase-in, it is expected that ZEVs will be able to meet the same requirements as ICE vehicles in many applications. If currently available ZEV vehicles cannot meet the daily needs of a fleet, the ACF Regulation allows fleets to apply for a Daily Usage Exemption to acquire a vehicle that will fulfill a fleet's needs. This exemption allows the use of real-world energy usage instead of energy calculations from battery capacity to support an exemption request if needed. Additionally, the ACF Regulation includes all-wheel drive as a key characteristic under the ZEV Purchase Exemption when determining ZEV availability.

m) Zero-Emissions Technology – Range and Work Capacity

Comment Summary: The commenters state that ZEV technology is not ready for use due to limited range, work capacity, or capability to meet operational needs. They argue that electric trucks cannot maintain enough charge for a full work shift, ICEs are superior in loaded power and range, and ZEVs are not capable of performing the same job functions as current trucks. Commenters state that the limited range of EVs is not applicable for interstate operations. They also mention that available ZEVs do not meet GVWR, towing, or range specifications, and express concerns about inconsistencies in supply chains and disruptions in the timely delivery of goods due to inadequate range and performance of heavy-duty vehicles. The commenters suggest that the most suitable use case for capable ZEVs is Class 5 and lower vehicles with limited range requirements and sufficient overnight charging time.

Commenter: [004-45d, 004-WT1, 006-45d, 011-45d, 011-OT1, 016-OT1, 017-OT1, 019-45d, 021-45d, 025-WT1, 027-45d, 029-WT1, 033-45d, 037-WT1, 038-45d, 039-45d, 041-45d, 042-45d, 050-45d, 051-45d, 052-45d, 057-45d, 058-45d, 065-45d, 067-45d, 068-45d, 069-45d, 070-45d, 072-45d, 074-45d, 075-45d, 080-45d, 081-45d, 117-45d, 121-45d, 128-45d, 129-45d, 132-45d, 134-45d, 141-45d, 142-45d, 144-45d, 146-45d, 148-OT1, 149-45d, 152-45d, 153-45d, 157-45d, 167-45d, 173-45d, 179-45d, 184-45d, 187-45d, 190-45d, 194-45d, 204-45d, 205-45d, 207-45d, 219-45d, 232-45d, 233-45d, 234-45d, 249-45d, 251-45d, 256-45d, 258-45d, 259-45d, 260-45d, 272-45d, 278-45d, 279-45d, 282-45d, 284-45d, 285-45d, 290-45d, 292-45d, 295-45d, 301-45d, 302-45d, 304-45d, 308-45d, 310-45d, 314-45d, 322-45d, 339-45d, 347-45d]

Agency Response: Changes were made in response to these comments. The ACF Regulation has incorporated the Daily Usage Exemption to help fleets comply if available ZEV technology is not capable of meeting the primary functions and operational needs of a fleet. Specifically, the Daily Usage Exemption allows fleet owners to purchase a new ICE vehicle if available BEVs cannot meet the daily usage requirements, and FCEVs and NZEVs are not available to purchase. Fleet owners have the option to use real-world data from a BEV in a given application in comparison to the ICE vehicles in the fleet. FCEVs and NZEVs have similar fueling time and range as ICE vehicles and would not justify the need for an exemption if available to purchase. This exemption addresses fleet owner's concerns about ZEV range, work capacity, performance, and capability.

However, CARB disagrees that ZEVs are not capable of performing the same functions as most trucks. As described in Chapter I.H.5. of the ACF ISOR, operational truck data shows that most trucks operating in California average less than 100 miles per day. There are multiple BEV medium- and heavy-duty non-tractors capable of a 100 to 200-mile range on a single charge available that meet the range and weight requirements for a majority of operations.[80] In addition, FCEVs are emerging as a ZEV technology that is capable of ranges and fueling times that are comparable to conventional vehicles.[81] FCEVs have the feasibility of being integrated into regular fleet operations as they can provide similar capacity, range, and fueling capabilities as conventional vehicles.

CARB also disagrees with the assertion that BEVs will not be applicable for interstate operations. For example, a fully loaded battery-electric Tesla Semi, weighing just under 82,000 pounds, recently completed a 500-mile test run on a single charge in usual traffic conditions. This demonstration by the Tesla Semi shows that ZEV technology is advancing and will be capable of interstate transportation by 2030 (when the sleeper cab tractor phase-in requirement starts).

The ZEV Milestones Option is phased in based on ZEV suitability. Box trucks, vans, and light-duty package delivery vehicles as the first truck types (i.e., Group 1) required to transition. Vehicles in Group 2 and Group 3 are given more time to transition because they are expected to have higher daily mileage needs, have more varied use cases and fewer of these ZEV models are available today. Manufacturers are announcing the production of heavy-duty models capable of higher ranges that will be available in the market to meet the demand of Group 2 vehicles in 2027.

n) Zero-Emissions Technology – Emergency Response

Comment Summary: The commenters express concerns about the availability of EVs during emergency events, both declared and undeclared, as EVs cannot be independently powered or carry fuel without electricity, which may not be available during emergencies.

Commenter: [003-WT1, 056-45d, 083-OT1, 164-45d, 233-45d, 237-45d, 241-45d, 263-45d, 292-45d, 300-45d]

Agency Response: Changes were made in response to these comments. The ZEV requirements are phased in over several decades providing a smooth transition to ZEVs, and technology and infrastructure is expected to continue to improve. The Mutual Aid Exemption was modified to provide earlier access to the exemption. Mobile fueling for ZEVs may be an option for fleets working in the field using the same avenues as other necessary supplies or fuel for ICE vehicles during emergency events. If a fleet cannot be reasonably fueled with mobile fueling, fleets may apply for an exemption under the Mutual Aid Assistance provision of the ACF Regulation. This provision includes other criteria that would allow fleets to purchase new ICE vehicles for vehicles that may be called upon to respond to declared emergency events wherever they may be needed.

Additionally, emergency vehicles, as defined in the CVC section 165, are exempt from the requirements of the ACF Regulation.

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[80] California HVIP, HVIP Eligible Vehicles, 2022 (web link: https://californiahvip.org/vehiclecatalog/, last accessed August 2022).

[81] Hyundai, Hyundai's XCIENT Fuel Cell Hitting the Road in California, 2021 (https://www.hyundainews.com/en-us/releases/3362, last accessed August 2022).

o) Zero-Emissions Technology – Vehicle-To-Grid Technology Interferes with Emergency Resilience

Comment Summary: The commenters state that ZEVs may become a power source for the grid when energy availability is low, drawing down stored battery energy, which would compromise the ability of fleet vehicles to respond to emergencies.

Commenter: [269-45d]

Agency Response: No changes were made in response to these comments. While ZEVs possess capabilities that ICE vehicles do not have, including the ability to supplement grid energy and lower the risk of customer outage, it is up to fleet owners to manage fleet operations to mitigate risk. The Regulation does not have any requirements for ZEVs to be used to supplement the grid. Additionally, fleets may choose to install energy storage on-site as a method to further mitigate risk.

p) Zero-Emissions Technology – Fuel Cell Technology

Comment Summary: The commenters express concerns about the readiness and feasibility of hydrogen technology, or request CARB to consider alternative compliance pathways for fleets transitioning to hydrogen fuel. They argue that focusing on battery-electric technology is not realistic and ask for pathways to incorporate hydrogen fuel cell technology into ACF. They point out issues related to FCEV supply, infrastructure, and suitability for long-haul operations. They also highlight concerns about maintaining two fueling infrastructures at a single facility and the lack of proven FCEV Class 8 tractors for hauling freight from remote origin points.

Commenter: [001-45d, 002-OT1, 011-45d, 015-WT1, 030-OT1, 092-OT1, 109-45d, 147-45d, 234-45d, 259-45d, 261-45d, 284-45d]

Agency Response: No changes were made in response to these comments. The ACF Regulation has a technology-neutral approach for transitioning conventional vehicles to zero tailpipe emissions and does not specifically require either BEVs or FCEVs as compliance options. This approach means that fleets that may not be able to fulfill their needs with one ZEV technology may use any alternative ZEV technology so long as it meets the criteria outlined in the ACF Regulation language. It is ultimately up to individual fleets to determine which ZEV technology is right for them. While FCEV options, supply, and infrastructure are currently limited compared to ICE vehicles, it is expected that this will change over the course of the ACF Regulation's long period of phase-in. For additional information regarding ZEV availability, including for that of FCEVs, please refer to responses in section "Zero-Emissions Technology – Availability" in "Zero-Emissions Vehicle Technology Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

q) Zero-Emissions Technology – Manufacturer Orders

Comment Summary: The commenters state that the manufacturers they rely on to supply their specific agricultural equipment will be inundated with equipment orders due to the low ZEV variety.

Commenter: [004-45d, 010-45d, 177-45d, 272-45d]

Agency Response: No changes were made in response to these comments. Not all agricultural equipment will need to be replaced immediately due to the long phase-in period of the ACF Regulation, allowing ZEV variety to increase over time. Additionally, the ZEV Milestones Option allows fleets to have some flexibility in how they wish to introduce ZEVs to their fleet so long as they meet the ZEV threshold, allowing fleets to place relevant orders and receive equipment in a timely manner. If ZEV equipment delivery is delayed due to circumstances beyond the fleet's control, fleets may have the option of retaining operation of existing equipment by applying for the Vehicle Delivery Delay provision of the ACF Regulation.

r) Zero-Emissions Technology – Large Companies Prioritized

Comment Summary: The commenters suggest that larger companies with greater capital will be prioritized by ZEV manufacturers, potentially disadvantaging small businesses.

Commenter: [021-45d, 033-45d, 148-OT1, 157-45d, 165-45d, 251-45d, 258-45d, 301-45d, 302-45d, 308-45d, 331-45d]

Agency Response: No changes were made in response to these comments. The Regulation has provisions to address if manufacturers prioritize large orders placed by large corporations over smaller orders. Starting with the 2024 vehicle model year, the ACT Regulation will require manufacturers to produce and sell ZE medium- and heavy-duty trucks which is expected to grow the ZEV market rapidly for all businesses, regardless of capital or size. During the interim, the ACF Regulation contains the Vehicle Delivery Delay provision. This provision, under the Model Year Schedule, would allow fleets to delay retiring vehicles until the replacement ZEV is delivered. Under the ZEV Milestones Option, this provision would allow a fleet to remain in compliance until ZEVs are delivered.

s) Zero-Emissions Technology – Non-Exhaust Emissions

Comment Summary: Commenter states that ZEVs weigh more than comparable ICE vehicles which will increase entrained road dust emissions or increase tire PM emissions.

Commenter: [270-45d]

Agency Response: No changes were made in response to these comments. Please refer to the EA RTC document, responses to Comment Letters 48-2, 261-6, and 270-3 for a discussion on PM from non-exhaust emissions. It is incorrect to assume ZEVs are always heavier than a comparable ICE vehicle. Today, BEVs with 100-mile range weigh about the same as a conventional vehicle. While some ZEVs may currently weigh more than their ICE vehicle counterparts, the long phase-in of requirements under the ACF Regulation may bring ZEV weight closer in line with ICE vehicles due to benefits from improved battery density, body material improvements, and general lightweighting.

t) Zero-Emissions Technology – Power Take-Offs

Comment Summary: The commenters claim that no ZEVs currently offer a solution to replace their trucks with specific PTO requirements, highlighting a gap in available technology.

Commenter: [024-WT1, 219-45d, 260-45d]

Agency Response: No changes were made in response to these comments. Several ZEV models are available on the market with PTO equipment, such as trash trucks and bucket trucks. It is expected that as ZE technology matures, additional options for PTO equipment or transmission will become available. If a ZEV configuration cannot replace a vehicle being retired, fleets may choose to utilize the ZEV Purchase Exemption to purchase a new ICE vehicle. Fleet owners may also take advantage of the Daily Usage Exemption, if the ZEV cannot meet the operation needs of an ICE vehicle in the same configuration.

u) Zero-Emissions Technology – Wastewater Services

Comment Summary: The commenters assert that ZE technology is not yet available to essential public wastewater service providers at the level needed to ensure uninterrupted, reliable essential services.

Commenter: [151-OT1, 309-45d, 326-45d]

Agency Response: No changes were made in response to these comments. The long phase-in period of the ACF Regulation allows fleets to slowly introduce and test available ZEVs in the market to familiarize themselves with the technology and plan future ZEV integration. As the ZEV market improves, additional ZEV models may be introduced with capabilities like that of ICE vehicles. Current ZEVs may fulfill some of a fleet's needs as the data gathered from Large-Entity Reporting indicates that most vehicles travel less than 100 miles per day. Fleets may choose to purchase NZEVs to fulfill their obligations until 2035 or utilize the ZEV Milestones Option Fleets for the flexibility to plan which vehicles to replace ZEVs. Fleets with mutual aid agreements may also choose to apply for the Mutual Aid Assistance provision to retain up to 25 percent of vehicles as ICE vehicles.

If no vehicle configuration is available to fulfill the needs of a wastewater fleet, the fleet may choose to apply for the ZEV Purchase Exemption provision to purchase a new ICE vehicle if a ZEV is not available. If a vehicle configuration is available but performance cannot meet the needs of the fleet, the fleet may choose to apply for the Daily Usage Exemption to purchase a new ICE vehicle so long as at least 10 percent of the fleet is composed of ZEVs.

v) Zero-Emissions Technology – Rural Communities

Comment Summary: The commenters express concerns about the adequacy of ZE technology for waste collection vehicles in rural communities, suggesting it may not be ready by the time regulatory requirements become effective.

Commenter: [180-45d]

Agency Response: No changes were made in response to these comments. There are currently more than six ZE waste collection vehicles commercially available with additional models expected to be available by the first milestone under the ZEV Milestones Option in 2027. Additionally, if a waste collection vehicle has a heavy front axle, this milestone date is pushed to 2030. If a ZE waste collection vehicle with adequate range still does not exist by this time, rural waste collection fleets may choose to apply for exemptions under the Daily Usage Exemption provision. For additional information on flexibility options, please see responses in section "Zero-Emissions Technology – Wastewater Services" in "Zero-Emissions Vehicle Technology Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

w) Zero-Emissions Technology – Rental Vehicles

Comment Summary: The commenters mention the absence of specialized vehicles with PTO systems and the infeasibility of renting electric heavy-duty vehicles like water trucks and dump trucks.

Commenter: [024-WT1]

Agency Response: No changes were made in response to these comments. Please see the response in "Zero-Emissions Technology – Power Take-Offs" in this section regarding PTO availability concerns. The ACF Regulation is phased-in slowly over a long period of time, so rental companies may choose to utilize the ZEV Milestones Option for the flexibility to convert less specialized equipment first while introducing more specialized ZEVs later when the market is more mature and additional options for ZEVs become available. Fuel infrastructure for ZEVs may similarly become more widespread as the Regulation moves forward, potentially improving the feasibility of renting vehicles like water trucks or dump trucks. Rental fleets may also choose to purchase NZEVs to remain in compliance with the ACF Regulation until 2035. NZEVs are operated similarly to ICE vehicles but with the ability to operate without emissions for a number of miles.

Fleets may also assist renters in setting up mobile or temporary fueling options to operate ZE specialized vehicles offsite, if feasible, to make specialized ZEVs more attractive to renters.

x) Zero-Emissions Technology – Vehicle Safety Concerns

Comment Summary: The commenters raise safety concerns regarding electric trucks, such as the inability to shut off or de-electrify during loading and the risk of static electricity discharge while loading or carrying flammable materials.

Commenter: [164-45d, 197-45d]

Agency Response: No changes were made in response to these comments. If a fleet can show that operating ZEVs may violate safety standards that they are subject to, the fleet may apply for an exemption under the ZEV Purchase Exemption provision. CARB is not currently aware of any additional safety risks during the operation of electric trucks versus conventional trucks. If safety becomes an issue during the implementation of the ACF Regulation, necessary action will be taken to ensure the safety of operators and the public.

y) Zero-Emissions Technology – Infrastructure Buildout Safety Concerns

Comment Summary: Commenters cite increased health and safety risks associated with the infrastructure buildout resulting from ZEV deployment under ACF.

Commenter: [259-45d]

Agency Response: No changes were made in response to these comments. The ACF Regulation includes a ZEV Infrastructure Delay Extension if there are unexpected health and safety risks present during infrastructure buildout, allowing fleets additional time to resolve any safety issues with fuel infrastructure.

z) Zero-Emissions Technology – Vehicle Operation Safety Concerns

Comment Summary: Some commenters highlight concerns stemming from vehicles running out of energy during usage, potentially affecting the safety of operators or the public.

Commenter: [058-45d, 334-45d, 335-45d]

Agency Response: No changes were made in response to these comments. ZEVs, like ICE vehicles, will typically notify operators when stored energy is low and will cease operation in a manner that reserves enough energy for emergency situations. Fleets may also choose to utilize the ZEV Milestones Option to slowly phase-in ZEVs in roles where they are appropriate. As the ZEV market matures over the implementation of the ACF Regulation, additional ZEV models may become available that alleviate the concerns of fleets. If no ZEV is available that can replace an ICE vehicle's role, fleets may choose to apply for the Daily Usage Exemption to remain in compliance without jeopardizing their fleet's operations.

aa) Zero-Emissions Technology – Service Quantity and Quality

Comment Summary: The commenters are concerned about a lack of a skilled technician workforce able to support maintenance of ZEV and acknowledges it will take time to develop. One of the commenters further claims that because there might be a lack of qualified technicians, this could cause fleets to be inoperable which the commenter then assumes smaller fleets would get the work instead, thus leading to more emissions.

Commenter: [116-45d, 207-45d, 239-45d, 246-45d, 269-45d]

Agency Response: No changes were made in response to these comments. They are out-of-scope and speculative. However, CARB agrees that there is a need to shift the existing workforce and recruit new additional skilled and trained technicians to support ZEV and other clean transportation technology adoption in the medium- and heavy-duty market as it expands. The technology is generally the same as in light-duty vehicles and can be planned for to support the ZEV market expansion. There are multiple efforts already underway in the light-duty space which are working to address the commenters' concerns. This includes training and certification for EVITP, given legislative mandates pursuant to AB 118. Workforce training and development projects are being funded by CEC and CARB that are promoting skill building, upskilling, retraining, and an expansion of the workforce across the clean transportation sector, including EV charging and fueling infrastructure. One specific example is the Inclusive, Diverse, Equitable, Accessible, and Local ZEV Workforce Pilot Project. This project also has a focus on preparing dislocated, unemployed, and new workforce entrants for ZEV careers to further broaden the scale and impact of the clean transportation workforce statewide, with a specific focus on low-income and disadvantaged communities. It also includes a focus on public transit and driver workforce training. CARB is also working with our partners to implement clean mobility investments as part of the Funding Plan for Clean Transportation Incentives that allow for a more inclusive, local workforce development as the transition to ZE occurs and methods of building the green economy evolve. CARB disagrees that additional transitional alternatives, besides NZEVs, are needed to allow infrastructure and workforce skill sets to catch up as the process of building the ZEV and broader clean transportation workforce is already well underway.

While technicians will need to be trained over time to create an effective servicing arm, the ACF Regulation introduces ZEVs into fleets steadily over a long period of time, allowing a workforce adequate time to be trained and become effective in their duties. CARB expects that as manufacturers ramp up their production of ZEVs, trained and competent technicians will be available to service the ZEVs.

bb) Zero-Emissions Technology – Reliability of Smaller Manufacturers

Comment Summary: The commenters question the reliability and longevity of smaller or startup OEMs despite their models being considered "commercially available."

Commenter: [272-45d]

Agency Response: No changes were made in response to these comments. Starting 2024, vehicle manufacturers must sell medium- and heavy-duty ZEVs as an increasing percentage of annual sales under the ACT Regulation and more models will become available. Fleets have flexibility to purchase vehicles from any manufacturer in accordance with the Regulation. Large, well-established OEMs offer a wide range of ZEVs from which fleets may purchase the vehicles they need to comply with the ACF Regulation. Additionally, SLG fleets are not required to sell or retire any vehicles. The Regulation includes flexibility for fleets to make ZEV purchase decisions according to their priorities. To the extent that smaller manufacturers have the only ZEVs available to purchase by a fleet, the Regulation includes protections such as requiring manufacturer ZEV offerings be ZEP Certified which includes warranty requirements to help provide a fleet owner certainty.

cc) Zero-Emissions Technology – Variability of Day-to-Day Operations

Comment Summary: The commenters note that the Regulation does not address the variability of day-to-day operations for specialty, construction, equipment rental, and critical service maintenance vehicles.

Commenter: [003-WT1, 017-OT1, 058-45d, 164-45d, 205-45d, 239-45d, 256-45d, 259-45d, 263-45d, 304-45d]

Agency Response: No changes were made in response to these comments. The flexibility in the Regulation allows fleet owners to choose which trucks to purchase as ZEVs and best fit their operations. Fleet owners also have the option to purchase NZEVs instead of ZEVs until 2035. NZEVs have same fueling and operating characteristics as ICE vehicles but with the ability to operate without emissions for a number of miles. The Regulation also includes the Daily Usage Exemption to address situations where available BEVs cannot meet the needs of the fleet's typical duty cycle. Fleet owners can use data from any 30-day period from the prior year to support their exemption request and have the option to use real world data from ZEVs to support their request.

dd) Zero-Emissions Technology – Maintenance of Older Vehicles

Comment Summary: The commenters point out that the ACF ISOR does not evaluate the potential unintended negative consequences of trucking fleets maintaining their existing vehicles longer if ZEVs are unable to meet specific operational requirements. This scenario could result in fleets holding onto older, less environmentally friendly vehicles for extended periods.

Commenter: [255-45d]

Agency Response: No changes were made in response to these comments. The HPF model year schedule is aligned with the useful life requirements specified in SB 1 and cannot be made more restrictive. However, the Regulation also includes the ZEV Milestones Option that provides considerable flexibility to fleet owners to phase-in ZEVs as an increasing percentage of the fleet. The Regulation also includes exemptions that allows fleet owners to replace an older ICE vehicle with a new ICE vehicle in situations where the required ZEV configuration is not available, or the ZEV is unable to meet the functions and operational needs of the fleet such as the ZEV Purchase Exemption and the Daily Usage Exemption. For these reasons, fleet owners are not likely to hold on to less environmentally friendly vehicles.

SB 1 provides fleet owners with certainty about the "useful life" of their vehicles by establishing a timeframe before such vehicles can be retired, replaced, retrofitted, or repowered through new or amended Regulations. The useful life period is specified as the later of either (a) 13 years from the model year that the engine and emissions control systems are first certified or (b) (when the vehicle travels 800,000 vehicle miles traveled or 18 years from the model year that the engine and emissions control systems are first certified for use, whichever is earlier). However, CARB recently approved the HD I/M Regulation to control emissions more effectively from non-gasoline on-road heavy-duty vehicles with a GVWR greater than 14,000 pounds operating in California. The HD I/M Regulation requires affected heavy-duty vehicles to perform periodic emissions testing twice a year to show compliance at specified intervals to ensure that the emissions control systems maintain the same efficiency as the vehicle ages. Combining periodic vehicle testing with other emissions monitoring and expanded enforcement strategies, the HD I/M Regulation will ensure that vehicle's emissions control systems are properly functioning when traveling on California's roadways. As prices continue to decline and fleets realize lower operational costs associated with ZEVs, fleets may choose to turn over their vehicles early (rather than hold on to them longer) to realize the significant cost savings.

ee) Zero-Emissions Technology – Vehicle Weight

Comment Summary: The commenters express concerns about the weight of ZEVs, stating that the added weight impacts payload capabilities, road conditions, and overall vehicle performance. Moreover, they argue that pairing battery weight with existing payload specs often exceeds axle GVWR, forcing a choice between retaining operation time and payload capacity, and that choosing payload could lead to a 25 to 65 percent reduction in operation time.

Commenter: [011-45d, 020-45d, 023-45d, 029-WT1, 034-45d, 035-45d, 036-45d, 042-45d, 068-45d, 092-OT1, 098-45d, 128-45d, 129-45d, 132-OT1, 136-45d, 138-45d, 146-45d, 151-

45d, 153-45d, 167-45d, 173-45d, 175-45d, 178-45d, 179-45d, 205-45d, 259-45d, 260-45d, 261-45d, 264-45d, 270-45d, 278-45d, 279-45d, 282-45d, 287-45d, 304-45d, 310-45d, 322-45d, 334-45d]

Agency Response: No changes were made in response to these comments. As described in Chapter I.H.5. of the ACF ISOR, weight is not a major concern for ZEVs because the data clearly shows that for most operations in the medium-duty truck sector, the freight tends to "cube out" before weight overload becomes a constraint. According to the North American Council for Freight Efficiency, vehicle weight for Class 3 through 6 medium-duty EV applications do not present a significant risk for fleet operators because they have sufficient freight weight margins or have alternate choices in vehicle designs and GVWR ratings. Weight is also not a major concern for most operations using Class 7 and 8 tractors. This is because most tractors, or about 88 percent, operate in the dry van general freight market segment. According to North American Council for Freight Efficiency, these operations never travel at maximum weight because their trailers will reach the volumetric capacity "cube out" before reaching weight capacity "gross out," or because their routes and cargo patterns are not conducive to traveling with a full trailer.

As discussed in the Chapter I.H.5. of the ACF ISOR, AB 2061 allows ZEVs and NZEVs to exceed California maximum weight limits by 2,000 pounds which addresses some of the vehicle weight and payload capacity concerns of ZEV technology for weight limited loads in California. Additionally, weight is less of a concern for FCEVs as they have comparable range to combustion vehicles and weigh less than long-range BEVs with bigger batteries.[82] The different available ZEV technology options, BEV or FCEV, allow for fleet owners to select the technology that best fits the range and weight requirements of a fleet's operations. Furthermore, as described in Chapter I.H.5. of the ACF ISOR, battery technology is rapidly evolving which is resulting in a continued trend of higher battery energy density and lower battery weight and volume. As for FCEVs, hydrogen's greater energy density is well suited for longer range applications. These ZEV options, BEV or FCEV, allow fleet owners to select the technology that best fits the range and weight requirements of a fleet's operations. Fleet owners may also opt to use shorter range trucks with supplemental fueling at strategic locations.

However, CARB recognizes that some operations will require trucks to travel at maximum GVWR. To the extent that a fleet owner can demonstrate BEV range in the application is not enough to meet their daily needs, the Daily Usage Exemption allows fleet owners to purchase a new ICE vehicle. If the BEV range is lower while operating in the same operation conditions on similar assignments as ICE vehicles, including when fully loaded, the capability of the BEV would be used to justify the exemption. In addition, there are a number of flexibilities incorporated into the Regulation that accompany a long phase in schedule of compliance requirements that provide fleet owners considerable flexibility in how they transition to ZEVs. The Regulation is structured such that the truck types targeted in the Milestones Option for Group 1 ZEVs are used in operations that are well suited for the current state of technology. These truck types consist of box trucks, vans, and light-duty

[82] North American Council for Freight Efficiency, Making Sense of Heavy-Duty Hydrogen Fuel Cell Tractors, 2021 (Web link: https://nacfe.org/wp-content/uploads/2020/12/NACFE-Guidance-on-Hydrogen-Fuel-Cell-Tractors-FINAL-121620.pdf, last accessed January 2022).

package delivery vehicles which have operations characterized by stable routes and home base locations. Day cab tractor requirements do not begin until 2027 and sleeper-cab and specialty truck requirements do not begin until 2030. Specialty trucks are Class 8 trucks with a heavy front axle or perform their primary function while stationary. NZEVs may also be purchased in lieu of ZEVs until 2035. The first compliance requirement for sleeper cab tractors in the Regulation's Milestones Option begins in 2030. This timeline provides sufficient time for ZEV technology to continue to improve. And if the recent demonstration, as predicted by the Tesla Impact Report, of the Tesla Semi traveling 500 miles on a single charge and weighing just under 82,000 pounds is evidence of the continued advancements of ZEV technology, then the weight of a ZEV should not be a concern by 2030.[83]

ff) Zero-Emissions Technology – Vehicle Weight on Federal Highways

Comment Summary: Commenter raises concern that the 2,000-pound weight limit increase for ZEVs and NZEVs referenced by staff is not allowed on federal highways outside California and will necessitate additional vehicles, which will statistically adversely impact highway safety.

Commenter: [334-45d]

Agency Response: No changes were made in response to these comments. CARB disagrees that the 2,000-pound weight increase is limited to operations within California. Title 23 U.S. Code, Ch. 1, §127 (Vehicle Weight Limitation – Interstate System) allows natural gas and BEVs an increase of 2,000 pounds, up to 82,000 pounds GVWR, on federal highways, and therefore will not change impacts on highway safety as the commenter asserts.[84] Additionally, the Regulation provides the Daily Usage Exemption which offers fleet owners the ability to purchase a new ICE vehicle if an existing BEV is unable to meet the fleet's operational needs.

gg) Zero-Emissions Technology – Motorcoach Weight and Luggage Capacity Issues

Comment Summary: Commenters state that motor coaches operating at maximum gross vehicle road weight capacity would have reduced luggage capacity and difficulties servicing the same number of riders as ICE vehicles.

Commenter: [017-OT1, 314-45d]

Agency Response: No changes were made in response to these comments. The ACF Regulation has included several flexibilities such as extensions, exemptions, and vehicle useful life considerations that are designed to help a fleet comply. In addition, the Regulation gives fleets the option to use the milestone pathway which provides fleet owners flexibility in managing their fleet. For the motorcoach industry, buses are included in Group 2 vehicles and don't have a compliance requirement until 2027. CARB is confident that ZEV technology

[83] Tesla, 2020 Impact Report, 2020 (web link: https://www.tesla.com/ns_videos/2020-tesla-impact-report.pdf, last accessed August 2022).

[84] Federal Highway Administration, The Consolidation Appropriations ACT, 2019, (weblink: *https://ops.fhwa.dot.gov/freight/pol_plng_finance/policy/fastact/tswprovisions2019/index.htm*, last accessed May 2023)

will continue to improve and be able to provide the motorcoach industry with suitable ZEV options. However, the Regulation provides the Daily Usage Exemption which offers fleet owners the ability to purchase a new ICE vehicle if an existing BEV is unable to meet the buses operational needs.

2. Infrastructure and Grid Concerns

a) Grid Capacity and Resilience – Additional Grid Planning and Analysis Needed

Comment Summary: The commenters highlight CEC's lack of plans for uninterrupted electricity and the potential for grid collapse in response to the ACF Regulation and claims that electric supply growth would need to be higher than what the state has been able to achieve in any single year in the past. Commenters request CARB to work with officials from relevant agencies to conduct a feasibility study addressing grid upgrade costs, potential ratepayer increases, and timelines before adopting the Regulation. They also seek information on how the increased state electrical power demand will be met to accommodate the proposal.

Commenter: [001-45d, 021-WT1, 039-45d, 041-45d, 052-45d, 054-45d, 060-45d, 063-45d, 075-OT1, 083-45d, 085-45d, 104-45d, 115-OT1, 117-45d, 137-45d, 140-OT1, 162-45d, 177-45d, 189-45d, 207-45d, 249-45d, 252-45d, 258-45d, 260-45d, 270-45d, 286-45d, 308-45d, 322-45d, 331-45d, 335-45d]

Agency Response: No changes were made in response to these comments. State agencies are planning and coordinating on electrical infrastructure needed to support widespread electrification. The Regulation is being phased in over several decades and the expanding electricity needs can be planned for. By 2035, medium- and heavy-duty ZEVs will account for about 3 percent of total electricity demand statewide and less than two percent on peak between 5:00 PM and 8:00 PM. CARB is working with CEC and sharing data with them for long term planning efforts.[85]

The ACF Regulation is structured such that SLG fleets, drayage trucks, and HPF fleets would transition to a greater percentage of ZEVs well into the future and electrification is not expected to happen all at once. CARB understands the concerns commenters raise and acknowledges there will need to be expanded electricity generation, transmission, and distribution over the next 15 years. California’s electric grid will be capable of meeting additional demand from ACF, and new electric loads will place downward pressure on electric rates by spreading the high fixed costs of electricity generation to additional customers. See “Master Response 1 - Response to Comments on the Draft Environmental Analysis” for an assessment of grid impacts the response to Comment 270-10.

Several studies have shown no major technical challenges or risks have been identified that would prevent a growing ZEV fleet at the generation or transmission level, especially in the

[85] CEC, CED 2022 Hourly Forecast - CAISO - Planning Scenario, January 2023 (web link: https://efiling.energy.ca.gov/GetDocument.aspx?tn=248359&DocumentContentId=82768, last accessed January 2023).

near-term.[86] Additionally, based on historical growth rates, sufficient energy generation and generation capacity is expected to be available to support a growing EV fleet. State agencies have a history of planning for distribution upgrades and are further refining models and approaches to account for increased load from BEVs such as through CEC's AB 2127 Electric Vehicle Charging Infrastructure Assessment,[87] Integrated Energy Policy Report Electricity Demand Forecast,[88] CPUC Integrated Resource Planning and Long-Term Procurement Plan process, and CAISO transmission planning process. These multiple studies and processes evaluate demand and reliability needs of the overall electric system, local reliability needs specific to areas with transmission limitations, and flexibility needs like the resources required for renewable energy integration. The primary agencies will continue to evaluate and refine likely sources of load.

In addition to the completed long-term planning and analysis, coordination and strategizing is ongoing with other key agencies like the CTC, Caltrans, GO-Biz, and others to ensure the grid is prepared for electrification loads. Increasing electric loads from BEVs can be managed with charging during off-peak periods and with demand response signals to reduce load during peak periods. Further, BEVs are expected to eventually provide grid services by taking advantage of the onboard battery storage, notably by providing backup power to homes and community buildings at times of electric grid power outages, or by potentially providing two-way power flow to the grid allowing BEVs to become energy resources for utilities.

Historically, the state's electric grid has expanded and evolved as consumer demand for electricity services has grown, including with the recent emergence of EVs. California's existing grid and approved investments occurring now will allow the state to handle millions of EVs in the near-term, and projections show the broader western grid can handle up to 24 million light-duty, 200,000 medium-duty, and 150,000 heavy-duty EVs without requiring any additional power plants.[89,90] Longer term, transitioning medium- and heavy-duty vehicles to electrification is achievable with a gradual build out of clean energy resources – more gradual than during times of peak electricity sector growth in the past given EV loads can be distributed over non-peak hourly periods. With the Regulation, the increase in demand is predictable and can be planned for.

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[86] US DRIVE. Summary Report on EVs at Scale and the U.S. Electric Power System. U.S. Driving Research and Innovation for Vehicle Efficiency and Energy Sustainability (DRIVE), 2019 (web link: https://www.energy.gov/eere/vehicles/articles/summary-report-evs-scale-and-us-electric-power-system-2019, last accessed March 9, 2023).

[87] California Energy Commission, Assembly Bill 2127 Electric Vehicle Charging Infrastructure Assessment, 2021 (web link: https://efiling.energy.ca.gov/getdocument.aspx?tn=238853, last accessed August 2022).

[88] California Energy Commission, Transportation Energy Demand Forecast, 2021 (web link: https://efiling.energy.ca.gov/GetDocument.aspx?tn=240934, last accessed August 2022).

[89] Pacific Northwest National Laboratory 2020. Kintner-Meyer, Michael, et al, Electric Vehicles at Scale – Phase I Analysis: High EV Adoption Impacts on the Western U.S. Power Grid. Pacific Northwest National Laboratory, 2020 (web link: https://www.pnnl.gov/sites/default/files/media/file/EV-AT-SCALE_1_IMPACTS_final.pdf, last accessed March 9, 2023).

[90] Muratori et al 2021. Matteo Muratori et al, "The rise of electric vehicles—2020 status and future expectations," 2021 (web link: https://iopscience.iop.org/article/10.1088/2516- 1083/abe0ad/pdf, last accessed March 9, 2023).

Through cross-agency collaboration and data sharing, CEC staff are developing new tools and energy models such as the HEVI-Load model for heavy-duty EV infrastructure projections and the EDGE Tool to study regional distribution capacity. The various modeling approaches help predict likely sources of BEV loads throughout the state, including along highways and in more remote regions, and will allow for proactive planning while balancing utility distribution upgrade costs. Finally, SB 1020 would require State agencies to report on the reliability of the grid annually and identify gaps in achieving grid and local reliability.

For additional detailed information, please see responses to issues raised in sections "Grid Capacity and Resilience – Grid Capacity" and "Grid Capacity and Resilience – Grid Reliability" in "Infrastructure and Grid Concerns" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

b) Grid Capacity and Resilience – Grid Capacity

Comment Summary: The commenters raise numerous concerns about the grid's capacity and the supply of electricity, particularly during peak demand and emergencies, and its ability to support the ACF Regulation. They mention the risk of increased grid strain, blackouts, and failures due to the Regulation's implementation, and express doubts about whether the grid can support charging fleets during peak times. Commenters also question CARB's ability to demonstrate the grid's capacity to support the proposed number of charging stations for trucks, especially during heat advisories and other extreme events.

Commenter: [003-OT1, 005-45d, 009-WT2, 010-45d, 010-WT1, 019-45d, 028-45d, 028-OT1, 064-45d, 065-45d, 068-45d, 073-OT1, 091-45d, 116-45d, 116-OT1, 118-OT1, 135-45d, 151-OT1, 152-45d, 164-45d, 172-45d, 180-45d, 187-45d, 188-45d, 190-45d, 207-45d, 227-45d, 237-45d, 258-45d, 265-45d, 268-45d, 274-45d, 301-45d, 339-45d]

Agency Response: No changes were made in response to these comments. In addition to the response to "Grid Capacity and Resilience - Additional Grid Planning and Analysis Needed," which outlines the grid forecasting and procurement process and notes that the ACF Regulation will account for about 3 percent of total electricity demand statewide by 2035, significant investment has been approved to ensure sufficient grid capacity is available. In 2022 CPUC approved the 2021 Preferred System Plan, which authorized procurement of $49 billion in electric system upgrades by 2032 for the IOUs, representing about 40,500 MW of new renewable generation and storage resources, and requiring only limited transmission upgrades.[91] For comparison, in 2021 California's installed in-state generation nameplate capacity was 81,691 MW with about 30 percent of supply imported.[92] Under the CPUC process, as new needs are identified, additional procurement can be authorized. California's POUs are also investing heavily in grid operations.

Another key capacity and adequacy metric is the peak demand from heavy-duty vehicles. In addition to the latest Energy Demand Forecast, CEC conducted a ZEV demand analysis for

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[91] California Public Utilities Commission 2022, Decision Adopting 2021 Preferred System Plan Rulemaking 20-05-003, 2021 (web link: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M449/K173/449173804.PDF, last accessed August 2022).

[92] California Energy Commission, 2021 Total System Electric Generation, 2021 (weblink: https://www.energy.ca.gov/data-reports/energy-almanac/california-electricity-data/2021-total-system-electric-generation, last accessed August 2022).

the initial AB 2127 Report published in 2020 using the aggregated hourly charging load profiles of nine commercial vehicle type categories defined under CARB's Draft 2020 Mobile Source Strategy scenario.[93] The charging profiles varied significantly with use-case and travel requirement and the total estimated aggregate peak demand was about 2000 MW at 5:00 P.M., without any smart charging assumptions. California's grid demand varies throughout the year, but a typical summer daily peak is about 44,000 MW (with an all-time system peak of 52,000 MW in September 2023) representing a peak impact of only 4.5 percent in an unmanaged scenario. However, an unmanaged charging scenario is unrealistic because charging costs would be much higher than necessary compared to charging outside the 4:00 P.M. to 9:00 P.M. peak and therefore avoiding high time of day charges. The updated and refined forecast accounts for charge management and shows much smaller impacts. Since California's electric grid is designed for peak summer usage representing a few percent of the hours per year, adding load outside the peak hours carries a negligible impact to the grid overall. Smart charging systems can help ensure that only critical charging is done during peak hours and that most charging occurs during non-peak hours. EV charging and demand response strategies, along with vehicle grid services, will minimize the risk of grid blackouts from vehicle loads and minimize the risk of lost labor time, wages and charging costs.

Another study, by LBNL, noted that full national electrification will add about 15 percent to summer peak loads with heavy-duty electrification representing about one-third of that amount. The study also noted that the impact of additional load due to rapid national electrification is modest and not without historical precedence. It demonstrated that under full electrification scenarios (including transportation, buildings, and industry) electricity demand would grow at a lower rate from 2020 to 2050, 2.2 percent, than the highest historical demand growth in history from 1975-2005, 2.6 percent, this data was presented by LBNL at the CARB Medium- and Heavy-Duty Zero-Emissions Vehicle Fueling Infrastructure Forum in June 2021.[94] In addition, the ability to add significant renewable energy capacity while both decarbonizing the electric grid and growing load has been demonstrated through the 2010's in California. Ultimately, at the individual project level, the impact on the neighborhood electrical distribution network must be analyzed and addressed by the local utility.

Several current and historical actions help to ensure grid capacity and reliability with the ACF Regulation. CPUC opened a new proceeding to modernize and prepare the grid in anticipation of multiple distributed energy resources. With this new proceeding, CPUC aims to evolve grid capabilities to integrate distributed energy sources, optimize grid resources, maintain grid reliability, and provide reasonable rates. In addition to grid-level resources, state efforts have supported local generation that avoids the need for transmission upgrades through rapid growth of the distributed solar generation like the California Solar Initiative of SB 1 (Murray, Stats. 2006, ch. 132). In addition, steps to commercialize clean energy microgrids that support the critical needs of vulnerable populations impacted by grid

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[93] California Energy Commission, Assembly Bill 2127 Electric Vehicle Charging Infrastructure Assessment, 2021 (web link: https://efiling.energy.ca.gov/getdocument.aspx?tn=238853, last accessed August 2022).
[94] ACF ISOR Appendix E, Medium- and Heavy-Duty Zero Emission Vehicle Fueling Infrastructure Forum, Paving the Way Panel, June 2, 2021 (web link: https://www.youtube.com/watch?v=SojYFB9fshI, last accessed April 2023).

outages are ongoing. In 2021, CPUC approved development of the Microgrid Incentive Program and PG&E, SCE, and SDG&E held a series of stakeholder workshops to shape development of the new program. Several projects are underway under this initiative as part of SB 1339. Another key policy that helps support grid capacity are time-of-use rates, which provide signals to consumers in the form of electricity rate changes at different times of the day. Commercial rates that vary by hour mirror the cost of providing electricity and provide a key economic signal to encourage fueling at times when net demand is low, such as mid-morning through early afternoon or overnight. This signal shifts charging away from key peak periods and lowers the potential cost of fueling.

In addition, recent Federal legislation contains opportunities for additional support. The IIJA also known as the 'Bipartisan Infrastructure Law', provides approximately $350 billion for Federal highway programs over a 5-year period (fiscal years 2022 through 2026), invests roughly $65 billion to upgrade the power infrastructure, creates a new Grid Deployment Authority, invests in research and development for advanced transmission and electricity distribution technologies, and promotes smart grid technologies that deliver flexibility and resilience.[95] It also invests in demonstration projects and research hubs for next generation technologies like advanced nuclear, carbon capture, and clean hydrogen. The IRA also includes tax credits that support electrification and other measures.

c) Grid Capacity and Resilience – Grid Reliability

Comment Summary: The commenters state that California's power grid is currently unreliable and therefore incapable of supporting the proposed transition to ZEVs under the ACF Regulation. They express concerns about the impact of grid stress on their ability to charge vehicles, citing instances of blackouts, power shutoff events, and the grid being strained beyond its capacity and note CAISO short term deficit forecasts. The commenters suggest that CARB and CPUC should ensure the grid's reliability before requiring fleets to purchase ZEVs, and they emphasize the need to address grid issues before implementing the EV mandate. Additionally, they mention that CAISO had to ask EV owners not to charge their vehicles due to stress on the electric grid shortly after the Advanced Clean Cars II Regulation was passed, further highlighting the grid's current limitations.

Commenter: [009-WT2, 014-45d, 021-45d, 026-45d, 027-45d, 033-45d, 038-45d, 039-45d, 048-45d, 051-45d, 056-45d, 057-45d, 113-OT1, 117-45d, 139-OT1, 161-45d, 163-45d, 164-OT1, 167-45d, 170-45d, 176-45d, 184-45d, 188-45d, 189-45d, 204-45d, 207-45d, 232-45d, 251-45d, 259-45d, 265-45d, 268-45d, 269-45d, 281-45d, 292-45d, 295-45d, 302-45d, 347-45d]

Agency Response: No changes were made in response to these comments. Grid reliability is ensured via multiple regulatory requirements across a wide range of organizations and agencies. NERC sets reliability standards that ensure the effective and efficient reduction of reliability risks nationally. CPUC sets state standards for IOUs and most POUs follow the guidelines voluntarily as well. CARB does not have the authority to set reliability standards.

[95] Federal Highway Administration, U.S. Department of Transportation, National Electric Vehicle Infrastructure Formula Program, 2022 (web link: https://www.federalregister.gov/d/2022-12704, last accessed February 2023).

CPUC studies and sets standards for the probability of a power outage, called the loss of load expectation, which sets the allowable risk of an outage from equipment failure at one day per 10 years.[96] Utilities track and report outage frequency and duration annually. Also, a 15 percent resource adequacy requirement provides a buffer for the daily electricity demand forecasts to ensure stability.[97] Resource adequacy requirements are increasing to further reduce outage risk. The long-term planning processes ensure that new generation to meet demand will be built and tens of billions in investments have already been authorized by the CPUC.

As fire risk in California has grown, CPUC and IOUs have employed a number of power outages to mitigate the risk of accidental ignition from damaged utility equipment. A wide variety of environmental and economic influences affect the timing and length of PSPS and similar events, including the state of vegetative cover and moisture content, wind speed, temperature, and subjective decision-making by a utility company. While CPUC considers PSPS outage events as safety-related (as opposed to an unplanned outage from an equipment failure or traffic accident), all grid outages create uncertainty for vehicle fueling of all types. Therefore, understanding how utilities are addressing and mitigating supply disruptions is critical.

CPUC has directed the establishment of PSPS event policies to guide the behavior of the major IOUs, such as PG&E, SCE, and SDG&E. Efforts are underway at the major IOUs to address PSPS impacts on charging infrastructure, including improving communication, studying feasibility of grid-independent EV charging stations (e.g., mobile charging stations), and EV charging with backup generation. Improving communication both before and during potential or active de-energization events regarding the location and accessibility of charging stations near impacted areas can lessen impacts. Designing charging infrastructure to include energy storage and clean back-up power generation can also play an important role during emergencies. CPUC with CEC's support, leads ongoing efforts to develop standards, protocols, guidelines, methods, rates, and tariffs that serve to support and reduce barriers to microgrid deployment and increase resiliency. CPUC Decision 20-06-017, for example, has the potential to build support for distributed generation using localized microgrids that provide resiliency during power loss events, such as PSPS events and other declared emergencies.[98] The expectation is that the frequency and duration of planned PSPS events will gradually diminish as the grid is hardened to wildfires such as through undergrounding and vegetation management.

Outside of PSPS events, the utility industry follows reliability, outage, and resource adequacy standards from various regulators like NERC as well as CPUC and other sources. In addition,

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[96] California Public Utilities Commission, Electric System Reliability Annual Reports, 2022 (web link: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/infrastructure/electric-reliability/electric-system-reliability-annual-reports, last accessed August 2022).

[97] California Public Utilities Commission, Resource Adequacy Homepage, 2022 (web link: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/resource-adequacy-homepage, last accessed August 2022).

[98] California Public Utilities Commission, Decision 20-06-017: Actions to Accelerate Microgrid Deployment and Other Resiliency Solutions, June 11, 2020 (web link: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M340/K748/340748922.PDF, last accessed August 2022).

utilities have adopted short-term reliability standards to help monitor unscheduled power outages locally, such as outages from storms, car accidents with utility -poles, or equipment failures. These reliability standards for frequency and duration are stringent and allow for an acceptable outage risk of typically one to two hours per year.

CARB recognizes the state is implementing multiple goals simultaneously, such as decarbonization, water-use efficiency and fire threat abatement, and reliability is actively and adaptively being managed during this transformation. For example, fire hardening by undergrounding powerlines is ongoing, certain once-through cooling requirements have been delayed, Diablo Canyon Nuclear Power Station is scheduled to remain functional longer, and emergency demand response and generation programs have been created in response to extreme climate variability. The suite of shorter-term actions, combined with effective messaging across all agencies and organizations, is key to ensuring a high level of reliability. For additional information on meeting capacity needs, please see responses to issues raised in section "Grid Capacity and Resilience – Grid Capacity" in "Infrastructure and Grid Concerns" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

d) Grid Capacity and Resilience – Grid Capacity During Emergencies and for Essential Services

Comment Summary: The commenters express concern about grid reliability and insufficiency during natural disasters or other emergency events, and the potential impact on essential services and critical infrastructure like airports, hospitals, and water treatment facilities. They argue that the Regulation does not consider the power grid's vulnerability in such circumstances, which may result in hindered essential services and prioritized restoration of critical infrastructure, especially if critical support and maintenance vehicles are unable to fuel. Commenters also mention the general insufficiency and unreliability of the electric power grid in their service areas, potentially compromising essential public services if vehicles cannot be charged.

Commenter: [004-WT1, 024-WT1, 056-45d, 124-OT1, 237-45d, 245-45d, 272-45d]

Agency Response: Changes were made in response to these comments. Emergency use provisions, including the mutual aid provision, were enhanced to provide greater flexibility. Any vehicle, regardless of fuel type, must be fueled to be used, whether for evacuation or any other use. Refueling risks from emergency power loss are similar for conventional vehicles. For example, diesel powered vehicles may also run out of fuel, or the tank may be low at the time of an emergency, and liquid fueling stations require electricity to operate. These considerations are not new or unique to ZEVs.

e) Grid Capacity and Resilience – Grid Reliability and Availability Statewide

Comment Summary: The commenters state concerns about the impact of EV chargers on the power grid, including overloading transformers, potential transformer explosions, and the need for more transformers and power plants in neighborhoods. They also mention significant delays in PG&E territory due to load capacity issues and the risk of concentrated charging stations causing problems at weak spots on the grid. Commenters inquire about

CARB's plans to guarantee grid reliability and capability for fleet sites requiring fast charging locations, as well as addressing the lack of integrated capacity in utility territories.

Commenter: [011-45d, 020-OT1, 120-45d, 166-45d, 207-45d, 223-45d, 246-45d, 282-45d]

Agency Response: No changes were made in response to these comments. Potential for neighborhood distribution system impacts can vary based on local substation, circuit, transformer, and feeder designs. Utilities will upgrade the electrical system over the coming decades and through duration of the Regulation and will facilitate expansion of electrical service where needed. Utilities monitor the age, health and load limits of transformers and replace or upgrade transformers as conditions change which increases system capacity and prevents catastrophic failures. Occasionally specific projects may face delays due to local grid limitations and infrastructure delay provisions provide requisite flexibility for unusual situations. Distributed energy resources like solar and storage are strategies that can be used to reduce costs and improve reliability. In addition, the CEC's EVSE Deployment and Grid Evaluation or EDGE Tool investigates local distribution impacts that allow utilities to identify and plan for local impacts early.

f) Grid Capacity and Resilience – Public Agency Data Sharing and Transition Plan Requirement

Comment Summary: The commenters request that CARB share location-specific data collected from the ACT LER with utilities to help them plan for grid capacity investments. They also recommend that the Regulation include a requirement for fleets to develop and report ZEV transition plans to CARB or utilities that can inform State agency and utility transportation electrification and system planning.

Commenter: [001-OT1, 035-OT1, 207-45d, 229-45d, 297-45d, 342-45d]

Agency Response: No changes were made in response to these comments. State agencies and utilities are already examining the impact of transportation electrification on the electrical grid and sharing information to inform planning. Staff at CEC, CPUC and CAISO regularly meet to proactively discuss, analyze, and coordinate local and regional grid impacts. The State agencies continue to refine models, tools, and detailed data sets. Pursuant to AB 2700, CARB, CEC, and CPUC will share information already gathered by CARB through Regulations with the state's utilities to support grid planning and infrastructure investments. However, planning agencies and utilities will still need to project where and when new load will be needed to serve the loads.

Adding a requirement for fleets subject to the Regulation to submit a one-time plan for a specified period, such as ten years, would be non-binding, would increase the administrative burden for fleet owners and staff. Fleet plans to deploy ZEVs are partly dependent on the information the utilities can provide the fleet owner. For example, if the utility identifies some site locations are relatively easy to upgrade and identifies barriers at other locations, it will change the feasibility of a statewide plan and the fleet strategy. Fleets and utilities will need to work together and adapt strategies over time. To the extent possible, fleets of all sizes, but especially those adopting large numbers of ZEVs, should contact their local utilities early and often. Utilities have dedicated funds for technical assistance and provide advisory services to customers adopting EVs far in advance of vehicle purchase or delivery. Utilities can help customers determine on-site infrastructure needs such as power requirements and the number and type of chargers required on the customer side of the meter. Additionally, the utility can suggest load management strategies to maximize charging efficiency and lower customer bills.

As part of the ZEV Infrastructure Delay Extension, a fleet owner who is experiencing a delay in obtaining site power will be required to submit information on their preliminary site capacity evaluations for all sites where their fleets are domiciled. Although this is an initial snapshot and not necessarily a long-term projection, the data collected and shared pursuant to AB 2700 will be enough to start the conversation between a fleet and their electric utility and inform grid planning.

g) Grid Capacity and Resilience – Grid Reliability Outside of California

Comment Summary: The commenters suggest CARB must also account for power grids outside of the state because interstate fleets are required to comply with the Regulation. Commenter states CARB must evaluate emissions impacts from increased demand for electricity generation out of state that is imported to California, due to California's reliance on imported power as the second largest importer in the nation.

Commenter: [009-WT2, 259-45d, 322-45d]

Agency Response: No changes were made in response to these comments. The commenter incorrectly assumes that the Regulation applies to fleets operated or controlled exclusively outside of California. The ACF Regulation only applies to vehicles that are owned, operated, or directed to operate in California. Notwithstanding that response, national electrical reliability and demand growth is already closely regulated and tracked to ensure extremely high levels of availability, although this is outside CARBs regulatory scope. Reliability for the bulk national electric grid is regulated by NERC, which oversees six regional reliability coordinators that encompass all the interconnected power systems of Canada, the contiguous United States, and a portion of Mexico. California’s grid is located within the Western Interconnection, which covers the Pacific Ocean to the Rocky Mountain states. NERC also sets robust standards for physical and cyber security protection. NERC is subject to oversight by the U.S. Federal Energy Regulatory Commission. This body of standards and oversight, including the annual NERC Long Term Reliability Assessment, ensures a reliable national electric grid as demand grows, including from electrification. CARB will continue to track impacts of electrification. In addition, California imports approximately 30 percent of its electric consumption and the Renewable Portfolio Standards, which set progressively cleaner renewable energy requirements, apply to these resources as well and will ensure out of state generation meets clean energy standards.

h) Grid Capacity and Resilience – Public Building Retrofits in Smaller Communities

Comment Summary: The commenter states that the electric provider in their small community is not equipped to handle the impact of retrofitting buildings, such as schools and government agencies, as required by the ACF Regulation.

Commenter: [013-45d]

Agency Response: No changes were made in response to these comments. Load serving entities are required to meet certain reliability and planning requirements. The installation of chargers may require electrical upgrades to existing buildings and all utilities must support growth. CARB is coordinating with CEC and CPUC to ensure rural parts of California have access to adequate electrical supplies with regulatory compliance extensions available for unusual circumstances. In the event there are delays beyond fleet owner's control, the Infrastructure Delay Extension can provide more time, up to five years for the utility to make the upgrades.

i) Grid Capacity and Resilience – Estimation of Natural Gas Power Plants Needed

Comment Summary: The commenter states that 1,000 natural gas power plants will need to be built every year for the next 10 years to support the EVs deployed as a result of the ACF Regulation.

Commenter: [020-45d]

Agency Response: No changes were made in response to these comments. The comment suggests that power generation for the electric grid will need to grow exponentially and presumes the demand will be met by natural gas power plants to meet the new demand from the implementation of the ACF Regulation, which is an extreme over estimation and goes against policy objectives. CEC modeled the demand from the Regulation and found that by 2035, medium- and heavy-duty ZEVs will account for about three percent of total electricity demand statewide and less than two percent on peak between 5:00 P.M. and 8:00 P.M.[99] Furthermore, the 2022 Scoping Plan Scenario includes existing natural gas-power plants, along with other renewable and zero-carbon resources selected by the RESOLVE model, to meet increased electricity demand and reliability needs through 2045. Carbon capture and sequestration was included on existing natural gas generation in the electricity sector to achieve 85 percent below 1990 emission levels by 2045 as codified in AB 1279.[100] In addition, in a July 22, 2022, letter from Governor Newsom to Board Chair Liane Randolph, the administration made it clear that State agencies must plan for an energy transition that avoids the need for new natural gas plants to meet our long-term energy goals. For more information, please see the EA RTC, response to Comment Letter 270-10.

j) Grid Capacity and Resilience – Formal Public Agency Agreement Needed for Grid Upgrades

Comment Summary: The commenter requests that CARB enter into a formal arrangement with partner agencies to improve interagency coordination on energy infrastructure. They also ask for timely upgrades to the grid to support ZEVs and suggest that a feasibility study be conducted to determine the costs, potential ratepayer increases, and timeline for completing the upgrades before the Regulation is adopted.

Commenter: [207-45d]

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[99] CEC, CED 2022 Hourly Forecast - CAISO - Planning Scenario, January 2023 (web link: https://efiling.energy.ca.gov/GetDocument.aspx?tn=248359&DocumentContentId=82768, last accessed January 2023).

[100] CARB, 2022 Scoping Plan For Achieving Carbon Neutrality, November 16, 2022 (web link: https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf, last accessed January 2023).

Agency Response: No changes were made in response to these comments. However, CARB, CEC, CPUC, California State Transportation Agency, CTC, Caltrans, GO-Biz, and the Department of General Service signed onto a Statement of Intent which outlines and formalizes the significant coordination already occurring between California's agencies to ensure the demand for charging stations and hydrogen fueling will be met. The principles of cooperation contained in the Statement of Intent include ensuring equity in infrastructure development and deployment, data sharing between agencies, regular and meaningful communication between agencies, joint grant solicitations where feasible and robust engagement with fleets and other stakeholders to the Resolution. CARB has been coordinating planning and feasibility with sister agencies for years.

k) Grid Capacity and Resilience – Link Grid Readiness to Regulatory Requirements

Comment Summary: The commenter states that the ACF ISOR does not recognize the challenges highlighted in the 2022 Scoping Plan and suggests that more coordination is needed among various stakeholders for transportation electrification to be successful. They propose building a mechanism into the ACF Regulation or implementation plan that links grid readiness to regulatory requirements.

Commenter: [207-45d]

Agency Response: No changes were made in response to these comments. As discussed in Chapter I.G. of the ACF ISOR, grid and infrastructure challenges as well as inter-agency coordination are described in detail. The Regulation coordinates with the clean-air goals outlined in the 2022 Scoping Plan and other key planning documents. The ACF Regulation phases in over multiple decades which, when coupled with infrastructure delay provisions, allows sufficient time for any necessary grid upgrades, so no additional mechanisms are required. For an overview of cross-agency collaboration, please see responses to issues raised in section "Grid Capacity and Resilience – Additional Grid Planning and Analysis Needed" in "Infrastructure and Grid concerns" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

l) Grid Capacity and Resilience – Vehicle-to-Grid Technology Concerns

Comment Summary: Commenter states that allowing bidirectional charging, when ZEVs become a power source for the grid when energy availability is low, excuses electric utilities from making the upgrades already needed to their infrastructure; and can interfere with emergency operations if vehicles do not have full charges when needed.

Commenter: [269-45d]

Agency Response: No changes were made in response to these comments. California is strategizing to unlock the vast storage potential of ZEVs through the use of vehicle to electricity load support. Significant work in standards, hardware and software remains to move beyond early demonstration projects and allow the technology to improve grid resiliency. Grid planning efforts do not assume the mandatory use of vehicle to grid technology to support reliable operations or to avoid key infrastructure upgrades, although owners may save significantly by opting to participate in potential programs. In addition to bidirectional strategies, there are other distributed energy technologies and efforts that can improve grid reliability for ZEV chargers, such as microgrids, load management through co-sited storage, on-site renewables, and automated load management software. Availability of time-of-use rates and demand response programs, exploring broader vehicle-to-grid alternatives, and including export capabilities, are additional options to consider. Simple strategies can be deployed to ensure emergency vehicle availability such as keeping higher states of charge even during system peaks or onsite backup generation or energy storage.

m) Infrastructure Availability – General

Comment Summary: The commenters state that the Board must ensure equally accelerated deployment of fueling and charging infrastructure to support reduced emission vehicle mandates. They express concerns about the current insufficient and unreliable infrastructure for ZEVs, emphasizing that there is no place to charge a semi-truck and that the ACF Regulation does not guarantee adequate infrastructure for freight operations. Commenters also mention that infrastructure development can take years to complete and stress the importance of not relying solely on the private sector for infrastructure development.

Commenter: [001-45d, 003-OT1, 004-45d, 004-WT1, 006-45d, 006-WT1, 010-WT1, 011-45d, 011-OT1, 012-WT1, 013-OT1, 014-45d, 016-OT1, 017-OT1, 021-45d, 021-OT1, 025-WT1, 027-45d, 030-45d, 030-WT1, 033-45d, 037-WT1, 038-45d, 039-45d, 041-45d, 042-45d, 049-45d, 051-45d, 052-45d, 057-45d, 059-45d, 061-45d, 068-45d, 069-45d, 070-45d, 075-OT1, 080-OT1, 090-45d, 092-OT1, 103-45d, 105-OT1, 108-45d, 109-45d, 110-45d, 116-OT1, 117-45d, 120-OT1, 124-45d, 125-45d, 125-OT1, 128-45d, 129-45d, 135-45d, 136-45d, 138-45d, 139-45d, 143-45d, 146-45d, 147-45d,148-45d, 150-45d, 152-45d, 153-45d, 155-45d, 157-45d, 157-OT1, 161-45d, 161-OT1, 164-OT1, 167-45d, 168-45d, 175-45d, 179-45d, 184-45d, 188-45d, 189-45d, 190-45d, 191-45d, 194-45d, 197-45d, 198-45d, 204-45d, 207-45d, 223-45d, 227-45d, 228-45d, 230-45d, 232-45d, 239-45d, 243-45d, 246-45d, 249-45d, 251-45d, 253-45d, 255-45d, 256-45d, 258-45d, 259-45d, 265-45d, 268-45d, 270-45d, 272-45d, 279-45d, 281-45d, 282-45d, 283-45d, 284-45d, 288-45d, 295-45d, 301-45d, 302-45d, 304-45d, 308-45d, 320-45d, 322-45d, 323-45d, 324-45d, 330-45d, 331-45d, 335-45d, 339-45d, 342-45d, 347-45d]

Agency Response: Changes were made in response to these comments. Infrastructure delays are accounted for in the Regulation, and additional time and access criteria were provided to account for potential delays in completion of infrastructure installation projects. However, no other changes were made in response to ensuring infrastructure deployments. The Regulation is phased in over 20 years, and CARB is collaborating with other State agencies including CEC, CPUC, and GO-Biz, along with IOUs and POUs to actively plan for this transition. ZEV infrastructure for medium- and heavy-duty vehicles is in fact commercially available today for BEVs and FCEVs and there is no reason ZEV infrastructure should not be deployed by businesses in the same way other fuels are.

There continues to be increasing interest and investment in ZEV charging infrastructure for heavy-duty vehicles across all levels of government and the public, which is critical to the widespread adoption of ZEVs. The federal government recently enacted legislation providing significant support for ZEVs. The IRA of 2022, Pub. L. 117-169, 136 Stat. 1818, 2090 (2022) provides significant tax credits for new and used ZEVs (extending the credit for 10 years for up to $7,500 for new vehicles and adding a credit up to $4,000 for used light-duty vehicles), EV charging infrastructure (up to $1,000 credit for residential installations and up to $30,000 credit for commercial installations), and other support for clean transportation technology. As one1f these two new programs, NEVI provides $5 billion as the first major Federal funding program that focuses on a nationwide development of EV charging infrastructure.

In addition to federal investment, CARB is working in tandem with CEC to invest in the charging infrastructure and technologies needed to transition the on-road mobile source section to ZEV throughout the state through its Clean Transportation Plan. CEC and CARB are also supporting strategic regional planning efforts (i.e., Regional Transportation Plans/Sustainable Communities Strategies) to support adoption of ZEVs. CEC is the primary State agency leading this transition and is building a corridor of conveniently located direct-current fast chargers to allow drivers of ZEVs, including trucks, with the freedom to travel throughout the state. As of December 2022, the State currently supports approximately 80,000 public and shared EV charging stations, including over 8,500 direct-current fast chargers, with additional investments underway to meet the 2025 goal of 250,000 public and shared EV charging stations as directed by Executive Order B-48-18. Pursuant to AB 2127, CEC is required to publish a biennial report on the charging needs of five million ZEVs by 2030 and will adjust the level and degree of investments based on the reports' findings. These efforts have been bolstered by recent legislation, such as AB 2700 that require the state's public electric utilities and private electrical corporations to develop plans to meet the need for ZEVs based on data provided by CEC.

Significant investments have been made to support medium- and heavy-duty vehicles. EnergIIZE, CEC's block grant project for medium- and heavy-duty ZEV infrastructure, provides financial incentives to increase the deployment of commercial ZE medium- and heavy-duty vehicle infrastructure. EnergIIZE representatives have collaborated closely with CARB's on-road vehicle program staff to complement available funding, such as HVIP. Each IOU has medium- and heavy-duty programs to help fund direct-current fast charging stations, including infrastructure on the customer side of the meter and the chargers themselves. Importantly for customers not receiving service through these medium- and heavy-duty programs, each IOU created new ZEV Infrastructure Rules, implemented pursuant to AB 841, that ensure that the cost of upgrades completed on the utility side of the meter will not be borne by the ZEV customer but by all ratepayers. With the ability to fund more off-road and non-road vehicle infrastructure through recent general fund appropriations, CEC staff will begin exploring ways to partner infrastructure funding with other programs, such as CARB's Clean Off-Road Equipment Voucher Incentive Project.

Additionally, CTC is working alongside CEC and other State agencies on SB 671 to determine the five most polluting freight corridors as well as priority freight corridors that would most benefit from ZEV infrastructure. In addition, the Assessment will identify potential freight ZE infrastructure projects, and barriers and recommended solutions related to the transition to ZE freight. The SB 671 Assessment will help guide future funding opportunities to specifically target the priority corridors.

Another resource that will be useful is the Medium- and Heavy-Duty Electric Vehicle Infrastructure Load, Operations and Deployment modeling tool. This tool will analyze where infrastructure should be located based on several factors, such as most used truck routes and vehicle types (agriculture included). Further, CEC has funded medium- and heavy-duty ZEV Blueprint planning grants for numerous industries, including those handling heavy machinery, concrete mixers, and logging materials. Once the blueprints are developed, CEC can take lessons learned from the plans to inform future grant funding opportunities to better meet the needs of those industry sectors. Completed projects will also be eligible for deployment funding under a separate CEC grant funding opportunity.

In addition to these public efforts, private efforts are also underway. For example, OEMs have partnered up with different fueling companies with private investments to install infrastructure across North America. Truck manufacturers have backed up their ZEV production targets with private investment in rolling out infrastructure necessary for the success of these vehicles including the Daimler led team's $650 million for the West Coast, Southeast Coast, and Texas; [101] Volvo's team of their dealerships to create a California charging corridor[102] alongside Pilot/Flying-J to electrify truck stops nationally[103]; Hyundai partnerships to install hydrogen fueling from the San Pedro ports into Texas[104]; and Nikola's initial Southern California hydrogen fueling stations and hydrogen supply agreements as a step toward their a national network[105]. GM has partnered with Pilot/Flying-J to roll out 2,000 cobranded public fast charging points as well[106].

Private investment is creating ZEV infrastructure in California and beyond including public charging, electrified truck stops, depots, and all-inclusive "vehicle-as-a-service" packages

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[101] Daimler Truck Press Release. Daimler Truck North America, NextEra Energy Resources and BlackRock Renewable Power Announce Plans To Accelerate Public Charging Infrastructure For Commercial Vehicles Across The U.S. January 2022. (web link: https://media.daimlertruck.com/marsMediaSite/en/instance/ko/Daimler-Truck-North-America-NextEra-Energy-Resources-and-BlackRock-Renewable-Power-Announce-Plans-To-Accelerate-Public-Charging-Infrastructure-For-Commercial-Vehicles-Across-The-US.xhtml?oid=51874160, last accessed March 2023).

[102] Volvo Press Release. Volvo Trucks Constructing California Electrified Charging Corridor for Medium- and Heavy-Duty Electric Vehicles, July 2022. (weblink: https://www.volvotrucks.us/news-and-stories/press-releases/2022/july/constructing-california-electrified-charging-corridor-for-medium-and-heavy-duty-electric-vehicles/, last accessed March 2023).

[103] Flying J Press Release. Pilot Company and Volvo Group Partner to Build Charging Network for Medium- and Heavy-Duty Electric Trucks (web link: https://pilotflyingj.com/press-release/20462, last accessed March 2023).

[104] Albuquerque Journal. NM to be part of 'clean freight corridor', September 2022 web link: https://www.abqjournal.com/2535134/nm-to-be-part-of-clean-freight-corridor.html, last accessed March 2023).

[105] Forbes. Nikola To Run Hydrogen Production, Fuel Cell Truck Stations Under 'HYLA' Brandy. January 2023 (web link: https://www.forbes.com/sites/alanohnsman/2023/01/25/nikola-to-run-hydrogen-production-fuel-cell-truck-stations-under-hyla-brand/?sh=61bea4c32612, last accessed March 2023).

[106] Flying J Press Release. GM and Pilot Company to Build Out Coast-to-Coast EV Fast Charging Network (web link: https://pilotflyingj.com/press-release/19335, last accessed March 2023).

including examples from Einride[107], Highland Electric[108,109], Prologis[110], TerraWatt's multistate I-10 electrification[111], Thompson Truck Centers[112], Volvo/Mack[113], WattEV[114,115,116], ZEEM[117,118], and others. There are also similar efforts in Europe where examples include a project by a Total/Air Liquide partnership developing a major hydrogen corridor from Benelux port facilities through France and Germany[119] and another project by BP Pulse creating a Rhine-Alpine charging corridor through Germany[120].

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[107] FreightWaves. Einride EV truck network to launch near Port of LA, November 2022. (web link: https://www.freightwaves.com/news/einride-to-build-ev-truck-charging-facility-near-port-of-la, last accessed March 2023).

[108] Electrive.com. Highland Electric Fleets coordinates V2G programme with electric school buses, August 2022 (web link: https://www.electrive.com/2022/08/28/highland-electric-fleets-coordinates-v2g-programme-with-electric-school-buses/, last accessed March 2023).

[109] Daimler Truck Press Release. Highland Electric Fleets and Thomas Built Buses Sign Agreement to Make Electric School Buses an Affordable Option Today, March 2022 (web link: https://northamerica.daimlertruck.com/PressDetail/highland-electric-fleets-and-thomas-built-2022-03-17, last accessed March 2023).

[110] Prologis Press Release. Prologis Announces Major EV Truck Installations in Southern California November 2022 (web link: https://www.prologis.com/news-research/press-releases/prologis-announces-major-ev-truck-installations-southern-california, last accessed March 2023).

[111] Business Wire Press Release. TeraWatt Developing I-10 Electric Corridor, the First Network of Electric Heavy-Duty Charging Centers, October 2022 (web link: https://www.businesswire.com/news/home/20221020005252/en/TeraWatt-Developing-I-10-Electric-Corridor-the-First-Network-of-Electric-Heavy-Duty-Charging-Centers/, last accessed March 2023).

[112] InsideEVs News. Nikola Gets Order For 10 Nikola Tre With An Option For Up To 100, December 2021. (web link: https://insideevs.com/news/556723/nikola-tre-loi-100-trucks/, last accessed March 2023).

[113] Volvo Press Release – North America. Mack Launches Vehicle-as-a-Service (VaaS) Program for Battery Electric Vehicles, February 2022 (web link: https://www.volvogroup.com/en/news-and-media/news/2022/feb/mack-launches-vehicle-as-a-service-vaas-program-for-battery-electric-vehicles.html, last accessed March 2023).

[114] WattEV. WattEV to Provide 20 Zero-Emission Trucks to Major Shipping and Logistics Partner, December 2022(web link: https://www.wattev.com/post/wattev-to-provide-20-zero-emission-trucks-to-major-shipping-and-logistics-partner, last accessed March 2023).

[115] WattEV. WattEV To Electrify TTSI Heavy-Duty Truck Fleet. July 2021 (web link: https://www.wattev.com/post/wattev-to-electrify-ttsi-heavy-duty-truck-fleet, last accessed March 2023).

[116] WattEV. WattEV Breaks Ground on 21st Century Truck Stop, December 2021. (web link: https://www.wattev.com/post/wattev-breaks-ground-on-21st-century-truck-stop, last accessed March 2023).

[117] FleetOwner. Zeem's electric FaaS helps fleet meet customers' zero-emission needs, December 2022 (web link: https://www.fleetowner.com/emissions-efficiency/article/21256088/fleet-finds-ways-to-meet-shippers-zeroemission-needs-with-zeems-ev-fleetasaservice, last accessed March 2023).

[118] Business Wire. Zeem Solutions Launches First Electric Vehicle Transportation-As-A-Service Depot, March 2022(web link: https://www.businesswire.com/news/home/20220330005269/en/Zeem-Solutions-Launches-First-Electric-Vehicle-Transportation-As-A-Service-Depot, last accessed March 2023).

[119] Air Liquide Press Release. Air Liquide and TotalEnergies join forces to develop a network of over 100 hydrogen stations for heavy duty vehicles in Europe, February 2023 (web link: https://www.airliquide.com/group/press-releases-news/2023-02-02/air-liquide-and-totalenergies-join-forces-develop-network-over-100-hydrogen-stations-heavy-duty, last accessed March 2023).

[120] BP Global Press Release. bp pulse builds Europe's first public charging corridor for electric trucks along major logistics route, January 2023 (web link: https://www.bp.com/en/global/corporate/news-and-insights/press-releases/bp-pulse-build-europes-first-public-charging-corridor-for-electric-trucks-along-major-logistics-route.html, last accessed March 2023).

POUs are also investing in EV charging infrastructure. Most notably, the Los Angeles Department of Water and Power has been authorized to spend a maximum of $40 million per fiscal year from 2019 to 2029 to reach 10,000 chargers by 2022; 25,000 by 2025; and 28,000 by 2028.

Finally, new business models are being developed as medium- and heavy-duty vehicle infrastructure begins to roll out through public and private investment. These include:

- Charging as a service: The fleet would pay a monthly or yearly subscription fee to avoid paying the upfront costs of equipment, installation, and permitting. The infrastructure can be either owned by the service provider or the customer.
- Shared revenue: Under this model, the charging company will install the stations for the fleet and take on the costs, then collect the revenue the stations receive from drivers charging their vehicles. This cost and revenue could also be split between the fleet and the ZEV charging contractor.
- Trucking-as-a-service: This model eliminates the upfront costs for fleets. For a monthly or yearly fee, it offers drivers and small fleets access to a service provider's heavy-duty battery-electric trucks and would include charging and maintenance. Drivers would reserve a truck and when ready would use it for their own routes and then return it when finished or upon a low battery. This model also allows a truck to be swapped with a fully charged one while waiting for a full charge on the original vehicle.
- Utility programs: Utilities are offering incentive or rebate programs for EVSE. A typical example would involve the utilities performing a design-build and installation of ZEV infrastructure. These programs usually obtain a commitment from the fleet to operate and maintain the equipment for a certain period, usually ten years, and enroll in time of use rate periods for businesses. This would be similar to a turnkey approach.

n) Infrastructure Availability – Drivers Park Truck at Home

Comment Summary: The commenters state that installing infrastructure for charging is not possible, practical, or cost-effective when drivers take trucks home at the end of the workday and cannot burden drivers with infrastructure responsibilities.

Commenter: [014-OT1, 219-45d]

Agency Response: No changes were made in response to these comments.

As discussed in Chapter VIII.B.5. of the ACF ISOR, non-tractor trucks were assumed to depot charge until 2030 as most of these vehicles have ample opportunity to refuel at a parking lot or depot during downtime. After 2030 as more vehicles transition to ZE, a portion of the non-tractor fleet is assumed to use retail charging to address more variable operations.

Staff recognize it is not uncommon for drivers to take smaller trucks home, which can be fueled with the same chargers as electric cars. Some ZEVs already come with features to track where and how much electricity is used so that employees can be reimbursed. In some cases, there may be some changes in fleet management practices that can optimize ZEV infrastructure location and cost.

Staff disagree with the concept that drivers would be responsible for installing infrastructure at home to fuel a work truck. Staff disagree with the concept that drivers would be responsible for installing infrastructure at home to fuel a work truck. Per the ACF Regulation, the regulatory responsibilities fall on the fleet owner who needs to ensure that their fleet as a whole is in compliance. They have numerous options to ensure access to infrastructure in situations where the vehicle currently returns with the driver to their home including relying on public charging enroute, paying for installation of a charger at the driver's home rather than at the fleet's depot, modifying their operations so vehicles will remain at the fleet's depot, among other options. In addition, staff notes that per analysis in the ACT Regulation, infrastructure installed at homes is typically lower cost than infrastructure at a centralized depot, although there are some tradeoffs including loss of potential LCFS revenue generation.[121] Given the breath of options available to fleets, staff disagrees with the commenter's assertion that infrastructure is not feasible when the when drivers take home or it will be cost prohibitive.

o) Infrastructure Availability – Fast Charging

Comment Summary: The commenters express concerns about the lack of available fast charging infrastructure, stating that direct-current or Level 3 quick charging infrastructure is needed near fleet locations and charging ZEVs will affect their hours of service.

Commenter: [058-45d, 139-45d, 164-45d, 272-45d]

Agency Response: No changes were made in response to these comments. Depot charging for BEVs is the optimal choice for many fleets subject to the Regulation and fleet owners have flexibility in determining which trucks to deploy as ZEVs first. As discussed in Chapter I.G. of the ACF ISOR, conventional fuel suppliers are working with industry to develop fast charging solutions at, or near, truck stops. The Regulation does not distinguish between BEV or fuel cell technologies, and as more of these trucks become available, high-speed hydrogen refueling infrastructure will increasingly be an option with the ability to fill a 70-kilogram tank in seven minutes. Hydrogen station developers are currently adding hydrogen fueling to several retail heavy-duty diesel stations. Efforts are ongoing to provide balanced charging and fueling opportunities for affected fleets. Faster chargers with speeds up to 350 kW are being deployed in the field today and work is underway to develop and demonstrate chargers that exceed one MW, up to 3.75 MW, which would allow even the largest vehicles to recharge in well under an hour and potentially in as little as 20 minutes. PG&E has an EV Fast Charge program that is designed to enable public fast charging and complements State and privately funded initiatives within their territory. The $22 million program runs through 2025 and aims to install approximately 50 plazas for direct-current fast charging in corridor and urban sites. PG&E would pay for and build the infrastructure from the electric grid to the fast-charging equipment.

p) Infrastructure Availability – Leased Facilities

Comment Summary: The commenters state that they lease or rent their facilities and are unable to install charging infrastructure.

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[121] California Air Resources Board, Attachment C: Updated Costs and Benefits Analysis for the Proposed Advanced Clean Trucks Regulation, 2020 (web link: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2019/act2019/30dayattc.pdf, last accessed May 2023).

Commenter: [006-45d, 008-45d, 282-45d, 289-45d, 313-45d, 322-45d]

Agency Response: No changes were made in response to these comments. AB 2565 makes a term in a lease, contract, security instrument, or other instrument affecting the lease of a commercial or residential property void and unenforceable if it prohibits or unreasonably restricts the installation of an EV charging station in a lessee's designated parking space. CARB plans to provide education and outreach to landlords to advise them of the future requirements so they can be prepared. In addition, as more ZEVs are deployed property owners and parking providers will need to support charging installation if they want to retain tenants. CARB continues to meet with warehouse owners regarding the necessity of including charging and fueling infrastructure as an amenity at their warehouses.

q) Infrastructure Availability – Outside of California

Comment Summary: The commenters state that ZEV infrastructure is unavailable outside of California, burdening long-haul out-of-state operations that originate in California.

Commenter: [230-45d, 256-45d, 259-45d]

Agency Response: No changes were made in response to these comments. The commenter incorrectly assumes that the Regulation applies to fleets operated or controlled exclusively outside of California. The ACF Regulation only applies to vehicles that are owned, operated, or directed to operate in California. Notwithstanding that response, the HPF Regulation took into consideration the feasibility of interstate truck operation when establishing the ZEV Milestone Schedule which gives long-haul trucks until 2030 to begin their phase in.

Cross-jurisdictional planning is important for a robust charging system, especially for long-haul vehicles. One example of multi-state planning is the West Coast Clean Transit Corridor Initiative which is an ongoing effort among 16 utilities to support the development of heavy-duty EV charging facilities along Interstate 5 (I-5), from San Diego to British Columbia. Following an initial June 2020 report outlining conceptual charging sites, the west coast utilities are conducting grid readiness assessments in preparation for infrastructure installations and upgrades that will support vehicle charging capacities of at least 3.5 MW. As of June 2020, 27 conceptual charging sites would be located about 50 miles apart along I-5 (and other interstate highways) with a 2025 target for initial station operations. The stations would be primarily suitable for medium-duty trucks with the ability to expand as the market and technology develops. Concurrently, 41 additional sites would be located at similar intervals and expanded in the same manner along arterial highways.

In support of the initiative, Portland General Electric completed the first commercial public charging station designed for medium- and heavy-duty EVs in Portland, Oregon. The site debuted with eight charging stations ready for MW-level charging, which is a rate four times faster than most fast-charging options currently available and capable of recharging a delivery vehicle in as little as 20 minutes.

ZEV infrastructure build out rates are occurring at unprecedented levels due to federal stimulus dollars and private investment. This buildout is occurring across the nation in strategic locations. As one of the new BIL programs, the NEVI Formula Program[122] provides $5 billion as the first major Federal funding program that focuses on a nationwide development of EV charging infrastructure. Although the NEVI Program is geared toward light-duty public charging, pull through access and higher clearance access requirements could allow for larger EVs to utilize the charging stations.

In addition, the Regulation allows for NZEVs to be counted as ZEVs until the 2035 model year and have similar fueling time and access to conventional fuels as ICE vehicles.

r) Infrastructure Availability – Publicly Accessible

Comment Summary: The commenters assert that retail infrastructure is not ready or available in line with the Regulation timeline, suggesting that CARB should develop public infrastructure or delay the Regulation, and include a provision addressing situations with no public or retail infrastructure.

Commenter: [002-WT1, 021-45d, 024-WT1, 026-OT1, 063-45d, 080-OT1, 083-45d, 085-45d, 093-45d, 094-45d, 156-OT1, 167-45d, 170-45d, 207-45d, 253-45d, 282-45d, 286-45d, 289-45d, 313-45d, 322-45d]

Agency Response: No changes were made in response to these comments. CARB does not develop public or private infrastructure and is not the body with the authority to set public infrastructure standards. Long-haul and intrastate trucking operations do have a need for a publicly available charging and hydrogen fuel network. The State has made, and continues to make, significant investments in medium- and heavy-duty ZEV infrastructure, including roughly $2 billion over the past two fiscal years. This includes investments through the EnergIIZE block grant with multiple funding lanes to address various vehicle and vocation segments. Funding opportunities have also supported planning blueprint creation, transit agencies, drayage trucks, public retail stations, and other innovative use cases. Each IOU has a variety of medium- and heavy-duty ZEV programs that can help pay for infrastructure on the customer side of the meter up to and including the chargers themselves. In addition, California seaports and some third-party infrastructure providers are currently developing public retail charging infrastructure. Lastly, fleets that utilize rental vehicles may use depot charging solutions in addition to retail charging buildout this decade.

CARB staff are confident the ACF Regulation targets fleets best suited for electrification while allowing flexibility over a longer time horizon for the more challenging use cases. The ACF Regulation is structured to phase in ZEV deployments where they are best suited to begin accelerating the transition to ZEVs in all truck market segments. This approach also considers infrastructure planning and network development strategies that will complement market expansion. Based on funding availability and efforts already underway by entities to provide retail charging, in addition to the exemptions and extensions provided in the ACF Regulation, fleets already have the flexibility and time needed to address retail infrastructure availability issues.

[122] Federal Highway Administration, U.S. Department of Transportation, National Electric Vehicle Infrastructure Formula Program, 2022 (web link: https://www.federalregister.gov/d/2022-12704, last accessed February 2023).

s) Infrastructure Availability – Rural and Remote Area Accessibility

Comment Summary: The commenters express concerns about the feasibility of ZEV infrastructure installation at facilities with no grid connection, temporary locations like parking lots, or rural areas with limited utility or grid connections. They mention the infeasibility of electric heavy construction rental vehicles at remote sites and the inefficiency of diesel generators for charging, which do not result in emissions reductions. Commenters also raise concerns about potential delays in emergency response times in remote areas and the limited access to required infrastructure for farmers in remote and rural areas.

Commenter: [007-45d, 014-45d, 020-OT1, 054-45d, 058-45d, 060-45d, 063-45d, 080-OT1, 083-45d, 085-45d, 093-45d, 094-45d, 104-45d, 113-OT1, 137-45d, 140-OT1, 167-45d, 219-45d, 239-45d, 304-45d, 322-45d, 339-45d]

Agency Response: Changes were made in response to these comments. Staff developed a ZEV infrastructure site electrification delay provision that extends compliance for fleet owners who are experiencing delays in obtaining grid power to their site due to circumstances outside of their control. A fleet owner may also consider off grid generation and storage solutions, or temporary mobile ZEV fueling options for some of their sites. Grid improvements are urgently being conducted to mitigate risk, including in rural areas. CPUC has directed impacted utilities to implement mitigation strategies during outages. Several examples include creating local community microgrids, incentivizing solar and storage for households with medical needs in designated high fire risk areas, and potentially pre-positioning backup generation equipment such as trailers with full batteries in key locations, like charging hubs.

Private industry is seeing a market for providing dispatchable charging solutions for more remote locations, such as construction sites in rural areas. In mid-2022, General Motors started producing hydrogen fuel cell powered Mobile Power Generators that can be used to fast charge EVs at power ranging from 60 to 600 kW. CAISO also conducts studies on local grid distribution risks that may serve as a resource to know where to target rural resiliency efforts. In addition, CEC has analyzed the availability of public chargers across California. The analysis examined the location and distance vehicle owners would need to travel to publicly charge in time and miles. The ongoing work has a light-duty vehicle focus but there is significant overlap with medium-duty vehicles and serves as foundation for additional study. The ongoing Caltrans truck parking study will also provide valuable insights into rural needs. AB 841 provides that rural projects will not face potentially expensive utility grid upgrade costs for their projects. In addition, the federal infrastructure bill provides significant funding targeted for rural infrastructure that can augment State efforts.

t) Infrastructure Availability – Incentivized Through Regulatory Requirements and Government Agency Coordination

Comment Summary: The commenters state that the Regulation will provide certainty to spur investment in infrastructure for medium- and heavy-duty ZEVs. They acknowledge that fueling or charging infrastructure is a challenge but believe it can be solved with proactive measures from CARB, CEC, CPUC, and other State agencies.

Commenter: [041-OT1, 044-OT1, 122-OT1, 141-OT1, 149-OT1, 297-45d, 316-45d]

Agency Response: No changes were made in response to these comments. The approved Regulation will provide more certainty for investors to support the market for ZEV charging and fueling and recognize coordination is important. Many State agencies are working together to address the growing need for ZE fueling infrastructure in California, with the focus on efforts that will benefit ZE medium- and heavy-duty fleets. These agencies include CARB, GO-Biz, CEC, CPUC, CBSC, IBank, SGC, and Caltrans, where CEC is the primary agency tasked with supporting ZEV fueling infrastructure.

3. Alternative Fuels and Combustion Vehicles

a) Alternative Fuels and Combustion Vehicles – General Comments

Comment Summary: The commenters state that the ACF Regulation should include reduced-emission fuel types and an extended compliance timeline until battery technology advances. They suggest that CARB reevaluate its stance on combustion engines for a diversified energy approach and ensure parity with clean technologies like biofuels. Commenters recommend exempting biofuels and incentivizing carriers to switch to renewable fuels for a seamless transition, as opposed to mandating EVs after 2024. They claim that low or negative CI fuels offer cost-effective GHG reduction options and request a reevaluation of ACF to include interim technologies until 2030 for High Priority Fleet and drayage truck operations.

Commenter: [007-WT1, 025-WT1, 049-45d, 075-OT1, 135-OT1, 146-45d, 241-45d, 256-45d, 282-45d, 284-45d, 350-45d]

Agency Response: No changes were made in response to these comments. The commenter is suggesting an approach that is already included in this Regulation's Legal Baseline and would not achieve any new NOx or GHG emissions reductions. The HD Omnibus Regulation achieves the maximum feasible emissions reductions from ICE engines starting in 2024 and the LCFS Regulation requires the maximum reduction in CI of transportation fuels. CARB cannot double count the same emissions benefits that is already required by Regulation and claim it is achieving something new. This Regulation goes beyond combustion to seek further emissions reductions than existing Regulations and achieves new emissions benefits through the gradual phase-in of proven ZEV technologies beyond those already expected from existing Regulations.

The commenter claims continued use of biofuels in ICE vehicles would result in lower overall costs than the Regulation but fails to realize the true cost of producing biofuels is higher than fossil fuel counterparts. The LCFS requires fuel providers to lower CI of the transportation fuels they sell. The higher costs of producing the fuel are reduced by the credits paid for by fuel suppliers to comply with the Regulation and make the renewable fuel available at a price at the pump that is generally comparable to the conventional fuel counterpart. As discussed in Chapter II.E.1. of the ACF ISOR, particularly Figure 47, ZEVs offer the lowest cost and the greatest emissions benefits compared to both diesel and CNG vehicles. If the actual cost of producing RD or renewable CNG without LCFS credits was added to the analysis for CNG vehicles it would only make their cost even higher and the cost of ZEVs even more favorable. The commenter cannot double count by claiming emissions benefits from renewable fuels that are a result of the LCFS Regulation, and if the commenter wants to claim emissions benefits of using renewable fuel without including it in the LCFS Regulation, then the full costs of producing the renewable fuels needs to be included in the cost analysis.

The Regulation requires increasing numbers of ZEVs over the next two decades which will allow for ZEV technologies to improve and for infrastructure to get built, as well as allow the use of NZEV as defined in the Regulation (until 2035 MY) that can further ease range anxiety and soften the transition from ICE vehicles to ZEV. In the event that a ZEV (or NZEV until 2035) is not available or the fleet owner qualifies for the Daily Usage Exemption, the fleet owner can purchase a new ICE vehicle of any type provided it is certified to California emissions standards.

Together, low-carbon fuels, including hydrogen and electricity, as well as ZEV technologies can achieve a carbon neutral transportation ecosystem. This Regulation is a vehicle emission strategy and is expected to affect the types of transportation fuels in a way that supports CARB's other plans and programs. LCFS is a transportation-fuels performance standard that requires increasingly low carbon fuel alternatives for the types of fuels demanded by California's transportation sector. The LCFS supports both the transition to ZEVs and the decarbonization of legacy ICE vehicles currently on the road. This Regulation also helps support the build-out of California's newest transportation ecosystem, ZEVs that use low carbon fuels including electricity and hydrogen.

b) Alternative Fuels and Combustion Vehicles – Compressed Natural Gas is Cleaner Than Diesel

Comment Summary: The commenter states that CNG would be a good transition alternative while the ZEV tech and infrastructure is being developed, and that they are cleaner than diesel.

Commenter: [029-WT1, 284-45d]

Agency Response: No changes were made in response to these comments. The commenter's assertion that CNG is cleaner than diesel is unsupported by any data and all engines sold in California must be certified to the HD Omnibus standards starting in 2024. The intent of the Regulation is to transition fleets to ZEV consistent with Governor Newsom's Executive Order N-79-20 and to meet public health needs identified in both the State SIP Strategy and the Climate Change Scoping Plan. Please refer to Chapter II.E.1. of the ACF ISOR for a discussion of issues associated with the operations and emissions characteristics of CNG-fueled vehicles. As discussed in Chapter IX.B.8. of the ACF ISOR, the number of Class 2b through 8 CNG vehicles projected for 2025 is relatively small at approximately one percent of California's inventory. Expanding the market for CNG fleets could lead to stranded CNG fueling infrastructure assets as the ZEV market expands and more models become available. Also as stated in Chapter II.E.I. of the ACF ISOR, CNG vehicles operate at a 15 to 20 percent lower fuel economy than their diesel counterparts and after factoring in upstream methane emissions, natural gas trucks are more harmful to the climate than diesel trucks. [123,124] Methane is a powerful GHG, and studies show that less than two percent leakage from

[123] CEC Energy Almanac, Transportation Natural Gas in California, 2016 (web link: https://ww2.energy.ca.gov/almanac/transportation_data/cng-lng.html, last accessed August 2022).

[124] International Council on Clean Transportation, A comparison of NOx emissions from heavy-duty diesel, natural gas, and electric vehicles, 2021 (web link: https://theicct.org/sites/default/files/publications/low-nox-hdvs-compared-sept21.pdf, last accessed August 2022).

pipelines and CNG fueling infrastructure can negate gains from lower tailpipe CO_2 emissions than diesel.

Lastly, the 200 Truck Study is a comprehensive, multi-year, four-phase program, conducted by the University of California at Riverside and West Virginia University who collaborated to test more than 200 heavy-duty vehicles, making it one of the world's largest efforts to test in-use heavy-duty vehicle tailpipe emissions. Data from the 200 Truck Study shows real-world emission data for a number of vehicles certified to the 0.2 g per bp-hr. NOx standard, where refuse diesel vehicles operated slightly above the standard while natural gas diesel trucks were more than 300 percent of the standard.[125] Regardless of the fuel type, combustion-powered vehicles regularly produce emissions above their certified levels. The HD Omnibus rulemaking and HD I/M program will help mitigate this, but ultimately ZEV are the only technology which cannot become high emitters.

c) Alternative Fuels and Combustion Vehicles – Allow Postal Service to use Natural Gas Vehicles

Comment Summary: The commenter suggests the Postal Service has predictable alternative fuel consumption and routes that their service contractors can rely on which makes those infrastructure investments less risky stating that "transportation companies have greater confidence that these alternative fuel trucks can be deployed and their cost recouped over the contract term and have been able to invest in the more expensive trucks that utilize RNG or CNG by financing those costs over multiple years and locking in long-term fuel agreements often at prices lower than the prevailing cost of diesel."

Commenter: [256-45d]

Agency Response: No changes were made in response to these comments. As explained in Chapter IV.A.7(a) of the ACF FSOR, as the master response to cost comments, the TCO including incremental ZEV purchase cost predicts that many businesses will experience net benefits from ownership and operation of ZEVs. It is worth noting that the Postal Service's predictable routes and energy demand can similarly reduce risks associated with developing ZEV infrastructure in the same way as the commenter describes for RNG or CNG.

d) Alternative Fuels and Combustion Vehicles – Allow an "Optional Low NOx" Combustion Vehicle Combusting Biomethane to Count as a "NZEV"

Comment Summary: The commenters state that the proposed Regulations should allow for flexibility, permitting the optional addition of an ICE vehicle meeting the outdated "optional Low NOx" standard while combusting exclusively biomethane, something that they call a "NZEV" in lieu of a ZEV without a sunset provision. They emphasize the importance of the ACF Regulation's implementation, expressing concerns that the current draft might create gaps in achieving its intended goals. The commenters request that existing near-zero-

[125] Leonard et al. January 2023. In-Use Emissions Testing and Activity Profiles for On-Road Heavy-Duty Vehicles: Summary of 200 Heavy-Duty Vehicle Emissions Testing Program from the University of California, Riverside and West Virginia University (web link: https://www.energy.ca.gov/publications/2023/use-emissions-testing-and-activity-profiles-road-heavy-duty-vehicles-summary-200, last accessed March 2023).

emissions carbon negative solutions, such as RNG vehicles, be included in the Regulation as flexibility options. They also suggest that ICE vehicles powered by RNG be considered the same as NZEVs if they meet specific emissions standards. Additionally, they request an early adopter pathway for fleets that have already invested in low-carbon fuels and low-NOx technology.

Commenter: [010-WT1, 034-OT1, 120-45d, 167-45d, 174-45d, 216-45d, 234-45d, 253-45d, 270-45d, 281-45d, 284-45d, 304-45d, 310-45d, 326-45d]

Agency Response: No changes were made in response to these comments. The Board has already adopted the LCFS Regulation to increase the use of low carbon fuels and adopted the HD Omnibus Regulation to maximize the emissions reductions from ICE engines. Together, they result in the most stringent emissions standards for ICE engines and maximize the use of low carbon fuels in such ICE engines. Renewable fuels used in transportation are a result of the LCFS Regulation and cannot be double counted and starting 2024 all engines sold in California will need to meet the emissions standards of the emissions standards most stringent engine standard required due to the HD Omnibus Regulation and cannot be double counted. Staff interprets most commenters usage of the term “NZEV” to refer to an outdated meaning of an ICE vehicle using biomethane with an engine certified to the older “optional low NOx” standard.

As described in Chapter I.F. of the ACF ISOR, NZEVs are defined as vehicles capable of operating as a ZEV for a certain number of miles as established in Title 13, CCR section 1963(c)(16) which count as a ZEV under this Regulation until 2035. Essentially, NZEVs are PHEVs powered by both an ICE and battery-electric powertrain that are capable of operating like a ZEV for a minimum number of miles. The commenters also incorrectly assume that engines certified to the older “optional low NOx” standard would meet the HD Omnibus standard starting in 2024 which is counter to the results of the recent 200 Trucks Study.

The 200 Truck Study found that real-world operational characteristics, such as idle time and duty cycles, as well as deteriorating emission control systems can lead to real-world ICE vehicle emissions that are often much higher than their certification standard. For example, the study found that engines certified to the older “optional low-NOx” standards repeatedly referenced by commenters in fact emit levels of NOx up to 6.5 times higher than the standards while in-use.[126] In contrast, newer 2024 engines certified to California’s HD Omnibus Regulation are anticipated to emit in-use levels of NOx that are at most, 1.5 to two times the certification standard because of the increased stringency of the HD Omnibus Regulation. That Regulation primarily requires new 2024 conventional ICEs to certify to a 0.05 gram of NOx per brake horsepower-hour (g/bhp-hr.) standard and new 2027 and later conventional internal combustion engines to certify to a 0.02 g/bhp-hr. NOx standard. requires engine manufacturers to demonstrate compliance with those standards over substantially longer periods, and to use test methods that more accurately reflect the emissions performance of conventional internal combustion engines in the real world.

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[126] Leonard et al. January 2023. In-Use Emissions Testing and Activity Profiles for On-Road Heavy-Duty Vehicles: Summary of 200 Heavy-Duty Vehicle Emissions Testing Program from the University of California, Riverside and West Virginia University (web link: https://www.energy.ca.gov/publications/2023/use-emissions-testing-and-activity-profiles-road-heavy-duty-vehicles-summary-200, last accessed March 2023).

Specifically, the HD Omnibus Regulation establishes emissions standards measured over test conditions that reflect sustained engine operations at low engine loads, such as engine idling, where conventional engines, such as the engines mentioned by the commenters, are least able to control NOx emissions.

Furthermore, any low carbon fuels, such as RNG, which are produced and sold because of the LCFS Regulation would not result in new emissions benefits by including these fuels in the Regulation. The LCFS sets a statewide declining target to reduce the CI of transportation fuels by 20 percent by 2030. The emissions benefits associated with the LCFS Regulation have already been accounted for in the regulatory baseline. When estimating the benefits of the LCFS Regulation and its amendments, staff recognized that the LCFS Regulation by itself would not be sufficient to encourage manufacturers to begin producing ZEVs because it would mean manufacturers would need to switch to a new vehicle propulsion technology and a new fuel ecosystem rather than continue with status quo.

e) Alternative Fuels and Combustion Vehicles – Require "Optional Low NOx" Combustion Vehicles Combusting Biomethane When Zero-Emission Vehicles Are Not Available

Comment Summary: The commenters urge CARB to reevaluate its assessments and support of alternative fuels as a transitional solution when ZEVs are inadequate or unavailable. They advocate for embracing diverse technology options to achieve early emissions reductions and recommend that ACF consider alternative compliance options like natural gas/RNG vehicles during the transition to ZEVs.

Commenter: [015-WT1, 167-45d, 216-45d, 261-45d, 329-45d, 342-45d]

Agency Response: Changes were made in response to these comments. Alternative fuel engines and renewable fuels that are a result of the LCFS Regulation are already part of the baseline and do not result in any new emissions benefits. The 15-day modifications to the Regulation now require any new ICE vehicle purchased under the ZEV Purchase and Daily Use Exemptions to be certified to California's emissions standards and emissions related requirements. This means regulated fleets would not be able to purchase higher emitting federally certified engines to operate in their California fleet if granted exemptions. Starting 2024, California standards are the lowest emissions feasible for ICE vehicles due to the HD Omnibus Regulation. This means that fleet owners can purchase an alternative fueled vehicle if it meets the standards when granted these exemptions. Furthermore, the Board approved the Waste and Wastewater Fleet Option for vehicles using biomethane in a narrow extension for qualified fleets even though no new emissions benefits can be claimed by the use of biomethane, and the change would result in fewer NOx and GHG benefits from these vehicles.

Furthermore, any low carbon fuels, such as RNG, which are produced and sold because of the LCFS Regulation would not result in new emissions benefits by including these fuels in the Regulation. The LCFS sets a statewide declining target to reduce the CI of transportation fuels by 20 percent by 2030. The emissions benefits associated with the LCFS Regulation have already been accounted for in the regulatory baseline. When estimating the benefits of the LCFS Regulation and its amendments, staff recognized that the LCFS Regulation by itself would not be sufficient to encourage manufacturers to begin producing ZEV because it would mean manufacturers would need to switch to a new vehicle propulsion technology and a new fuel ecosystem rather than continue with status quo.

f) Alternative Fuels and Combustion Vehicles – Low Carbon Intensity Fuels (General)

Comment Summary: The commenters emphasize the potential benefits of renewable fuels, such as biofuels from organic waste, RD, biodiesel, and RNG, for achieving lower CI and faster GHG reductions than battery-electric and hydrogen vehicles. They highlight that these fuels can leverage existing infrastructure and offer greater consumer choice, while also suggesting that using biogas generated from waste and wastewater fleets could lead to greater emissions reductions than ZEVs.

Commenter: 167-45d, 216-45d, 253-45d, 259-45d, 264-45d, 321-45d]

Agency Response: No changes were made in response to these comments. The board already adopted the LCFS Regulation to increase the use of low carbon fuels and adopted the HD Omnibus Regulation to maximize the emissions reductions from ICE engines. Together, they result in the most stringent emissions standards for ICE engines and maximize the use of low carbon fuels in such engines. Together, they result in the most stringent emissions standards for ICE engines and maximize the use of low carbon fuels in such engines.

The LCFS Regulation already requires low carbon transportation fuels and is the reason these fuels are cost competitive at the pump. The GHG emission benefits of renewable fuels resulting from resulting from the LCFS Regulation cannot be double counted as achieving something new. Although low CI fuels are highly valued in the LCFS market, these fuels do not achieve any more reductions than meeting the statewide benchmark. CARB's LCFS Regulation requires fuel producers and importers to reduce the average statewide CI of transportation fuels and includes a credit mechanism to provide flexibility to regulated parties to meet the applicable standards. In this way, the LCFS Regulation is already working to reduce lifecycle GHG emissions from transportation fuels as commenters note and would not generate additional GHG reductions. RD and biodiesel blends used in ICE engines continue to emit criteria pollutants where ZEVs do not. On the other hand, increasing ZEV deployment will result in eliminating tail pipe pollution, will achieve new GHG reductions, and will reduce total energy use due to their greater efficiency.

As discussed in Chapter II.D of the ACF ISOR, low-carbon fuels are important in the transition to carbon neutrality, but their supply is limited, and they will be increasingly directed towards other end uses and as a feedstock for hydrogen. The development of the average blend of biofuels and biogas in fossil diesel, gasoline, and natural gas based on current policies and projected supply was analyzed and, due to a number of factors, including competing demand from other sectors and high cost of production, researchers found it is not feasible to supply sufficient low-carbon biofuels such as residues and waste-based biodiesel, ethanol, or biomethane to substantially displace fossil fuels in combustion engine cars.[127] As discussed

[127] Bieker, George. A Global Comparison of the Life-Cycle Greenhouse Gas Emissions of Combustion Engine and Electric Passenger Cars. 2021 (web link: https://theicct.org/publication/a-global-comparison-of-the-life-

in the 2022 Scoping Plan, these limited supplies will be increasingly directed towards harder to decarbonize sectors and to other end uses besides transportation, which will reduce the available supply for on-road transportation.[128] For a full discussion on lifecycle emissions, please see the EA RTC, Master Response 4 and response to Comment Letter 270-4. The primary focus of this Regulation is to transition to ZE for the medium- and heavy-duty on-road sector, because requirements improving the emissions performance of ICE vehicles is already being achieved through the HD Omnibus Regulation and the LCFS Regulation.

g) Alternative Fuels and Combustion Vehicles – Treat Renewable Natural Gas Vehicles as Zero-Emissions Vehicles

Comment Summary: The commenters state that California's future fleet policies should include natural gas and RNG technologies for their potential to reduce emissions and diversify energy options. They argue that the solid waste industry, which already has a large percentage of natural gas vehicles, should be allowed alternative compliance pathways using RNG. They highlight RNG's net positive environmental impact, as it removes more carbon dioxide than it emits, and suggest that RNG-powered trucks should be treated as ZEVs when suitable ZEV options are unavailable. They also note that public infrastructure for RNG is already in place for CNG vehicles, which could eliminate the need for diesel trucks. The commenters emphasize the need for flexibility to focus on market-ready technologies, such as RNG, and request an assessment of the CI and lifetime emissions of bridge technologies like RNG to achieve near-term greenhouse gas emissions reductions.

Commenter: [007-WT1, 010-WT1, 033-OT1, 078-OT1, 114-45d, 167-45d, 175-45d, 216-45d, 223-45d, 241-45d, 253-45d, 261-45d, 280-45d, 281-45d]

Agency Response: Changes were made in response to these comments. The waste and wastewater provision gives some fleets more time to use biomethane in their existing CNG vehicles. The commenter asserts there would be emissions benefits realized by including natural gas and RNG technology in the ACF Regulation; however, the Board already adopted the LCFS Regulation to increase the use of low carbon fuels and adopted the HD Omnibus Regulation to maximize the emissions reductions from ICE engines including alternative fuel engines. Together, they result in the most stringent emissions standards for ICE engines and maximize the use of low carbon fuels in such engines. Together, they result in the most stringent emissions standards for ICEs and maximize the use of low carbon fuels in such engines. The benefits of these existing Regulations are part of the baseline and cannot be double counted. Therefore, natural gas and RNG technologies would not result in any additional emissions benefits from inclusion in the ACF Regulation.

It would not be appropriate to count RNG-fueled vehicles as ZEVs because such vehicles have tailpipe emissions, cannot meet the definition of ZEVs, and are consequently not equivalent to ZEVs. It would not be appropriate to count RNG-fueled vehicles as ZEVs because such vehicles have tailpipe emissions, cannot meet the definition of ZEVs, and are

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cycle-greenhouse-gas-emissions-of-combustion-engine-and-electric-passenger-cars/, last accessed January 2023).

[128] CARB, 2022 Scoping Plan For Achieving Carbon Neutrality, November 16, 2022 (web link: https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf, last accessed January 2023).

consequently not equivalent to ZEVs. The Regulation already considers alternative fuel engines as a compliance strategy when exemptions are granted to purchase ICE vehicles.

Biomethane with negative CI scores is limited to dairy/swine manure facilities and in some cases biomethane-derived from the anaerobic digestion of organic waste; those facilities capture methane that would otherwise be released into the atmosphere. Although low-CI biomethane is available, this fuel is fungible and can be directed towards other sectors or end-uses. As discussed in Chapter II.D.1. of the ACF ISOR, California has the potential to produce approximately 90.6 billion cubic feet per year of biomethane from dairy, landfill, municipal solid waste, and wastewater treatment facility sources[129] which represents only four to five percent of California's total annual consumption[130]. Although renewable biomethane will continue to play a role in some fleets and for legacy vehicles, the 2022 Scoping Plan shows these limited biofuels will need to be directed towards harder to decarbonize sectors such as existing buildings and for industrial processes that require high heat; or can be used in the transportation sector as hydrogen for FCEV and electricity for BEVs.

Staff disagrees with the commenter's assertion that new infrastructure would not be required if the CNG vehicle fleet was expanded. As explained in Chapter IX.B.8. of the ACF ISOR, California's CNG truck population is relatively small at about one percent of California's heavy-duty sector and the infrastructure built for this small number of vehicles is not expansive. Any significant increase in CNG trucks would require expanding CNG fueling infrastructure. Any newly installed infrastructure would not be able to be fully utilized in its economic life as the fleet transitions to ZEVs, which would result in stranded assets and higher costs for no benefits.

h) Alternative Fuels and Combustion Vehicles – Low Carbon Intensity Fuels (Renewable Diesel)

Comment Summary: The commenters state that California's future fleet policies should include advanced diesel, ICE technologies, and renewable fuels, such as RD and biodiesel blends, as they offer near-zero-emissions while utilizing renewable biofuels. They argue that these technologies provide greater emissions reductions and leverage existing infrastructure compared to EVs. The commenters request flexibility when using RD, highlighting its immediate advantages, and request the inclusion of diverse technologies in the proposed ACF Regulation to assist California in reaching its emissions reduction objectives. The commenters state that when using 100 percent RD, diesel vehicles of all model-years can provide up to six times more GHG emissions reductions than medium- and heavy-duty EVs powered by U.S. grid average electricity.

Commenter: [007-WT1, 010-WT1, 022-WT1, 091-45d, 146-45d, 148-OT1, 211-45d, 223-45d, 241-45d, 259-45d, 264-45d, 284-45d, 303-45d]

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[129] STEPS Program UC Davis, Jaffee et al. "The Feasibility of Renewable Natural Gas as a Large-Scale, Low Carbon Substitute Contract No. 13-307, 2016 (web link: https://ww2.arb.ca.gov/sites/default/files/classic/research/apr/past/13-307.pdf, last accessed August 2022).

[130] US EIA website on data for natural gas consumption by end use. (web link: https://www.eia.gov/dnav/ng/ng_cons_sum_dcu_SCA_a.htm, last accessed August 2022).

Agency Response: No changes were made in response to these comments. The board already adopted the LCFS Regulation to increase the use of low carbon fuels and adopted the HD Omnibus Regulation to maximize the emissions reductions from ICE engines. Together, they result in the most stringent emissions standards for ICE engines and maximize the use of low carbon fuels in such engines. Together, they result in the most stringent emissions standards for ICE engines and maximize the use of low carbon fuels in such engines. The benefits of these existing Regulations are part of the baseline and cannot be double counted.

Fueling with 100 percent RD can only be guaranteed for unique situations, such as on-site fueling or when delivered directly to customers. Although, low CI fuels are highly valued in the LCFS market, these fuels do not achieve any more reductions than meeting the statewide benchmark. Comparing the grid-average CI to the statewide declining CI benchmark for diesel fuel is more appropriate for a statewide Regulation. The 2023 LCFS benchmark for diesel fuel is 89 gCO_2e/MJ and the average CI in California for grid electricity used as a transportation fuel is 81 gCO_2e/MJ.[131] This means that electricity as a transportation fuel is already cleaner than diesel on a MJ-to-MJ basis. Additionally, BEV are three to four times more efficient at putting the MJ to work than equivalent ICE vehicles,[132] therefore a BEV emits even less GHGs on a fuel cycle basis than an equivalent ICE vehicle running on diesel. Regardless, the combustion of biofuel still emits toxic pollution which causes cancer, premature death and has other adverse health impacts.[133,134] Furthermore, the 2022 Scoping Plan assumes RD from fats, oils and greases, if held constant at the total, presently announced in-state refining capacity will cap out at approximately two billion gallons well below the current demand and barely meeting the post ACF demand from the medium- and heavy-duty sectors.[135,136] Furthermore, these renewable fuel supplies will be increasingly directed towards harder to decarbonize sectors and to other end uses besides transportation, which will reduce the available supply for on-road transportation.[137]

[131] California Air Resources Board. 2023 Carbon Intensity Values for California Average Grid Electricity Used as a Transportation Fuel in California and Electricity Supplied Under the Smart Charging or Smart Electrolysis Provision (web link: https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/fuelpathways/comments/tier2/2023_elec_update.pdf, last accessed March 2023).

[132] California Air Resources Board, LCFS Guidance 20-04 Requesting EER-Adjusted Carbon Intensity Using a Tier 2 Pathway Application Energy Efficiency Ratio, 2020 (web link: https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/guidance/lcfsguidance_20-04.pdf, last accessed January 2022).

[133] Environmental Science & Technology, *Ambient and Emission Trends of Toxic Air Contaminants in California*, 2015 (web link: https://pubs.acs.org/doi/full/10.1021/acs.est.5b02766, last accessed May 2022).

[134] California Air Resources Board, *Overview: Diesel Exhaust & Health | California Air Resources Board*, (web link: https://ww2.arb.ca.gov/resources/overview-diesel-exhaust-and-health, last accessed March 2022).

[135] CARB, 2022 Scoping Plan For Achieving Carbon Neutrality, November 16, 2022 (web link: https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf, last accessed January 2023).

[136] CARB, Updated Advanced Clean Fleets Inventory Analysis, 2023

[137] CARB, 2022 Scoping Plan For Achieving Carbon Neutrality, November 16, 2022 (web link: https://ww2.arb.ca.gov/sites/default/files/2022-08/2022_State_SIP_Strategy.pdf, last accessed January 2023).

i) Alternative Fuels and Combustion Vehicles – Low Carbon Intensity Fuels (Renewable Propane)

Comment Summary: The commenters state that the proposed amendments focus on electricity as the sole low-carbon fuel for ZEVs, overlooking other viable options including renewable propane, which has a lower CI than grid electricity for transportation. They emphasize that low-carbon alternatives like propane are readily available for straight truck operations without additional vehicle modifications, while a ZEV fleet would require adjustments due to charging times.

Commenter: [055-45d, 256-45d]

Agency Response: No changes were made in response to these comments. The Board already adopted the LCFS Regulation to increase the use of low carbon fuels and adopted the HD Omnibus Regulation to maximize the emissions reductions from ICE engines. Together, they result in the most stringent emissions standards for ICE engines and maximize the use of low carbon fuels in such engines. The benefits of these existing Regulations are part of the Regulation's Legal Baseline and cannot be double counted. Although, low CI fuels are highly valued in the LCFS market, these fuels do not achieve any more reductions than meeting the statewide benchmark. Also explained in the general response, the cost to produce low CI fuels is reduced by LCFS and Federal Renewable Fuel Standard incentives creating a false sense of affordability.

The CI for renewable propane is around 30 gCO_2e/MJ which is lower than for grid electricity used as a transportation fuel. However, for the same reasons explained in the general response on low CI fuels, the cost to produce and the quantity of available feedstocks to produce renewable fuels, makes a full transition to low CI fuels infeasible. California's electrical power is generated from natural gas, hydroelectric, and renewable energy sources, with the latter increasingly making up larger portions due to California's Renewable Portfolio Standard and SB 100. Over time California's grid should continue to decarbonize, as mandated. Finally, BEVs are three to four times more efficient at putting the MJ to work than equivalent ICE vehicles.

The commenter notes that a ZEV fleet would require adjustments due to charging times. This Regulation is structured to phase-in the most feasible fleets to ZE first, such as those that return to a depot to charge overnight thus charging needs can be met with a minor adjustment — to plug the vehicle in overnight. Over time as more ZEV public infrastructure is available, then longer mileage trucks will be required to make their switch to ZE. Furthermore, FCEVs allow utilizing the same fueling patterns as ICE vehicles. Furthermore, FCEVs allow utilizing the same fueling patterns as ICE vehicles.

j) Alternative Fuels and Combustion Vehicles – Low Carbon Intensity Fuels (Renewable Hydrogen)

Comment Summary: Commenter states that ACF should allow for compliance with H2ICE in commercial trucking as it is a viable option in some vocations where current BEV technology is not feasible. They advocate for embracing diverse technology options to achieve early emissions reductions and recommend that ACF consider alternative compliance options like hydrogen blended fuel in ICE vehicles during the transition to ZEVs. The commenter suggests that CARB should include transitional technologies like H2ICE and e-fuels in the Regulation to help bridge the transition until ZEV technology is feasible.

Commenter: [010-WT1, 075-OT1, 135-OT1, 217-45d, 234-45d, 241-45d, 248-45d, 329-45d, 342-45d, 349-45d]

Agency Response: No changes were made in response to these comments. The board already adopted the LCFS Regulation to increase the use of low carbon fuels and adopted the HD Omnibus Regulation to maximize the emissions reductions from ICE engines. Together, they result in the most stringent emissions standards for ICE engines and maximize the use of low carbon fuels in such engines. Together, they result in the most stringent emissions standards for ICE engines and maximize the use of low carbon fuels in such engines. The benefits of these existing Regulations are part of the baseline and cannot be double counted.

The LCFS Regulation has a provision that allows for "capacity credits" which help bridge the increasing demand for hydrogen during the transition from ICE vehicles to FCEV. ZEVs are already feasible and available as explained in the section on ZEV technology. Further, H2ICE are not bridging technologies, they are ICE vehicles burning alternative fuels. H2ICE vehicles would be covered under the HD Omnibus Regulation and can be used for compliance with that rule. Also, these vehicles can be purchased by fleets covered in this rule when ZEVs are unavailable or do not meet a fleet's daily usage needs, or if the fleet is meeting their Milestone Schedule if they opted into that compliance pathway. This is assuming the H2ICE can meet the standards to be California certified ICE engines, or when fleet owners using the ZEV Milestones Option purchase used or new ICE vehicles subject to the ICE Vehicle Additions requirements of HPF Regulation.

Also discussed in Chapter I.F. of the ACF ISOR, NZEVs are defined as vehicles capable of operating as a ZEV for a certain number of miles as established in title 13, CCR section 1963(c)(16). Essentially, these vehicles are PHEVs powered by both an ICE and battery-electric powertrain that are capable of operating like a ZEV for a limited time. NZEVs are considered a bridge technology, which will assist in the development of the full ZEV market as they have the same electric drivetrain components and can help with range anxiety while ZEV fueling and charging infrastructure is built out.

k) Alternative Fuels and Combustion Vehicles – Overreliance on Fuel Cell Vehicles

Comment Summary: The commenter refers to figure ES-2 in the CARB report "2022 Annual Evaluation of Fuel Cell Electric Vehicle Deployment and Hydrogen Fuel Station Network Development" Annual Evaluation which forecasts new station development leveling off after 2028 and this is justification to allow for H2ICE vehicles. These projections indicate a critical need to ease overreliance on FCEV as an effective alternative to BEVs after 2028.

Commenter: [234-45d]

Agency Response: No changes were made in response to these comments. Staff disagree that FCEVs are over-relied upon. Staff analysis in the ACF ISOR and SRIA is a reasonable estimate of potential outcomes of BEV and FCEV deployment and is not a forecast. ZEVs are treated equally in the Regulation and over time the market will adjust as conditions change. Staff analysis was informed by the LER data which showed most non-tractors drive less than 100 miles in a single day, and most day cab tractors drive less than 200 miles per day. FCEVs are already commercially available with similar fueling times and range as ICE vehicles. BEV tractors are also available that have recently demonstrated 500 miles of range on a single charge. Staff expect both technologies to have a role, but the market will ultimately determine what proportion of the fleet is NZEV, BEV, or FCEV.

The report the commenter references does not reflect the requirements of the ACF Regulation and does not factor in other state's adoption of the ACT Regulation, and is focused on light-duty ZEV deployments. Also, the report and figure cited by the commenter to support their claim is a snapshot of AB 8 which requires CEC to co-fund the development of hydrogen fueling stations until there are at least 100 stations operating in the state. CEC surpassed this goal by committing funding as early as 2020 to more than 150 stations through the AB 8 program, with the milestone of 100 stations projected to be achieved by 2024. These stations are rated for dispensing hydrogen into 10kg or smaller hydrogen tanks, which are more than adequate for a smaller truck. These developments will also build the hydrogen ecosystem for medium- and heavy-duty vehicles by expanding the generation, transportation, and distribution networks for hydrogen. As more manufacturers bring larger FCEV products to market, demand for medium- and heavy-duty stations will grow as well. Although successful, this program only represents a small window and snapshot in time, not an entire picture or projection for hydrogen station buildout. Over time the buildout of ZEV infrastructure is expected to keep pace with expected ZEV deployments to meet the needs of the market as it grows.

l) Alternative Fuels and Combustion Vehicles – Workforce Transition Support

Comment Summary: The commenter suggests including lower-emitting combustion technologies in ACF to ensure a more inclusive workforce during California's transition to ZE. They emphasize the importance of transitional technologies that leverage ICE technology, utilizing existing skill sets in the workforce trained to maintain fossil fuel engines. The commenter contends that low-emissions ICE technologies can serve as a steppingstone for both application demands and workforce retraining and reskilling, allowing skill sets to catch up to electricity and hydrogen needs.

Commenter: [014-45d]

Agency Response: No changes were made in response to these comments. ICE engines and the workforce that currently support them would not gain any knowledge or experience with electric drivetrains or their supply chains by continuing to service ICE vehicles. As explained in the Chapter I.F. of the ACF ISOR, NZEVs as defined in the Regulation are considered a bridge technology, which will assist in the development of the full ZEV market as they have the same electric drivetrain components. These vehicles provide flexibility to meet applications that are not currently well-suited for full ZEVs and promote the development of ZE component supply chains, training, and education as well as provide an opportunity for fleets to gain experience with electric drivetrains without range anxiety. Furthermore, the transition to ZE is over two decades which is ample time to finish out a career in the ICE vehicle maintenance field. Lastly, even after full implementation of the Regulation there will still be about half of California's medium- to heavy-duty fleet using ICE technologies. Transitional technologies that utilize ICE technology are redundant and unnecessary.

Important to note, CARB staff are also working closely with several State agencies, such as CEC and the California Workforce Development Board, on how to not only advance workforce training and development in our existing projects, but to also identify gaps and collaborate on focus areas to enhance training and career pathways. For example, CARB is working closely with the CEC through an interagency agreement ($1-2M) to implement a total of 14 small and large ZEV training programs throughout the state that broadly support various types of ZEV and infrastructure training programs and technologies. Seven of these projects help support the heavy-duty sector by offering training opportunities and upskilling in ZEV technologies, commercial licensing and logistics jobs, transit and school bus technologies, operations and deployment of a changing infrastructure, and servicing alternative fuel vehicles. To date, CARB has carved out a total of $4.575 million investment funding specifically for workforce training and development programs: One effort is the development of an Adult Education and Vocation Schools ZEV Training Solicitation ($1.5M) which offers funding to support or expand existing ZEV trainings and programs in adult education and vocational schools to train low income/disadvantaged community residents in clean transportation principles and applications and to strengthen or develop ZEV and infrastructure curriculum. There are potential opportunities for heavy-duty ZEV training, funding, and partnerships through this effort. Funding has also been carved out to develop new or expand an existing pre-apprenticeship program through an interagency agreement with CEC ($1.075M). The objective is to provide skill-building opportunities and pathways to clean transportation jobs, including supporting high-road job training principles, expanding on-the-job skills, and connecting students to paid apprenticeship and other jobs opportunities that tie into the heavy-duty sector. There are potential opportunities for transit funding, training, and partnerships through the CARB/CEC IAA for this effort.

m) Alternative Fuels and Combustion Vehicles – Rule Conflicts with Organic Waste Diversion

Comment Summary: Commenter states this technology forcing Regulation creates conflict with public agencies and their ratepayers that faithfully invested in statutory compliance to mitigate methane and divert organics from landfills, or SB 1383. The commenters request that in relation to fleets implementing SB 1383, consideration should be given to all fleets involved in the provision of these services.

Commenter: [024-OT1, 180-45d, 207-45d, 253-45d, 280-45d, 292-45d, 304-45d, 309-45d, 310-45d, 321-45d, 326-45d]

Agency Response: A change was made in response to these comments. However, staff disagrees with the comment that the Regulation conflicts with SB 1383 for the same reasons as discussed in Chapter II.D.1. of the ACF ISOR. SB 1383 establishes, among other things, a statewide organic-waste diversion target of 75 percent reduction of landfilled organic waste by 2025, when compared to 2014-levels. SB 1383 does not require the use of biomethane to fuel combustion vehicles. Since the Staff Report was released, the Board provided direction for staff to recognize the statutory compliance obligations for some waste and wastewater fleets to mitigate harmful methane emissions by diverting organics from landfills, and to provide more time for these fleet's transition to ZEV. Although organic diversion can be interpreted more broadly to include agricultural and forestry waste, staff's interpretation and the Board's direction was to focus on those fleets involved in diverting organics to facilities that have invested in anaerobic digestion technologies, such as those at wastewater treatment facilities or stand-alone digesters. The Regulation was modified to include new provision that allows waste and wastewater fleets to delay their ZEV transition until 2030 for existing CNG vehicles operating exclusively on biomethane, thus giving more time to transition biomethane production to other hard to decarbonize sector or to produce hydrogen for FCEVs.

n) Alternative Fuels and Combustion Vehicles – Support Biomethane Market

Comment Summary: Commenter states support for the use of biogas as a renewable source of fuel for vehicles and equipment in California. They suggest that CARB should incentivize the use of low-carbon fuels from organic waste to meet the requirements of various plans such as SB 1383 and Forest Carbon Plan. The commenter requests CARB recognize the investment made by early adopters of low-NOx technology, specifically SB 1383 fleets. The commenter recommends delayed implementation and availability for SB 1383 fleets and other early adopters. They propose that CARB recognize biomethane from wastewater facilities as a renewable source of fuel for transportation purposes**.** The commenter also recommends that CARB support expanding the use of RNG to replace diesel vehicles as part of ACF.

Commenter: [072-OT1, 078-OT1, 079-OT1, 109-OT1, 121-OT1, 158-OT1, 167-45d, 304-45d]

Agency Response: Changes were made in response to these comments. The Board approved a change to add a waste and wastewater provision that allows additional time for fleets that are using biomethane in their trucks additional time for the biomethane to be directed to hard-to-decarbonize sectors or to produce hydrogen for use in FCEVs which aligns with the Scoping Plan and SB 1440.

The California biomethane market needs to be expanded but not at the expense of deploying ZEVs where feasible. ZEVs using low-carbon fuels are the most effective way to reduce emissions from the transportation sector. Most of the biomethane used in California's transportation sector is not produced from California-sourced municipal organic waste and California's market for biomethane in transportation fuels is saturated. Biomethane is used in the transportation sector mainly because of the LCFS and federal Renewable Fuel Standard. Biomethane is unlikely to be cost competitive with fossil gas without programs like the LCFS. The current incentive structure has supported methane reduction projects both in California and throughout the United States, and there is a need to continue to incentivize deployment of these projects, particularly this decade. Producing hydrogen from the biomethane is a proven technology that can optimize both objectives, incentivizing methane capture and powering ZEV. Finally, the potential to create low carbon fuels from California's organic waste products is limited and these fuels will increasingly be directed towards harder to decarbonize sectors than over the road transportation.[138]

Staff are also mindful of the importance of backsliding on GHG reductions. It is anticipated that while biomethane demand in the transportation sector is expected to decline over time, biomethane can displace fossil fuels in other sectors on the path to carbon neutrality. Also recognizing that biomethane can still play a key role as a feedstock for hydrogen production used in future transportation ecosystems.

Although outside the scope of this Regulation, changes are being proposed for the LCFS Amendments which is a separate rulemaking that could align the deliverability requirements of biomethane with those of other fuels in the program.

4. Emissions Inventory Issues

a) Emissions Inventory – Methodology Comments

Comment Summary: The commenters state the electricity to power ZEVs must also be ZE and have concerns about transferring emissions from mobile to stationary sources. The commenters claim that ZEVs do not reduce carbon emissions because power grids rely on carbon-based fuels.

Commenter: [059-45d, 135-OT1, 202-45d]

Agency Response: No changes were made in response to these comments. Actions to reduce emissions from all sectors of the economy, not only the transportation sector, will need to occur to meet targets called for in CARB’s SIP and Scoping Plan. California’s electrical power is generated from natural gas, hydroelectric, and renewable energy sources, with the latter increasingly making up larger portions due to California’s Renewable Portfolio Standard and SB 100, which over time will become increasingly decarbonized. Furthermore, ZE technologies, including ZEVs, are more efficient than combustion technologies and will be increasingly put to work to drive down carbon emissions across all economic sectors on our path towards climate neutrality. ICE vehicles, in contrast, are considerably less efficient, can become high emitters, and their emissions tend to increase with age.

For more information on the environmental analysis, please refer to the Final EA, Chapter 4.0, Section B, Impact 6-2: Long-Term Operational-Related Impacts on Energy Demand for more information.

b) Emissions Inventory – Upstream Emissions

Comment Summary: The commenters argue that the emissions inventory doesn't address upstream emissions impacts or lifecycle emissions of heavy-duty vehicles, rendering CARB's analysis inadequate. They urge CARB to perform a lifecycle emissions analysis on ZEVs compared to conventional fuels and criticize the EA for failing to assess battery-electric and FCEVs' total emissions. They cite a study that concludes biomethane has the lowest GHG

[138] CARB, 2022 Scoping Plan For Achieving Carbon Neutrality, November 16, 2022. (web link: *https://ww2.arb.ca.gov/sites/default/files/2022-12/2022-sp.pdf*, last accessed March 2023).

emissions and advocate for a full lifecycle analysis of all emissions associated with covered transportation fuels.

Commenter: [167-45d, 241-45d, 253-45d, 259-45d, 270-45d, 281-45d, 282-45d, 290-45d, 319-45d, 334-45d, 349-45d]

Agency Response: No changes were made in response to these comments. CARB has fulfilled its statutory obligations by conducting a full and robust EA, which included evaluations of upstream fuel cycle emissions, lifecycle emissions, low-carbon fuels, BEV and battery production, and electricity generation. Furthermore, California has a number of separate requirements on transportation fuel production and feedstock collection to reduce upstream emission impacts. Additional information on lifecycle emissions analysis on ZEVs compared to liquid fuels is provided in Chapter IV.3. of this FSOR. For more information on lifecycle analysis and upstream emissions see CEQA EA Master Response 4 and RTC 270-4.

c) Particulate Matter Emissions from Tire Wear

Comment Summary: The commenters suggest that the Regulation focuses primarily on tailpipe emissions without considering tire wear emissions, which are reportedly 400 times greater than real-world tailpipe emissions. They express concern about the worsening situation with EVs due to their increased weight.

Commenter: [028-OT1]

Agency Response: No changes were made in response to these comments. This comment is addressed in the EA RTC, response to Comment Letter 48-2.

5. Additional/Alternative Analysis Issues

a) 100 Percent ZEV Sales by 2040 Feasibility Analysis

Comment Summary: The commenters state that there is no assessment in ACF regarding the technical feasibility of converting all new truck sales to ZEVs by 2040, the cost-effectiveness of trucking fleets to only purchase ZEVs beginning in 2040.

Commenter: [161-OT1, 255-45d]

Agency Response: No changes were made in response to these comments. The commenter's assertion that there is no cost-effectiveness or technical feasibility analysis of the 100 percent ZEV sales requirement by 2040 is incorrect. Staff's analysis included cost-effectiveness analysis through 2040, which shows that the TCO for ZEVs is favorable by 2036 compared to ICE vehicles. See the Cost Analysis chapter of the ACF ISOR, the SRIA, and the updated analysis in Appendix B of the ACF 15-Day Notice. Chapter I.F. of the ACF ISOR describes the state of the ZEV market, including the existence of the ACT Regulation which requires manufacturers to sell an increasing proportion of their annual sales in California as ZEVs, and sufficiently demonstrates the technological feasibility of the ACF requirement. The ACF ISOR evaluated cost-effectiveness for trucking fleets purchasing ZEVs during the entire analysis period including 100 percent ZEV purchases starting in 2040 in Chapter VIII., these calculations were updated to reflect the shift to 100 percent by 2036 as part of the ACF 15-Day Notice package in Appendix B.

b) ISOR Alternatives 7 and 8 Analysis

Comment Summary: The commenter argues that CARB's rejection of Alternatives 7 and 8 in the ACF ISOR was based on narrow readings of the ACF objectives. Specifically, they claim that CARB did not fully consider the lifecycle GHG emissions differences of fuel alternatives, including RNG (biomethane), when rejecting Alternative 7, which proposes early action credit for adopters of biomethane vehicles. Additionally, the commenter notes that CARB did not provide an explanation of how ACF would reduce PM10 from tire wear in comparison to existing vehicles. The commenter suggests weight sensitive applications would require larger fleet sizes to do the same work and therefore increase tire and brake wear and associated PM2.5 and PM10 emissions. The commenter states the ACF ISOR claims Alternatives 7 and 8 would not achieve the goal of maximizing transportation electrification while resulting in no additional NOx, but the future use of FCEV also would not appear to meet this objective.

Commenter: [261-45d]

Agency Response: No changes were made as a result of this comment. The commenter incorrectly states that CARB assumed the ACF Regulation would reduce tire wear. The Executive Summary of the ISOR describes ZEVs and NZEVs will reduce brake wear due to regenerative braking and not tire wear.

The commenter suggests that Chapter IX.B. of the ACF ISOR, Alternatives 7 and 8, would reduce PM10 emissions from tire wear when compared to the Regulation. The analysis assumed PM emissions from tire wear were similar enough between comparable ZEVs and ICE vehicles that further distinction was not warranted. Please refer to the EA RTC, responses to Comment Letters 48-2, 261-6, and 270-3 for a more detailed discussion on PM from tire wear as part of the Regulation's EA. The commenter suggests fleets would require more ZEVs to do the same work as their replacement ICE vehicles. The Regulation's optional ZEV Milestone schedule gives fleets until 2030 to transition trucks with a heavy front axle. Also, it was not assumed that weight differences between BEV and comparable ICE vehicles would necessitate a greater than one to one replacement. Please refer to the section on "Zero-Emissions Vehicle Technology Issues – Zero-Emissions Technology-General" in this section for more information.

The commenter also incorrectly states that FCEVs would not achieve the goal of maximizing transportation electrification and would not reduce NOx. This statement is unsupported. FCEVs and BEVs are defined as ZEVs which do not emit NOx or other exhaust pollution.

c) Focus Zero-Emission Vehicle Requirements on Return to Base Concept Alternative Analysis

Comment Summary: The commenters believe that CARB misinterpreted their suggested Alternative proposals for ACF that include a NOx-focused clean combustion strategy for early years, a level playing field for private and federal fleets using a purchase mandate similar to the public sector requirements, a return-to-base alternative that focuses on fleets that can rely wholly on depot charging, and a near-zero carbon liquid fuels alternative that allows a compliance pathway for challenging fleets and vehicles. The commenters state CARB staff incorrectly asserted their proposals would limit ZEV deployment, stating they were designed to enable a feasible and cost-effective level of ZEV deployment supported by real- world evidence over an achievable timeline, yielding actual, sustainable real-world emissions reductions. The commenters feel that CARB should have included an alternative that assesses commercial vehicles leading to significant NOx reductions in the next decade while scaling up ZEV deployment beyond what is required for ACT, which would meet CARB's goals for ACF in a more cost-effective manner.

Commenter: [207-45d]

Agency Response: Changes were made in response to these comments. The Board directed a change to provide a longer phase-in for CNG powered trucks operated by waste and wastewater fleets who exclusively use biomethane, to recognize investments these fleets have made to reduce methane from landfills and put it to work. Because the biomethane use is already part of the LCFS Regulation, this change would delay achieving new GHG reductions and the delay in ZEV adoption would result in delaying NOx reductions from these fleets. This alternative is closer to what the commenter was requesting.

However, we disagree with the commenter’s assertion that their alternatives were mischaracterized. Feasible alternatives were evaluated, and other concepts were dismissed. A discussion of the reasons why staff rejected these proposals are presented in Chapter IX.B. of the ACF ISOR. As described in the Staff Report, the Board already adopted the LCFS Regulation to increase the use of low carbon fuels and adopted the HD Omnibus Regulation to maximize the emissions reductions from ICE engines. Together, they result in the most stringent emissions standards for ICE engines and maximize the use of low carbon fuels in such engines. The benefits of these existing Regulations are part of the baseline and cannot be double counted. Repeating these existing requirements in this Regulation would achieve nothing new.

The commenter requests CARB consider standards that rely on continued use of biofuels along with what the commenters describe as the cleanest combustion engines. The Draft EA considered this as Alternative 2 which is described on pages 154 through 156, but ultimately rejected this Alternative because it would fail to meet most of the basic project objectives, while not avoiding a significant environmental impact.

Staff acknowledges the emissions reduction benefit of low CI liquid biofuels that are available because of the LCFS Regulation, but these benefits cannot be double counted nor claimed to be new GHG reductions and generally do not reduce criteria pollutants like NOx. Additionally, there are supply restrictions in scaling up California-sourced biofuel production, given limitations to low-carbon feedstocks at the scale needed if the Regulations were not adopted. Given these limitations, biofuel supplies should be focused on other sectors that are harder to decarbonize as described in the Scoping Plan.

The analysis in the Staff Report also recognized that the HD Omnibus Regulation set the maximum feasible emissions reductions from new ICE engines sold in California starting in 2024 and those benefits are also reflected in the Baseline and would not result in new emissions benefits regardless of the fuel type used. These emissions benefits cannot be double counted either.

d) Infrastructure Funding Gap Analysis

Comment Summary: The commenters suggest that CARB should conduct a gap analysis for infrastructure funding, which includes an assessment of the amount of available funding, the amount CEC is currently spending, and an evaluation of what is needed to support the deployment of ZEVs.

Commenter: [013-OT1]

Agency Response: No changes were made in response to these comments. The full cost of the Regulation without grants and rebates is reflected in the SRIA and updated in Chapter VIII. of the ACF ISOR, and finally in the ACF 15-Day Notice package as Appendix B. The Regulation is not predicated on securing any future grant or rebate programs, so no additional analysis is needed.

e) Mobile Fueling Emissions Analysis

Comment Summary: The commenters recommend that CARB conduct a comprehensive evaluation of the emissions associated with additional mobile fueling before implementing the requirements for mobile fueling.

Commenter: [291-45d]

Agency Response: Changes were made to define "mobile ZEV fueling provider" to mean an entity that provides the service of, or is engaged in the sale, rental, or lease of equipment for the purpose of, delivering hydrogen fuel or electricity directly from a mobile vehicle or portable equipment into another vehicle's fuel tank or battery for other than the dispenser's own consumption. Although utilizing a mobile ZEV fueling provider might be a compliance response for some fleets, it would be speculative to assume when, where, and if this compliance option might be exercised; therefore, modeling any emissions impacts would be unduly speculative. Therefore, no changes were made in response to this comment.

f) Fuel-Neutral Performance Standard Analysis

Comment Summary: The commenters state that CARB should conduct a multi-technology analysis to evaluate the feasibility of a fuel neutral performance-based standard in achieving emissions reductions targets set by the ACF Regulation on a faster timeline. They argue that phasing out liquid fuel vehicles entirely would limit flexibility, undermine incentives for technological innovation, and impose significant costs on fleet owners and customers of goods. Instead, the commenter suggests setting emissions reductions targets and creating a framework for different technologies to compete in achieving these goals.

Commenter: [011-OT1, 259-45d, 349-45d]

Agency Response: No changes were made in response to these comments, for the same reasons discussed in Chapter IX.D. of the ACF ISOR. The Regulation does not prescribe any specific technology or any equipment – rather, it allows regulated entities to acquire affected categories of any medium- and heavy-duty vehicles that have demonstrated that they emit zero emissions of criteria or GHG emissions and BEV and FCEV technologies have demonstrated this capability. The commenter suggests the Regulation is "based on the false and unsupported premise that ICE vehicles cannot achieve the same or better standard of performance as ZEV, notwithstanding numerous promising developments in carbon capture and other innovations in emissions reductions technologies." Please refer to CEQA EA Master Response 4 for response to emissions reductions from low-carbon fuels, and Master Response 5 for a discussion on the use of low-NOx engines in comparison to ZEV, and RTC

259-1 in response to carbon capture and sequestration, and in this document in the section on clean-combustion and low carbon fuels.

g) Zero-Emissions Vehicle Technological Feasibility, Availability, and Cost Analysis

Comment Summary: The commenter requests that CARB engage a team of experts and stakeholders to determine the availability and cost of vehicles needed to comply with the ACF Regulations, including technological feasibility of producing vehicles that will replace ICE vehicles on a one-to-one basis with the same capacity and power, and submit the report for public scrutiny.

Commenter: [286-45d]

Agency Response: No changes were made in response to these comments. The ACF ISOR is the document that assesses technological feasibility and cost impacts of the Regulation and was developed in conjunction with experts and with stakeholder input through an extensive public process and was submitted for public scrutiny consistent with the requirements of the APA. Through this process the Regulation was crafted to give fleet owners flexibility to manage their own purchase decisions and phase ZEVs in over a long timeframe. The Regulation also includes provisions to address a number of fleet specific circumstances, such as when a ZEV may not be available to purchase in a given configuration, demonstrated daily usage needs cannot be met with available ZEVs, or the fleet needs to retain a portion of the fleet as ICE vehicles to respond to mutual aid emergencies; any of these three options would allow a fleet owner to continue purchasing ICE vehicles.

h) Other Emergency Vehicle Configuration Analysis

Comment Summary: The commenters state that the ACF ISOR does not explain why only emergency vehicles defined in CVC section 165, and not any other configurations, must be afforded an exemption.

Commenter: [255-45d]

Agency Response: No changes were made in response to these comments. CARB does not have authority to regulate emergency vehicles as defined in CVC section 165 but does for other vehicles not covered by that definition. For the rationale on why only emergency vehicles defined in CVC section 165 are not covered by the Regulation, see section 2015(c) of Appendix H-2 to the ACF ISOR. There is no reason to believe that all other vehicles cannot be transitioned to ZEVs. Even though not required, ambulances, fire engines, and police vehicles are already being offered by manufacturers as ZEVs.

6. Cost Comments

a) Costs – Cost of the Regulation

Comment Summary: The commenters state that the cost of the Regulation is excessive and may have negative effects on the economy, cost of living, vulnerable communities, businesses, or transportation system. Some commenters believe that the analysis of costs is not accurate or adequate. Consequences cited include fleets going out of business, loss of jobs, increased costs for customers, and more investment in vehicles and infrastructure. Some commenters believe that the analysis of costs does not include the cumulative cost of all CARB Regulations.

Commenter: [001-45d, 004-45d, 004-WT1, 011-OT1, 018-OT1, 027-45d, 033-45d, 038-45d, 039-45d, 041-45d, 051-45d, 052-45d, 058-45d, 083-45d, 084-45d, 085-45d, 089-45d, 090-45d, 098-45d, 103-45d, 117-45d, 128-45d, 138-OT1, 150-45d, 152-45d, 153-45d, 155-45d, 157-45d, 164-45d, 168-45d, 175-45d, 184-45d, 190-45d, 191-45d, 193-45d, 200-45d, 207-45d, 228-45d, 232-45d, 233-45d, 239-45d, 251-45d, 253-45d, 254-45d, 257-45d, 258-45d, 259-45d, 278-45d, 290-45d, 292-45d, 295-45d, 297-45d, 301-45d, 302-45d, 308-45d, 323-45d, 324-45d, 331-45d, 334-45d, 335-45d, 339-45d, 347-45d]

Agency Response: No changes were made in response to these comments. CARB's economic analysis performed in Appendix C-1 to the ACF ISOR, Chapter VIII of the ACF ISOR, and Appendix B to the ACF 15-day changes was prepared pursuant to the requirements of the APA and SB 617. This analysis included direct costs on affected businesses including upfront costs, operating costs, and other miscellaneous costs associated with transitioning medium- and heavy-duty vehicles from ICE vehicles to ZEVs.

Staff analysis was developed through a lengthy public process. Staff held workgroup meetings on December 9, 2020, September 9, 2021, and February 11, 2022, to discuss costs associated with ZEVs and their infrastructure. Through these meetings, staff solicited feedback on data sources to use, updated our assumptions discussing CARB's economic analysis for the Regulation, and solicited public input on appropriate sources. CARB also performed literature reviews to identify sources discussing ZEV costs. Through this process, CARB was able to ensure the analysis was using up-to-date information which reflects the current state of the truck market and future projections on ZEV costs.

As discussed in Appendix B to the ACF 15-day changes, staff's updated analysis includes the impacts of the IRA.[139] On August 16th, 2022, President Joe Biden signed the IRA. This landmark piece of federal legislation establishes several provisions which will reduce costs of medium- and heavy-duty ZEVs and will accelerate the ZEV market. Some of the most significant provisions include tax credits of up to $40,000 per ZEV or 30 percent of each BEV charger, $3 billion dollars to convert the U.S. Postal Service fleet to ZE, up to $45/kWh for the production of batteries in the US, $3 billion in grants and $20 billion in loans to support ZE manufacturing in the U.S. These provisions encourage significant investments in ZEV manufacturing and accelerate ZEVs into the market. The fleet-focused provisions improve the TCO and lowers upfront cost for vehicle as well as infrastructure. Several studies have been

[139] Public Law No: 117-169 (Aug. 16, 2022) 136 Stat. 1818.

recently released which discuss the positive impact the IRA will have on the heavy-duty ZEV market.[140,141,142,143]

When factoring in upfront costs including vehicles and infrastructure, operating costs including fuel and maintenance, and other miscellaneous costs, Appendix B to the ACF 15-day changes found the Regulation is expected to result in a cumulative net savings to the State of $48.0 billion to 2050. Note that these cost savings do not include an additional $26 billion in expected health savings by 2050. These cost savings are due to a combination of factors. While ZEVs are expected to cost more upfront due to higher vehicle and infrastructure costs, there is an expected decrease in operating costs due to lower fuel costs, decreased maintenance expenses, and revenue from California's LCFS Regulation. This results in a lower TCO for ZEVs versus their ICE counterparts. As ZEV costs will decline over time, the savings ramp up. These findings are aligned with numerous other studies assessing

[140] Environmental Defense Fund, Inflation Reduction Act gives truck electrification a dose of adrenaline, 2022 (web link: https://blogs.edf.org/energyexchange/2022/09/12/inflation-reduction-act-gives-truck-electrification-a-dose-of-adrenaline/, last accessed January 2023).
[141] The International Council on Clean Transportation, Analysing the Impact of the Inflation Reduction Act on Electric Vehicle Uptake in the United States, 2023 (web link: https://theicct.org/wp-content/uploads/2023/01/ira-impact-evs-us-jan23.pdf, last accessed February 2023).
[142] Rocky Mountain Institute, The Inflation Reduction Act Will Help Electrify Heavy-Duty Trucking, 2022 (web link: https://rmi.org/inflation-reduction-act-will-help-electrify-heavy-duty-trucking/, last accessed January 2023).
[143] Roush, Inflation Reduction Act 2022 Impact Study, 2022 (web link: https://blogs.edf.org/climate411/files/2022/09/2022-09-EDF-Rouch-IRA-MHD-Final-1.pdf, last accessed January 2023).

costs of heavy-duty trucks released in recent years.[144,145,146,147,148,149,150,151,152,153,154] CARB's analysis considered the cumulative impact of related Regulations including the Phase 2 GHG, HD Omnibus, HD I/M, and LCFS. An alternative method to evaluate the Regulation is the cost-benefit ratio which compares the net benefits of the rule versus its costs. As calculated in Appendix B to the ACF 15-day changes, the cost-benefit ratio for the ACF analysis is 1.6 representing significantly higher benefits than costs. This cost-benefit ratio is greater than the "Accelerated ZEV Transition" and "Cleaner Combustion" alternatives modeled. CARB's analysis also included a number of sensitivity analyses as described in Chapter VIII of the ACF ISOR which evaluated the impact that changing assumptions regarding vehicle costs, fuel costs, LCFS credit prices, and the split between BEVs and FCEVs would have on the Regulation's total cost.

In addition to assessing the costs to businesses directly affected by the Regulation, CARB's analysis assessed the macroeconomic impacts of the Regulation on the overall California economy. This analysis included the impact of cost passthrough associated with both costs and cost savings. Broadly, CARB estimates the ACF Regulation would be unlikely to have a

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144 Atlas Public Policy, Assessing Financial Barriers to Adoption of Electric Trucks, 2020 (web link: https://atlaspolicy.com/wp-content/uploads/2020/02/Assessing-Financial-Barriers-to-Adoption-of-Electric-Trucks.pdf, last accessed August 2022).

145 CleanTechnica. Tesla Police Vehicle Brings Huge Monetary Savings To Westport, Connecticut, June 2021 (web link: https://cleantechnica.com/2021/06/02/tesla-police-vehicle-brings-huge-monetary-savings-to-westport-connecticut/, last accessed March 2023).

146 Environmental Defense Fund, Technical Review of Medium-Duty and Heavy-Duty Electrification Costs for MY 2027-2030, 2022 (web link: https://blogs.edf.org/climate411/files/2022/02/EDF-MDHD-Electrification-v1.6_20220209.pdf, last accessed March 2023).

147 ERM, Investment Reduction Act Supplemental Analysis: Analysis of Alternative Medium- and Heavy-Duty Zero-Emission Vehicle Business-As-Usual Scenarios, 2022 (web link: https://www.erm.com/contentassets/154d08e0d0674752925cd82c66b3e2b1/edf-zev-baseline-technical-memo-addendum.pdf, last accessed January 2023).

148 Hydrogen Council, Path to Hydrogen Competitiveness – A Cost Perspective, 2020 (web link: https://hydrogencouncil.com/wp-content/uploads/2020/01/Path-to-Hydrogen-Competitiveness_Full-Study-1.pdf, last accessed August 2022).

149 ICF International, Comparison of Medium-Duty and Heavy-Duty Technologies in California, 2019 (web link: https://caletc.aodesignsolutions.com/assets/files/ICF-Truck-Report_Final_December-2019.pdf, last accessed August 2022).

150 McKinsey, Preparing the World for Zero-Emission Trucks, 2022 (web link: https://www.mckinsey.com/~/media/mckinsey/industries/automotive%20and%20assembly/our%20insights/preparing%20the%20world%20for%20zero%20emission%20trucks/preparing-the-world-for-zero-emission-trucks-f.pdf, last accessed March 2023).

151 North American Council for Fuel Efficiency, Regional Haul, 2019 (web link: https://nacfe.org/regional-haul/, last accessed August 2022).

152 North American Council for Fuel Efficiency, Viable Class 7/8 Electric, Hybrid, and Alternative Fuel Tractors, 2019 (web link: https://nacfe.org/future-technology/viable-class-7-8/, last accessed August 2022).

153 University of California Los Angeles, Zero-Emission Drayage Trucks – Challenges and Opportunities for the San Pedro Bay Ports, 2019 (web link: https://innovation.luskin.ucla.edu/wp-content/uploads/2019/10/Zero_Emission_Drayage_Trucks.pdf, last accessed August 2022).

154 Union of Concerned Scientists, Ready to Work – Now is the Time for Heavy-Duty Electric Vehicles, 2019 (web link: https://www.ucsusa.org/sites/default/files/2019-12/ReadyforWorkFullReport.pdf, last accessed August 2022).

significant impact on the California economy. Overall, the change in the growth of jobs, state GDP, and output is projected to not exceed 0.2 percent of the Baseline.

In summary, CARB performed a thorough analysis which evaluated the impacts of the ACF Regulation on California's economy in accordance with State law and with ample opportunity for stakeholders to comment. This analysis found the Regulation is expected to result in net cost savings to California fleets as transitioning to ZEVs will lower transportation costs over time. This reduction is due to a combination of operational savings and declining upfront costs over time.

b) Costs – Zero-Emissions Vehicle Costs

Comment Summary: The commenters express concern that ZEVs are currently unaffordable for many due to their high cost compared to combustion-powered vehicles. They note that ZEVs may require significant incentives and tax credits to be economical at the point-of-sale, which could place a financial burden on fleet owners. Some commenters disagree with the idea that the cost of ZEVs will come down over time.

Commenter: [003-45d, 006-45d, 019-45d, 025-45d, 028-45d, 028-OT1, 031-45d, 038-45d, 048-45d, 053-45d, 054-45d, 055-45d, 059-45d, 060-45d, 063-45d, 063-OT1, 066-OT1, 068-45d, 070-OT1, 089-45d, 092-45d, 096-45d, 098-45d, 104-45d, 109-45d, 120-45d, 120-OT1, 135-45d, 158-45d, 159-45d, 161-45d, 162-45d, 172-45d, 173-45d, 175-45d, 180-45d, 182-45d, 187-45d, 188-45d, 189-45d, 194-45d, 200-45d, 204-45d, 219-45d, 220-45d, 223-45d, 227-45d, 230-45d, 232-45d, 259-45d, 264-45d, 265-45d, 268-45d, 269-45d, 274-45d, 279-45d, 284-45d, 291-45d, 295-45d, 299-45d, 322-45d, 324-45d, 335-45d, 339-45d, 347-45d]

Agency Response: No changes were made in response to these comments. As discussed in Chapter VIII of the ACF ISOR, CARB analyzed the direct costs of the Regulation including vehicle costs for both ICE vehicles and ZEVs. As discussed in section "Costs – Cost of the Regulation" in "Cost Comments" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses," staff's analysis was developed through a lengthy public process. Staff discussed vehicle cost assumptions in workgroup meetings held on December 9, 2020, and September 9, 2021, as well as at numerous individual meetings with stakeholders. CARB also performed literature reviews to identify sources discussing ZEV costs. CARB's analysis in the ACF ISOR reflects the results of this public process.

As discussed in Chapter VIII of the ACF ISOR, CARB's analysis found that purchases of most BEVs and FCEVs will cost more than their ICE counterparts in the near future. However, declining battery and component costs in addition to economies of scale are expected to lower the incremental costs of ZEVs as the market expands. The analysis performed in the SRIA and ISOR was robust and included expected cost changes for both combustion-powered vehicles as well as ZEVs. For ICE vehicle projections, staff's analysis in the SRIA and ISOR included the projected impacts of the Phase 2 Greenhouse Gas Regulation and the HD Omnibus Regulation, and this analysis was updated in Appendix B to the ACF 15-day changes to include the recently adopted Federal Clean Truck Plan. For ZEVs, CARB's analysis performed a bottom-up calculation based on recent studies from the U.S. Department of Energy, the National Academies of Sciences, Engineering, and Medicine, and others projecting expected component costs, component sizing, and indirect costs over time. The results of this analysis showed ZEVs are expected to cost more than their ICE counterparts until at least 2030. After that point, some ZEVs are expected to reach purchase price parity with their diesel counterparts as costs for ZEVs continue declining while combustion-powered costs increase over time. CARB's findings are collaborated by numerous other studies evaluating ZEV prices over time. [155,156,157,158,159,160,161,162,163,164,165,166]

In addition to purchase costs, the ACF Regulation evaluated the TCO of ZEVs versus ICE vehicles in Appendix G to the ACF ISOR. This analysis was performed by comparing gasoline, diesel, natural gas, battery-electric, and hydrogen fuel cell vehicles in six applications on a per-vehicle basis. These comparisons were performed in 2025, 2030, and 2035. In this analysis, the results showed the TCO for BEVs appear cost competitive with the established combustion technologies by 2025 in a variety of use cases. Significant savings are shown for battery-electric in the walk-in van, refuse truck, and day cab categories, even in the early years. FCEVs also appear to be competitive with combustion-powered technologies in the 2025 to 2030 timeframe for some vehicle types. Despite the higher upfront costs associated with vehicle costs and infrastructure, cost savings from lower fuel costs and LCFS revenue

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[155] Atlas Public Policy, Assessing Financial Barriers to Adoption of Electric Trucks, 2020 (web link: https://atlaspolicy.com/wp-content/uploads/2020/02/Assessing-Financial-Barriers-to-Adoption-of-Electric-Trucks.pdf, last accessed August 2022).
[156] Environmental Defense Fund, Technical Review of Medium-Duty and Heavy-Duty Electrification Costs for MY 2027-2030, 2022 (web link: https://blogs.edf.org/climate411/files/2022/02/EDF-MDHD-Electrification-v1.6_20220209.pdf, last accessed March 2023).
[157] ERM, Investment Reduction Act Supplemental Analysis: Analysis of Alternative Medium- and Heavy-Duty Zero-Emission Vehicle Business-As-Usual Scenarios, 2022 (web link: https://www.erm.com/contentassets/154d08e0d0674752925cd82c66b3e2b1/edf-zev-baseline-technical-memo-addendum.pdf, last accessed January 2023).
[158] Hydrogen Council, Path to Hydrogen Competitiveness – A Cost Perspective, 2020 (web link: https://hydrogencouncil.com/wp-content/uploads/2020/01/Path-to-Hydrogen-Competitiveness_Full-Study-1.pdf, last accessed August 2022).
[159] The International Council on Clean Transportation, A meta-study on purchase costs for zero-emission trucks, 2022 (web link: https://theicct.org/wp-content/uploads/2022/02/purchase-cost-ze-trucks-feb22-1.pdf, last accessed March 2023).
[160] ICF International, Comparison of Medium-Duty and Heavy-Duty Technologies in California, 2019 (web link: https://caletc.aodesignsolutions.com/assets/files/ICF-Truck-Report_Final_December-2019.pdf, last accessed August 2022).
[161] McKinsey, Preparing the World for Zero-Emission Trucks, 2022 (web link: https://www.mckinsey.com/~/media/mckinsey/industries/automotive%20and%20assembly/our%20insights/preparing%20the%20world%20for%20zero%20emission%20trucks/preparing-the-world-for-zero-emission-trucks-f.pdf, last accessed March 2023).
[162] North American Council for Freight Efficiency, Guidance Report: Medium-Duty Electric Trucks Cost of Ownership, 2018 (web link: https://nacfe.org/wp-content/uploads/2018/10/medium-duty-electric-trucks-cost-of-ownership.pdf, last accessed August 2022).
[163] North American Council for Fuel Efficiency, Regional Haul, 2019 (web link: https://nacfe.org/regional-haul/, last accessed August 2022).
[164] North American Council for Fuel Efficiency, Viable Class 7/8 Electric, Hybrid, and Alternative Fuel Tractors, 2019 (web link: https://nacfe.org/future-technology/viable-class-7-8/, last accessed August 2022).
[165] University of California Los Angeles, Zero-Emission Drayage Trucks – Challenges and Opportunities for the San Pedro Bay Ports, 2019 (web link: https://innovation.luskin.ucla.edu/wp-content/uploads/2019/10/Zero_Emission_Drayage_Trucks.pdf, last accessed August 2022).
[166] Union of Concerned Scientists, Ready to Work – Now is the Time for Heavy-Duty Electric Vehicles, 2019 (web link: https://www.ucsusa.org/sites/default/files/2019-12/ReadyforWorkFullReport.pdf, last accessed August 2022).

result in a positive TCO. The TCO for ZEVs is expected to further decrease over time as costs continue to decline. Staff note that numerous sources were updated in CARB's cost analysis between the release of the TCO paper in 2021 and the release of the ACF SRIA and ISOR in 2022. The TCO analysis for ZEVs in comparison to ICE vehicles did not change significantly due to these changes and as a result, the findings remain the same.

The initial economic analysis in the ACF ISOR does not include the effects of the IRA.[167] The IRA has multiple provisions which address the purchase costs of heavy-duty ZEVs, including tax credits available to the fleet of up to $40,000 per ZEV, up to $45/kWh to produce batteries in the US, $3 billion in grants and $20 billion in loans to support ZE manufacturing in the US. Analysis performed by analysts at ERM International Group shows factoring in the effects of the $40,000 Qualified Commercial Clean Vehicle Tax Credit alone accelerates purchase cost parity by five to 12 years with most models reaching parity from 2023 to 2028. Further reductions in purchase price due to the IRA may be possible due to other credits which have not been modeled. Numerous opportunities exist to defray these upfront costs and capture operational savings. HVIP and other commercial technology incentive programs aim to increase market penetration by reducing incremental costs, and therefore purchase price, while recognizing the long-term cost savings of operating a ZEV and stretching the benefits of State resources. However, CARB recognizes that circumstances vary by fleet and vehicle type, and we are continuously reassessing incentive amounts or mechanisms. Staff welcomes fleets to collaborate with us through our annual public process on funding. Simultaneously, truck financing models are evolving to better suit the nascent ZEV market, and new business models such as truck-as-a-service are appearing. These models allow fleets to operate ZEVs with a similar monthly payment to existing ICE vehicles by amortizing the upfront costs over time and capturing operational savings.

In summary, CARB's analysis found that, while ZEVs cost more than ICE vehicles currently, upfront costs are expected to keep declining and are forecasted to reach parity in the near future partly due to the IRA. On a TCO basis, ZEVs are expected to have a positive TCO in numerous applications over the course of this decade due to operational savings and declining upfront costs. Higher upfront costs are being addressed today through a combination of funding programs, financing, and innovative business models such as truck-as-a-service.

c) Costs – Infrastructure Costs

Comment Summary: The commenters raise concerns about the significant infrastructure costs required to support the deployment of ZEVs, including the costs for chargers, necessary site upgrades, and utility-side upgrades. Some believe that these costs are underestimated or omitted and cite examples of equipment or sites that incur higher costs. The commenters also question where the funding for these costs will come from, given that the infrastructure requirements far exceed the State's ability to fund and support them. Some also criticize utilities for using project approvals for ZEVs to make unnecessary distribution upgrades and power line undergrounds that should be paid for through normal business operations. The commenters highlight that rural infrastructure projects will incur additional costs, and some note that they will have to install infrastructure for leased sites. Some also request

[167] Public Law No: 117-169 (Aug. 16, 2022) 136 Stat. 1818.

information on the costs associated with building new generation or transmission to support the increased electrical demand. The commenters do not believe that infrastructure costs will decline over time.

Commenter: [006-45d, 011-45d, 013-45d, 014-45d, 014-OT1, 021-45d, 024-WT1, 028-45d, 042-45d, 048-45d, 058-45d, 080-OT1, 091-45d, 092-45d, 096-45d, 104-45d, 117-45d, 156-45d, 162-45d, 164-45d, 167-45d, 170-45d, 173-45d, 179-45d, 223-45d, 239-45d, 259-45d, 269-45d, 270-45d, 278-45d, 279-45d, 294-45d, 299-45d, 321-45d, 330-45d, 335-45d]

Agency Response: No changes were made in response to these comments. As discussed in Legal Response to Comment section II.B, the Regulation does not require fleets to install infrastructure, nonetheless CARB analyzed the direct costs of the Regulation including infrastructure for BEVs in Chapter VIII of the ACF ISOR.

CARB's infrastructure cost analysis is described in Chapter VIII of the ACF ISOR and uses a combination of real-world data from charger deployments and site construction for infrastructure. Charger costs were calculated using data from ICCT based on established trends for light-duty chargers with appropriate charger sizes being used for heavy-duty vehicles. Site infrastructure costs were calculated using actual data from numerous CARB and CEC funded heavy-duty ZEV pilot projects – this methodology was suggested by numerous stakeholders during workshops during regulatory development. These costs include all necessary work to prepare a site for BEV infrastructure including trenching, laying conduit, panel upgrades, permitting, and other associated costs. The ACF ISOR bases its analysis on the average cost calculated as is appropriate for a statewide estimate, but as displayed in Figure 65 of the ACF ISOR, infrastructure costs per site vary significantly.

Staff's analysis did not assume funding would be used for infrastructure and instead assumed the fleet would either pay for and install infrastructure at their own depots or use retail charging or refueling stations where infrastructure costs are embedded in the fuel cost the fleet would pay. Given that incentives are currently being offered by CEC and many of the state's utilities, fleets may see lower costs and CARB's analysis may be conservative. As described in the responses in section "Costs – Cost of the Regulation" in "Cost Comments" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses," despite the higher upfront vehicle and infrastructure costs, ZEVs are expected to have a positive TCO. And as described in the responses in section "Costs – Zero-Emissions Vehicle Costs" in "Cost Comments" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses," numerous new solutions to defray upfront costs associated with vehicles and infrastructure are emerging such as financing solutions and truck-as-a-service models. These models address many concerns raised by commenters regarding costs associated with infrastructure.

d) Costs – Not a One-to-One Replacement

Comment Summary: The commenters state ZEVs will cost more to operate due to not being a one-to-one replacement for existing vehicles and that more vehicles will be needed to perform the same work, and this should be addressed in the SRIA.

Commenter: [282-45d, 291-45d]

Agency Response: No changes were made in response to these comments. Staff disagrees with commenter's assertion that ZEVs will not be able to replace ICE vehicles on a one-to-one basis over the timeframe of the Regulation. The ACF Regulation's requirements are phased in over the course of the next two decades, providing flexibility for fleet owners to focus on vehicles that are most suitable for electrification first. The ZEV Milestones Option delays initial ZEV requirements for day cab tractors and work trucks until 2027, and delays sleeper cab and specialty vehicles until 2030. The data collected from fleets reporting for LER shows that nearly all straight trucks do not do more than 100 miles a day, and most day cab tractors operate less than 200 miles per day. ZEVs that are available today already can meet these range needs and technology is continuing to improve. Fuel cell trucks are also available today and more are expected in the near future. They have similar range, fueling times, and operational characteristics as ICE vehicles. Given the expected improvements in ZEV technology, and numerous technology options available such as lightweighting, fast charging, and hydrogen fuel cells, there is insufficient evidence to support the assertion that multiple ZEVs will be required to replace a single ICE vehicle. Exemptions are included in the case where a ZEV that meets the fleet's daily usage needs is not available.

e) Costs – State and Local Government Issues

Comment Summary: The commenters state that the Regulation will increase costs for local governments, leading to increased taxes, rates, or use of the city's general fund to recoup costs. They argue that local governments have less purchasing power and a two-year budget cycle that does not align with the Regulation's requirements, making ZEV purchases more expensive. Commenters are concerned about having to comply with the purchase requirements while also fulfilling their duty to spend public funds responsibly, resulting in a waste of public funds to solely comply with the Regulation.

Commenter: [014-45d, 089-45d, 101-OT1, 103-OT1, 129-45d, 179-45d, 180-45d, 274-45d, 279-45d]

Agency Response: No changes were made in response to these comments. The SLG requirements of the Regulation were designed to align with typical public fleet purchasing patterns by basing the requirements on the year the purchase order occurs consistent with existing practices and stakeholder comments. The purpose of the Regulation is to achieve criteria and GHG emissions reductions and is a cost-effective way to achieve needed health benefits to protect communities.

CARB's analysis and numerous other studies show these vehicles will have a positive TCO during the course of this Regulation. As a result, the total cost to the fleet is not expected to increase; rather, public fleets are expected to see a net cost decrease. Based on this analysis, the Regulation would not lead to rate increases or loss of services among public agencies as the commenter suggests.

f) Costs – Assembly Bill 5 Burden

Comment Summary: The commenters state that AB 5 is already putting an additional burden on the trucking industry, and adopting another Regulation will further strain truckers, brokers, and contractors.

Commenter: [028-OT1, 048-45d]

Agency Response: No changes were made in response to these comments. AB 5 established California law which requires businesses to classify their workers as employees or independent contractors. The ACF Regulation does not change AB 5 requirements. Any burdens due to AB 5 implementation are outside the scope of the Regulation. CARB recognizes the ACF Regulation will add upfront costs for vehicles and infrastructure in the near-term; however, the costs are offset from savings on fuel and maintenance, resulting in a favorable TCO in most cases. In addition, the Regulation is expected to result in a net savings to fleets overall through the course of the Regulation.

g) Costs – Battery Disposal

Comment Summary: Commenter states that CARB fails to discuss costs for recycling and disposal of EV batteries and the potential environmental hazards that may result from recycling and disposal.

Commenter: [270-45d]

Agency Response: No changes were made in response to these comments. As discussed in Chapter VIII of the ACF ISOR, costs associated with battery disposal were evaluated. CARB found that battery disposal may be a cost or cost saving depending on the state of the battery at the end of its life in the vehicle. These batteries can still be used for non-vehicular applications such as energy for grid storage. Alternatively, these batteries can also be recycled, and critical materials can be recovered for reuse in other applications. At this point, it is unclear how much value remains in the vehicle's battery at the end of its useful life, but it is speculative to claim there are additional costs which must be accounted for which exceed the battery's remaining value given it can still be used for other applications. For further discussion on battery recycling, please see the EA RTC document, Master Response 2, and responses to Comment Letter 83.

h) Costs – Passthrough to California Economy

Comment Summary: The commenter states that the SRIA underestimates economic impacts on communities due to price passthrough, especially low-income communities, from passthrough of higher vehicle and consumer costs.

Commenter: [259-45d, 322-45d]

Agency Response: No changes were made in response to these comments. As discussed in Chapter VIII of the ACF ISOR, CARB's cost analysis included the direct costs of the Regulation to businesses directly affected by the Regulation as well as macroeconomic impacts of the Regulation on the overall California economy. This analysis included the impact of cost passthrough associated with both costs and cost savings. Broadly, CARB estimates the Regulation would be unlikely to have a significant impact on the California economy. Overall, the change in the growth of jobs, state GDP, and output is projected to not exceed 0.2 percent of the Baseline. Overall, the Regulation would result in a cost savings, and passthrough to communities should be beneficial since the overall economic impact to fleets is positive.

i) Costs – Electricity Costs

Comment Summary: The commenters state that the Regulation will increase electricity costs, which will have a significant impact on low-income households.

Commenter: [051-45d, 052-45d, 147-OT1, 223-45d, 347-45d]

Agency Response: No changes were made in response to these comments. Staff's analysis used a combination of actual electricity rate schedules produced by the utilities, demand forecasts from CEC, and projections from the EIA to estimate future electricity costs. Broadly, the cost of electricity from depot charging is less expensive than diesel fuel and electricity from retail charging is similar to diesel. The impact of projected electricity demand and usage are incorporated into CEC projections. As discussed in Chapter VIII of the ACF ISOR, many BEVs and associated EVSE are able to set timers which allow fleets to charge their vehicles during off-peak periods and ultimately save the fleet money.

Similarly, staff disagrees with the assertion that the ACF Regulation will broadly cause increased electricity rates. To the contrary, research suggests that uptake of medium- and heavy-duty ZEVs may decrease electricity costs for all ratepayers as ZEVs can increase utilization of generation assets during off-peak hours.[168,169] Given this information, the commenter's assertion that the ACF Regulation will increase electricity costs is speculative and baseless.

j) Costs – Avoiding Peak Electricity Costs

Comment Summary: The commenters express concerns about the inefficiency and additional costs of charging ZEVs outside of peak hours, as it would require staff to return to work after 9:00 PM to plug in all vehicles.

Commenter: [269-45d]

Agency Response: As discussed in Chapter VIII of the ACF ISOR, many BEVs and associated EVSE can set timers which allow fleets to charge their vehicles during off-peak periods. This allows fleets to avoid peak electricity costs without having to dedicate staff time to plugging in chargers and ultimately save the fleet money. Fleets are using this technology already in real-world applications.[170]

k) Costs – Additional Labor Costs

Comment Summary: The commenters suggest that significant investments are necessary for workforce development for ZEVs. They also state that the costs of labor will increase for agencies.

Commenter: [059-45d, 278-45d, 279-45d, 291-45d, 299-45d, 335-45d]

Agency Response: No changes were made in response to these comments. As discussed in Chapter VIII of the ACF ISOR, staff modeled additional costs for transitional costs and workforce development recognizing the inherent additional costs associated with transitioning to a new technology. These costs include the cost of training the workforce to

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[168] E3, EVGrid: Electric Vehicle Grid Impacts Model, 2019 (web link: https://www.ethree.com/tools/electric-vehicle-grid-impacts-model-2/, last accessed May 2023).

[169] M.J. Bradley and Associates, MJB&A Analyzes State-Wide Costs and Benefits of Plug-in Vehicles in Five Northeast and Mid-Atlantic States, 2017. (web link: https://www.mjbradley.com/reports/mjba-analyzes-statewide-costs-and-benefits-plug-vehicles-five-northeast-and-mid-atlantic, last accessed May 2023).

[170] Houbbadi A, Trigui R, Pelissier S, Redondo-Iglesias E, Bouton T. Optimal Scheduling to Manage an Electric Bus Fleet Overnight Charging. Energies. 2019; 12(14):2727. (web link: https://doi.org/10.3390/en12142727, last accessed February 2023).

work with new BEVs and FCEVs. Workforce development costs decline over time as the current new technology becomes accepted over time and is the new business-as-usual.

l) Costs – Residual Values

Comment Summary: Commenter does not agree with our economic model because it assumes most of the equipment has no value and its replacement cost is not a regulatory burden but rather a capital necessity not attributable to the rule itself.

Commenter: [239-45d]

Agency Response: No changes were made in response to these comments. As described in Chapter VIII of the ACF ISOR, staff incorporated residual values into the rulemaking analysis. All vehicles have a residual value that declines over time from 100 percent of the vehicle's purchase price to eventual zero percent when the vehicle is 25 years old. The analysis includes the economic impact of turnover under the Legal Baseline as well as accelerated turnover due the ACF Regulation and past turnover due to Regulations such as the Truck and Bus Regulation.

CARB does not agree with the claim that vehicles' replacement costs in the baseline are a regulatory cost. Vehicles are a depreciating asset which inherently lose value over time as the vehicle ages. This is true regardless of any CARB Regulations and it is incorrect to assume vehicles can continue to operate indefinitely in absence of Regulation.

m) Costs – Low-Carbon Fuel Standards Assumptions

Comment Summary: The commenters state that the LCFS Regulation should be excluded from the analysis since the program is considered unreliable, and some fleets cannot access credits. They argue that the LCFS credit price is below the claimed value, and as more Regulations require the use of low-carbon fuels, the credit price will continue to decrease.

Commenter: [207-45d, 291-45d, 303-45d]

Agency Response: No changes were made in response to these comments. The LCFS is an approved Regulation that has been in place for over a decade. Fleets who own their own EVSE are able to generate credits and sell them on the LCFS market to generate revenue which can offset their fuel cost. As discussed in Chapter VIII of the ACF ISOR, staff made assumptions regarding where the use of LCFS revenue was appropriate. LCFS revenue was not included for fleets expected to be using public infrastructure such as retail charging or hydrogen infrastructure as it is speculative to assume that station operators will pass through these savings to fleet operators. This assumption may be overly conservative as station operators will have an incentive to use LCFS credits to lower their fuel prices in a competitive retail fueling market. LCFS revenue was included for fleets who perform depot charging as in these cases the fleet would be able to receive the LCFS revenue. Assuming fleets will ignore revenue from an existing market condition that is a result of Regulation would not be appropriate.

LCFS credit prices are inherently volatile. To provide more information to the public, Chapter VIII of the ACF ISOR contains sensitivity analyses showing the effects of changing various assumptions will have on the cost of the overall Regulation. One of the scenarios modelled was lowering the credit price of the LCFS Regulation substantially. This alternative scenario showed that even with a lower credit price, the Regulation as a whole would result in lower costs to California fleets. This result remains true with the Updated Cost and Benefits Analysis released as part of the ACF 15-Day Notice.

n) Costs – Maintenance Costs

Comment Summary: Commenter states assumed maintenance cost reductions for ZEVs are speculative.

Commenter: [291-45d]

Agency Response: No changes were made in response to these comments. As discussed in Chapter VIII of the ACF ISOR, ZEVs are modeled to have a lower maintenance cost than ICE vehicles as these vehicles have fewer moving parts, less scheduled maintenance requirements like oil and air filter changes and have reduced usage of parts such as brakes. This relationship is well documented for light-duty vehicles and similar trends are expected to occur for heavy-duty vehicles. Note that costs for battery replacements and fuel cell stack refurbishments are classified as "midlife costs" and were accounted separately.

o) Costs – Reporting Costs

Comment Summary: The commenters state that administrative costs for reporting and recordkeeping requirements for HPF should be accounted for in the regulatory analysis.

Commenter: [247-45d]

Agency Response: No changes were made in response to these comments. CARB accounted for costs associated with reporting and recordkeeping in the cost analysis as discussed in Chapter VIII of the ACF ISOR.

p) Costs – Small Fleets

Comment Summary: The commenters state that the Regulation will negatively impact small fleets and small, family-owned businesses, potentially putting them out of business. They explain that smaller fleets may not be able to afford the cost of new vehicles, ZEVs, or necessary supporting infrastructure, and as a result, the Regulation will give larger carriers a competitive advantage, forcing smaller operators out of business. Some commenters similarly assert that smaller public fleets will be at a disadvantage in their ability to comply with the Regulation because of the costs.

Commenter: [014-OT1, 018-OT1, 025-OT1, 030-45d, 031-45d, 033-45d, 037-45d, 039-45d, 044-45d, 046-45d, 052-45d, 053-45d, 066-OT1, 087-45d, 108-45d, 110-45d, 111-45d, 112-45d, 115-45d, 116-45d, 117-45d, 118-45d, 124-45d, 133-45d, 145-45d, 150-45d, 157-45d, 164-OT1, 165-45d, 182-45d, 195-45d, 203-45d, 225-45d, 249-45d, 250-45d, 251-45d, 258-45d, 274-45d, 287-45d, 288-45d, 289-45d, 301-45d, 302-45d, 308-45d, 313-45d, 320-45d, 323-45d, 331-45d, 336-45d, 339-45d, 340-45d]

Agency Response: No changes were made in response to these comments. This response is focused on small fleets affected by the HPF and SLG requirements.

The Regulation contains numerous provisions to ensure small public fleets can meet their regulatory requirements. The SLG requirements incorporate a three-year exemption for fleets with 10 or less vehicles as well as fleets located in designated low population counties. These provisions allow fleets more time to prepare for ZEV adoption and allow them to learn lessons from larger agencies who are acting first. As part of the ACF 15-Day changes to the ACF Regulation, SLG fleets can purchase NZEVs equally in place of ZEVs, which provides more flexibility and lower cost compared to full ZEVs. In addition, the ACF 15-Day changes allow public fleets access to the ZEV Milestone requirements which provides additional time to electrify work trucks and specialty vehicles which public fleets use. These provisions, combined with the lower costs ensure that this transition accommodates small public fleets.

The HPF requirements are focused on businesses well-suited to electrify. Small fleets are not directly regulated but may be affected if they operate under common ownership and control of a fleet owner subject to the HPF requirements. The Regulation is structured to ensure the regulatory burden is placed on the controlling party who needs to determine a pathway to achieve the Regulation's requirements. Strategies which can be used include offering incentives to smaller fleets under common ownership and control to convert to ZE, offering advantageous contracts to fleets utilizing ZEVs, preferentially hiring fleets which use ZEVs over fleets who have not electrified, and other creative solutions. This framework allows a transition to ZEV technologies while minimizing the regulatory burden smaller fleets will face as a result of this Regulation.

q) Costs – Stranded Natural Gas Assets Related to Senate Bill 1383

Comment Summary: The commenters express concern about the potential stranding of recent investments in natural gas vehicles and infrastructure. Some commenters specifically mention assets built recently to support organic waste diversion requirements of SB 1383.

Commenter: [022-OT1, 024-OT1, 078-OT1, 127-OT1, 167-45d, 234-45d, 292-45d, 321-45d]

Agency Response: Changes were made in response to these comments. As described in more detail in the responses in section "Waste and Wastewater Fleets – Include Exemption until 2033" in "Exemptions and Extensions – Waste and Wastewater Fleets" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses," CARB introduced a new Waste and Wastewater Fleet Option in the ACF 15-day changes that provides additional time for fleets implementing organic waste diversion programs pursuant to SB 1383. As a result of this provision, ZEV requirements for these fleets will not start until 2030. This provision allows additional time to move produced biomethane from the transportation sector to hard-to-decarbonize sectors or to produce green hydrogen which aligns with the Scoping Plan and SB 1440.

However, staff notes the ACF Regulation is phased-in over the upcoming decades and provides time for fleets to transition to ZEVs. The ACF Regulation provides all fleets the option to operate their vehicles for their full useful lives, which by extension ensures that infrastructure can continue to be utilized.

r) Costs – Supply Chain Issues

Comment Summary: The commenters state that the Regulation will have negative impacts on the transportation sector, supply chains, and the cost of living in California. They also state the existing or future supply chain issues will increase costs of ZEVs or ZEV infrastructure, or that the Regulation will exacerbate these issues. They express concern that the Regulation will exacerbate existing and future supply chain issues, such as high inflation, chip shortages, and the COVID-19 pandemic, which will impact the movement of critical goods like food, water, and medical supplies. Additionally, the commenters assert that the Regulation will lead to freight being diverted away from California. Commenters state a rapid transition to BEVs and FCEV risks raw material shortages and supply chain vulnerabilities from geopolitical rivals.

Commenter: [001-45d, 001-WT1, 021-45d, 025-WT1, 026-45d, 027-45d, 033-45d, 038-45d, 039-45d, 042-45d, 051-45d, 052-45d, 055-45d, 057-45d, 058-45d, 059-45d, 065-45d, 067-45d, 068-45d, 069-45d, 072-45d, 074-45d, 075-45d, 080-45d, 086-45d, 101-45d, 102-45d, 103-45d, 104-45d, 105-45d, 106-45d, 107-45d, 117-45d, 121-45d, 132-45d, 132-OT1, 134-45d, 135-45d, 138-45d, 139-45d, 141-45d, 142-45d, 143-45d, 144-45d, 148-45d, 148-OT1, 149-45d, 150-45d, 152-45d, 157-45d, 161-45d, 184-45d, 188-45d, 189-45d, 190-45d, 197-45d, 198-45d, 204-45d, 232-45d, 246-45d, 249-45d, 254-45d, 257-45d, 258-45d, 259-45d, 265-45d, 268-45d, 282-45d, 283-45d, 291-45d, 295-45d, 299-45d, 301-45d, 302-45d, 308-45d, 313-45d, 331-45d, 339-45d, 347-45d]

Comment Summary: CARB fails to assess or address impacts to its own economy, much less the national economy, as the result of one state accelerating electric or fuel cell freight transport that would cease to be reliable or functional outside its geographically confined network of charging infrastructure and support systems. In particular, CARB does not address how consumers will be impacted by higher costs of food and goods as the costs of replacing existing vehicles with ZEVs are passed through to customers. Nor does CARB recognize, much less attempt to quantify, the economic impact of supply-chain disruptions and bottlenecks likely to occur if fleet owners are forced to retire their existing vehicles before they can procure ZE replacements and if fleet owners acquire ZEV vehicles that are not supported by adequate infrastructure outside the State.

Commenter: [259-45d]

Agency Response: No changes were made in response to these comments. CARB disagrees with the speculative assumption that the Regulation will cause supply chain disruptions as commenters suggest, and notes that to the extent the commenters assume the ACF Regulation requires that they purchase ZEV vehicles outside of California, they are incorrect, because the ACF Regulation only applies to vehicles that are owned, operated, or directed to operate in California.

The ACF Regulation phases in ZEVs over the next two decades and the Regulation's requirements are designed to align with technological feasibility. The Regulation's structure ensures that existing trucks can continue to operate for their full useful life and ZEVs are gradually introduced into the fleet. In addition, the Regulation contains numerous provisions such as the ZEV Purchase Exemption, the Infrastructure Construction Delay Extension, and the 5-Day Pass which ensure the requirements are feasible and events outside of fleet's control can be addressed. The ZEV Milestones Option provides additional time and flexibility for day cab and sleeper cab tractors, recognizing necessary public infrastructure which will be needed to facilitate interstate goods movement. Through this regulatory structure, the ACF Regulation ensures goods can continue moving through California without disruption.

Manufacturers and other suppliers are making significant domestic investments to bolster the supply chain in part due to the recently passed IRA. The IRA strengthens domestic supply chains by incentivizing production of materials and components critical to decrease the United States' carbon emissions in line with declared goals. These investments are already occurring at the same time manufacturers are identifying ways to produce key components with less or no use of critical materials. This current trajectory is expected to continue, which alleviates raised concerns regarding supply chain disruptions due to the transition to ZEVs. The IRA is also a clear signal for the nationwide move to ZEVs, and multiple states have already adopted the ACT Regulation with many others committed to transitioning to ZEVs.

s) Costs – Greater Benefits than Estimated

Comment Summary: Commenter states that economic benefits are also likely to be greater than CARB estimates because learning curves for battery technologies should reduce the price differential between car and truck batteries more quickly than modeled.

Commenter: [209-45d]

Agency Response: No changes were made in response to these comments. CARB acknowledges that cost-savings may be greater than projected, but due to inherent uncertainty, are unable to predict how costs may decline directly as a result of the Regulation. As a result, the analysis may be overly conservative and greater savings are possible.

t) Costs – Response to Comments by the California Trucking Association and American Trucking Association Regarding the Total Cost of Ownership Document

Comment Summary: Commenter states the TCO document needs to be revised to incorporate the following comments.

- Fast charging infrastructure: Infrastructure rated at 500 kW or above is unlikely to exist today or in the near future. Staff should analyze cost based on currently available infrastructure.
- Ownership period: Staff should evaluate a range of truck ownership periods.
- Energy efficiency: Real-world efficiency of Class 8 drayage trucks is lower than modeled, with data suggesting a value of 2.8 kWh/mi.
- ZEV prices: Commenter states ZEV prices are unlikely to decline to the values described in the TCO paper given current prices listed today.
- Electricity fuel taxes: Taxes for electricity need to be explicitly included.
- Fuel costs: An analysis of the impact of ACF on fuel tax revenue is needed due to the potential for losses in tax revenue and the impact on associated services.
- Electricity prices: Data from CEC’s Demand Scenarios should be used to estimate electricity prices.
- Retail electricity prices: Higher electricity prices are shown on the CARB source provided. In addition, staff should evaluate the differences between retail light-duty and heavy-duty electricity prices.
- Diesel/natural gas efficiency: MPG values appear incorrect as they decline over time; due to the Phase 2 GHG Regulation, MPG values should go up over time.
- LCFS revenue: Commenter disagrees that it is reasonable to assume fleets will use owned chargers and claim LCFS credits. Commenter also asks to assess the impact of capacity credits in the LCFS rulemaking.
- Sleeper cab infrastructure: Infrastructure costs for retail charging should be explicitly modeled.

- Residual value: Staff's assumption that residual values are the same as diesel differs from the assumption in the ACT rulemaking that residual values are half of an equivalent diesel.
- Dwell times: Dwell time should be included in the TCO equation.
- Impact of payload decreases: The impact of payload decreases should be included.

Commenter: [282-45d]

Agency Response: No changes were made in response to these comments. The assumptions in CARB's analysis were appropriate as described in further detail below:

Fast charging infrastructure: First, staff notes the analysis is not predicated on any individual study including the cited study from LBNL, but on the total information available regarding ZE trucks. The ACF Regulation is designed to align with expected retail charging buildout. In the early years of the Regulation, staff expects fleets to deploy ZEVs in lower mileage applications where their needs can be met with solely depot charging and over time, more vehicles will use retail charging as it becomes available as shown in Table 40 in the ACF ISOR. Some applications such as sleeper cab tractors have delayed requirements to allow time for infrastructure to be built out.

Ownership period: The purpose of calculating the costs of a single truck over its SB 1-defined useful life is to evaluate the costs in a scenario that captures all costs over the vehicle's lifetime. In an alternative scenario where multiple fleets operate the same truck, the total cost will remain the same, but the costs will be apportioned between each fleet.

Energy efficiency: Staff recognizes the efficiency of all vehicles will vary based on their actual duty cycle. Staff's estimate of 2.1 kWh/mi is based on dynamometer testing of a ZE tractor operated in a variety of duty cycles. This data is collaborated by a recent study performed as part of the Volvo LIGHTs project which was funded as part of the California Climate Investments.[171] The data collected shows that the energy usage of both BEVs and diesel-powered trucks vary, but in all cases BEVs have significantly higher efficiency than diesel. The efficiency of BEVs is expected to further improve as this technology is relatively undeveloped and there remains significant room for improvements. Specifically for Class 8 BEVs, the data collected showed values of 1.7-2.2 kWh/mi which is in line with CARB's estimate.

ZEV prices: As described in more detail in the responses in section "Costs – Zero-Emissions Vehicle Costs" in "Cost Comments" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses," staff's analysis forecasted expected ZEV costs over time using available literature sources. CARB acknowledges the inherent uncertainty in projecting future prices, but historic trends to date and trends in the light-duty market show a rapid decline in prices for ZEVs. This is due to a combination of economies of scale, decreasing component costs, and manufacturers ramping up production for mass production. The ACT and ACF Regulations provide assurance to manufacturers and other participants in the ZEV market, which will help ensure these price reductions occur.

[171] CalStart, The Zero-Emission Freight Revolution: California Case Studies, 2022 (web link: https://cdn.lightsproject.com/downloads/volvo-lights-website-content-news-resource-evs35-zero-emission-freight-revolution-report.pdf, last accessed January 2023).

Electricity fuel taxes: As described in Chapter VIII of the ACF ISOR, staff modeled various taxes on electricity for BEVs including 3.53 percent for Utility User Taxes and $0.0003/kWh for the Energy Resources Fee. In the TCO paper, a flat fee of five percent was added to the calculated utility rates.

Fuel costs: As part of the ACF SRIA and ISOR, staff assessed the impact the ACF Regulation would have on fuel taxes on a statewide basis. Performing an assessment on an individual vehicle is less valuable to policymakers than the effect of the Regulation as a whole.

Electricity prices: CARB used data from the ACT LER to estimate what portion of vehicles would be able to charge overnight. Based on the data reported for different vehicle types, vehicles which could not charge overnight were assumed to use other options such as utilizing retail charging or pursuing FCEVs. This granular data is an appropriate data source for use in the ACF Regulation.

Retail electricity prices: The cost values shown in the TCO paper represent the value at the time of writing which was mid-2021. The retail charging values were updated for the release of the ACF ISOR and ACF SRIA. Retail charging costs fluctuate over time similar to other fuel, however historically electricity prices have been far more stable than petroleum-based fuels such as gasoline and diesel.

Diesel/natural gas efficiency: The fuel efficiency values in the TCO paper represent fuel economy estimates from an earlier version of EMFAC. Values in the ACF SRIA and ISOR have been updated to a more recent version of EMFAC which shows ICE vehicle fuel economies increasing over time as shown in Chapter 8.3 of Appendix C-1 to the ACF ISOR. This difference is due to uncertainty in how increased ZEV penetration from the ACT Regulation and other ZEV programs will impact the expected GHG reductions in the Phase 2 GHG Regulation. Given that the credits generated by ZEVs can be used to offset the requirements of the Phase 2 GHG Regulation, the expected fuel economy of ICE vehicles will vary based on the assumptions used.

LCFS revenue: As described in the response in section “Costs – Low-Carbon Fuel Standard Assumptions” in “Cost Comments” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses,” CARB’s assumptions for LCFS credits are appropriate. This analysis assumes BEVs using depot charging will receive LCFS credits, but fleets relying on retail refueling or recharging will not receive LCFS credits. Assessing the impact of capacity credits in the LCFS Regulation is out of the scope of this rulemaking given that at time of writing, no such credits are available for heavy-duty vehicles. To the extent that these credits are incorporated in a future LCFS rulemaking, they would be assessed at that point.

Sleeper cab infrastructure: Retail charging is similar to gasoline and diesel where the consumer pays a single price for the fuel which includes all associated costs of supplying the fuel. For this reason, electricity costs for retail charging are higher than electricity costs for depot charging as the retail charging cost includes the costs of land acquisition, installation of the infrastructure, site maintenance, and profit. In comparison, a fleet that is utilizing depot charging would bear all these costs separately from their electricity rate. Including a separate cost for retail charging infrastructure is effectively double counting and is not representative of costs that fleet owners would actually experience.

Residual value: Staff updated its assumptions between the ACT and ACF Regulations to reflect new data and as a result, many assumptions have changed. Residual values are the net result of a variety of different factors based around fleet demand for used vehicles. Residual values of ZEVs are an unknown quantity, but several factors were used to judge their potential magnitude versus diesel. ZEV technology is advancing rapidly which may lead to a loss of value of used vehicles versus new ZEVs. ZEVs will be required to comply with the ACF Regulation while the majority of diesel trucks will be mostly phased out of regulated fleets. ZEVs cost less to operate than ICE vehicles, which should command a premium in the used vehicle market but will require infrastructure which may dissuade some purchasers. Only California and other states which have adopted the ACT Regulation are guaranteed to see ZEV sales from manufacturers, so latent ZEV demand from other states which have not adopted the ACT Regulation may drive up used ZEV prices. All in all, it is unclear which factors will predominantly affect the residual values of ZEVs versus diesel vehicles, so an assumption that they will remain similar is appropriate.

Dwell times: First, monetizing dwell times does not make sense in numerous operations where vehicles are already expected to have downtime. As demonstrated in data collected in the ACT LER, many types of fleets park their vehicles overnight and can recharge their vehicles without increasing their dwell time. Options are expected for fleets utilizing retail charging which can minimize dwell time. FCEVs are becoming widely available and are expected to be able to be refueled in a similar timeframe to diesel trucks. Fast charging for BEVs is progressing with charging speeds of up to 500 kW available today, and work is underway to commercialize charging at speeds above one MW. Fleets will have numerous options available and can match their technology choice to their needs, including their dwell time considerations.

Impact of payload decreases: please see responses in section "Zero-Emissions Technology – Vehicle Weight" in "Zero-Emissions Vehicle Technology Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses" which outline how numerous options exist to address weight issues. Battery technology is continuing to improve, and FCEVs can be deployed without impacts to the vehicle's payload. Similar to the above response for "Dwell Times," fleets will have numerous options available and can match their technology choice to their needs, including their payload considerations.

u) Costs – Response to Comments from National Association of Fleet Administrators Fleet Management Association Regarding Vehicle Cost

Comment Summary: Commenter states the SRIA is deficient and misled the Board due to relying on outdated studies to evaluate vehicle cost and has failed to provide references for stakeholders to evaluate the information.

Commenter: [297-45d]

Agency Response: No changes were made in response to these comments. CARB engaged in a years-long public process to develop the ACF Regulation's cost analysis. This included releasing documents for discussion and updating sources to be used in the SRIA and ISOR economic analyses. The TCO document commenter references, was included as Appendix G to the ACF ISOR, was released as a part of this iterative process. The TCO document was initially published as part of the September 9, 2021, public workshop on the ACF Regulation to discuss staff's preliminary findings on ZEV costs. All references associated with the TCO paper are located in the paper itself or the associated workshop and have been available for the past three years.

The ACF SRIA and ISOR use updated sources for developing vehicle cost estimates. All sources are described in Chapter VIII of the ACF ISOR, section "New and Used Vehicle Prices," are referenced, include hyperlinks to the source document, and are available as part of the rulemaking record. All stakeholders have had access to this data and at no point did staff withhold data from the public or the Board. While there is inherent uncertainty with future cost projections of ZEVs, numerous studies performed by third parties show similar results to CARB's analysis regarding comparisons between ICE vehicles and ZEVs. While staff recognizes inflation is a concern currently, it impacts both ICE vehicles and ZEVs and to imply that ZEVs are disproportionately affected is speculative and presented without any supporting data.

v) Costs – Response to Comments from National Association of Fleet Administrators Fleet Management Association Regarding Response to Department of Finance Comments on Upfront and Ongoing Costs

Comment Summary: Commenter states CARB did not appropriately respond to comments from DOF. Commenter requests CARB split costs for public fleets between upfront costs and ongoing costs and to justify the statement that, "We expect the change in costs for State and local government fleets would be proportional to the number of vehicles in each fleet. However, larger fleets may have additional cost savings opportunities per vehicle due to their size."

Commenter: [297-45d]

Agency Response: No changes were made in response to these comments. Staff disagrees with the assertion that CARB failed to respond to comments from DOF or misled DOF in the responses to questions. First, contrary to the commenter's claim, staff separated upfront and operating costs for government agencies in Chapter VIII of the ACF ISOR, section "Fiscal Impacts" for both costs to State and local government. The data is consistent with CARB's statement that while upfront costs are expected to be higher, operating costs are expected to lead to lower overall costs. CARB's statement that larger agencies have additional opportunities for cost savings reflects the fact that larger agencies have access to economies of scale not available to smaller agencies. Larger agencies can make bulk purchases, negotiate lower prices with their higher buying power, and have greater flexibility to phase-in ZEVs. The fact that larger entities have more opportunities for cost savings via economies of scale is well understood economic principle and is not a novel or controversial fact. Additionally, the Board approved modifications to the SLG Regulation that were reflected in the 15-day changes to exempt the smallest agencies with 10 or less trucks until January 1, 2027, and provided access to the ZEV Milestones Option and purchase of NZEVs for all SLG fleets to increase flexibility.

w) Costs – Response to Comments from National Association of Fleet Administrators Fleet Management Association Regarding Response to Department of Finance Comments on Exemptions

Comment Summary: Commenter states CARB did not appropriately respond to comments from DOF and misled DOF by stating "the proposed Regulation has been updated since the SRIA to include a number of exemptions or extensions to minimize concerns where certain vehicle configurations may not be available as a ZEV, or if there are extended delays in receiving a ZEV" as CARB's response does not reflect regulated fleet's concerns with the newly included exemptions and extensions.

Commenter: [297-45d]

Agency Response: No changes were made in response to these comments. Staff disagrees with the assertion that CARB failed to respond to comments from DOF or misled DOF in the responses to questions. Staff disagree with the comment that CARB misled DOF by stating the Regulation has been updated with a number of exemptions to minimize concerns where certain vehicle configurations may not be available as a ZEV. Given that the ZEV Purchases Exemption and Infrastructure Delay Extensions did not exist when the ACF SRIA was submitted to DOF, this response is a factual statement which provides valuable insight into changes. In addition, since the release of the ACF ISOR, staff have made further changes in response to stakeholder feedback including adding new pathways in these exemptions as part of the ACF 15-Day changes to the ACF Regulation. Given this information, CARB's statement in response to DOF is factually correct regardless of whether the commenters believe the discussed exemptions address their own concerns.

x) Costs – Response to Comments from the California Bus Association

Comment Summary: Commenter states the cost of a motorcoach is not the same as a truck and should be treated differently and requires a more nuanced approach, stating that incentive "programs such as HVIP and Carl Moyer, are available to help incentivize fleet transition, however to ask our operators to shell out 50 percent more than they currently do for their buses without taking into consideration the facts… particular to the industry, is a recipe for the demise of the over the road motor coach." The commenter is referring to the loss of luggage space for BEV motorcoach and range concerns in the facts addressed above statement.

Commenter: [314-45d]

Agency Response: No changes were made in made in response to this comment. Staff analyzed the costs of motorcoaches as part of the rulemaking's economic analysis. Similar to other ZEVs, ZEV motorcoaches are expected to have higher upfront costs and lower operating costs versus other vehicles. The Regulation contains the Daily Usage Exemption which addresses situations where the available ZEVs cannot meet the fleet's needs and allows the purchase of an ICE vehicle. Under the ZEV Milestone pathway, three-axle buses such as motorcoaches are on the Group 2 schedule recognizing additional time may be necessary for ZEV technology to be fully viable in this category. Over time, improved battery technology and proliferation of fast charging stations are expected to remedy many of the challenges raised. Applications with high mileage and weight considerations such as some motorcoaches are ideal use case for FCEVs which are an eligible pathway for fleets in the ACF Regulation.

HVIP and other commercial technology incentive programs aim to increase market penetration by reducing incremental costs, and therefore purchase price, while recognizing the long-term cost savings of operating a ZEV and stretching the benefits of State resources. However, we recognize that circumstances vary by fleet and vehicle type, and we are continuously reassessing incentive amounts or mechanisms. We welcome fleets to collaborate with us through our annual public process.

7. Definition Issues

a) Add Definition "Direct" or "Direct the Operation of"

Comment Summary: The commenters request that CARB provide a clear definition for the terms "direct" or "direct the operation of"

Commenter: [200-45d]

Agency Response: No changes were made in response to these comments. The term "to direct" is a well understood term that is used in the ACF Regulation as it is generally defined in dictionaries.

b) Definition of "California Fleet" Regarding Declared Emergency Events and Mutual Aid

Comment Summary: The commenters request that the "California fleet" definition be revised to exclude vehicles operating solely in response to emergency events or mutual aid requests.

Commenter: [291-45d]

Agency Response: No changes were made in response to these comments. Public entities from outside California are not subject to the Regulation, and private entities that are responding to emergency events would be exempt under the HPF Regulation Section 2015.3 (f) Exemptions Pursuant to Declared Emergency Events.

c) Definition of "California Fleet" Regarding Interstate Fleets and Temporary Trips into or through California

Comment Summary: The commenters suggest modifying the "California fleet" definition to exclude temporarily present vehicles, transitory vehicles, those on long-haul routes, or those with only one day of presence in the state, to avoid unfairly impacting fleet ZEV requirements. They express concerns about the California fleet definition, stating it is problematic for interstate fleets and inconsistent among fleet types.

Commenter: [145-OT1, 282-45d, 284-45d, 322-45d]

Agency Response: Changes were made in response to these comments. The "5-Day Pass" was added to address interstate temporary vehicle use, allowing a fleet to operate a vehicle in California for five consecutive days one time per calendar year per vehicle. In addition, the restriction on vehicles that enter California one time was removed from the definition for "California fleet" and was applied to only fleets following the ZEV Milestones Option of the HPF Regulation. This restriction was not necessary for those using the Model Year Schedule because no new trucks may be added to the California fleet unless they are ZEVs, and it is not needed for the SLG Regulation. The rationale for why this is appropriate can be found in the ACF 15-Day Notice. However, no changes were made to the definition of California fleet as the definition is consistent among fleet types; the definition applies to all fleets subject to the Regulation, regardless of industry or makeup.

d) Definition of "California Fleet" Regarding Continual Compliance Management / Gamesmanship

Comment Summary: The commenters state that continually managing fleet-wide compliance is impractical due to continuous fleet size changes and ask for clear language on compliance, fleet definitions, and the time of year for evaluating fleet compliance in the ACF Regulation. The commenters express concerns about potential gamesmanship, stating that a fleet moving a non-ZEV or ZEV into California for one day should not be required to purchase additional ZEVs or be relieved of their obligation based on a single-day entry.

Commenter: [147-45d]

Agency Response: No changes were made in response to these comments. To establish fair and equitable requirements for all regulated fleets and to avoid potential gamesmanship, fleet owners are required to report changes to their fleet within 30 days. The Regulation requires the fleets to be in compliance every day of the year which is a requirement consistent with other CARB Regulations. Fleet owners that use the Model Year Schedule must remove vehicles that have exceeded their useful life by the end of the same calendar year and may not bring any new ICE vehicles into the fleet after the initial report in 2024. Exceptions only apply for exemptions that have been approved and reported in TRUCRS. Failure to apply for or wait for confirmation of approval is a violation. With the ZEV Milestones option, compliance is based on the number of ZEVs in the fleet as a percentage of the total California fleet. The fleet must remain in compliance with the ZEV milestones if newly adding a vehicle to the California fleet by operating it in California for the first time in a given year. The addition to the fleet must be reported within 30 days. A vehicle that comes into California in the middle of the year for a couple of months and does not return the rest of the year is still counted as part of the California fleet until the end of the calendar year. This approach prevents a fleet owner from bringing 12 different vehicles into California in sequence for one month at a time and claiming that only one vehicle operated in California that year. The intent was to make sure that vehicles sold, scrapped, or otherwise no longer owned or that no longer exist would reduce the number for purposes of the Milestones calculation; these vehicles would be removed from the California fleet size immediately for purposes of compliance. However, it was not intended to reduce the fleet size for vehicles still owned by the same fleet that are transferred out of state but are brought back to operate in California in the same or subsequent calendar year. Transferring a vehicle out of state and permanently allocating it to local operation somewhere else, then bringing it back to operate in California after it was transferred out of state, is not considered removing a vehicle from the California fleet by definition in the Regulation because the fleet owner is still eligible to continue operating that vehicle in the state. Indicating a vehicle is transferred out of state is effectively telling CARB the vehicle will not be operated in California the following year. Therefore, these vehicles would not be removed from the California fleet count until the end of the calendar year for purposes of the ZEV Milestones Calculation.

e) Definition of "California Fleet" Regarding Sold Vehicles

Comment Summary: The commenters request clarification on section 2015.2(b), asking if in-scope vehicles sold during the calendar year are excluded from the "California fleet" count compliance, regardless of replacement.

Commenter: [284-45d]

Agency Response: No changes were made in response to these comments. The Regulation requires the "California fleet" to be in compliance throughout the year, regardless of the selling or buying of vehicles, and requires fleet owners to report changes to their fleet, including any recently sold or purchased vehicles, within 30 days. A vehicle that is operated in California continues to be counted as a vehicle that operated in California during the calendar year. This approach prevents fleet owner from bringing 12 different vehicles into California in sequence for 1 month at a time and claiming that only one vehicle operated in California that year. The intent was to make sure that vehicles sold, scrapped, or otherwise no longer owned or that no longer exist, would reduce the number for purposes of the Milestones calculation; these vehicles would be removed from the California fleet size immediately for purposes of compliance. However, it was not intended to reduce the fleet size for vehicles that are still owned that are transferred out of state that could be brought back to operate in California in the same or subsequent calendar year. Transferring a vehicle out of state and permanently allocating it to local operation somewhere else, then bringing it back to operate in California after it was transferred out of state, is not considered removing a vehicle from the California fleet by definition in the Regulation because the fleet owner is still eligible to continue operating that vehicle in the state. Indicating a vehicle is transferred out of state is effectively telling CARB the vehicle will not be operated in California the following year. Therefore, these vehicles would not be removed from the California fleet count until the end of the calendar year for purposes of the ZEV Milestones Calculation.

f) Definition of "California Fleet" Regarding Vehicles Purchased with Incentive Funds

Comment Summary: The commenters mention section 2015(n) lacks explicit information on incentivized vehicles purchased before January 1, 2024, and request that ACF take a stronger stance to allow any incentivized vehicle to count towards the "California fleet."

Commenter: [284-45d]

Agency Response: No changes were made in response to these comments. The Regulation does not control nor set funding policy criteria. Those policies and criteria are determined by the legislation or policies established by the funding program administrators. The language in the Regulation regarding funding establishes a mechanism for funding programs to provide funding to fleets that comply with the ZEV Milestones Option if the funding program guidelines allow it. The January 1, 2024, start date references when such funded vehicles would be excluded from the compliance calculation to ensure the emission benefits are not double counted during the contract period specified in the funding program.

g) Definition of "California Fleet" Regarding Vehicle Purchase Commitments

Comment Summary: The commenters request that the "California fleet" definition exclude vehicles committed to before ACF Regulation adoption but delivered after, such as lease commitments made before the Regulation was proposed.

Commenter: [322-45d]

Agency Response: No changes were made in response to these comments. The "Vehicle purchase" or "purchase" definition references the placement of an order vehicle and describes vehicle commitments, including lease agreements with a contract term of one year or more. Section 2015.1(a)(1) of the HPF Regulation, which discusses the Model Year Schedule provision, states that new ICE vehicles may be added to the California fleet if the vehicle was purchased on or before the effective date of the Regulation. The ZEV Milestones Option allows ICE vehicles to be added to the fleet after the initial report, pursuant to the ICE Vehicle Additions requirements of the Regulation. Fleet owners may add 2010 to 2023 model year engines at any time whether or not they were purchased before the rule became effective. Similarly, a 2024 model year engine purchased before the Regulation took effect could also be reported as part of the California fleet after the initial report provided that it is a California certified engine.

h) Definition of Common Ownership and Control

Comment Summary: The commenters request that CARB modify the definitions of "common ownership or control" and "controlling party" to provide clarity, specifically addressing terms such as "in combination," "manages," "serves," and "directs or otherwise manages day-to-day operations." They argue that the current definitions lack clarity and are unworkable for today's trucking industry, as it is difficult to determine truck ownership status, truck owner business status, or truck count for implementing a ZEV purchase. They suggest focusing on exclusive, long-term relationships and aligning the definitions with the Truck and Bus Regulation and HVIP. Furthermore, they express concern that the Regulation's current definitions create unreasonable and incoherent classes of vehicles regulated separately under the ACF Regulation.

Commenter: [229-45d, 282-45d, 290-45d, 334-45d]

Agency Response: A change was made in response to these comments. The definition for "controlling party" was modified to specify that the term is applicable to managing day-to-day operations of vehicles, rather than fleets, because the definition of common ownership or control on which the controlling party definition is based applies to vehicles rather than fleets. This change is necessary for consistency and to prevent more than one reasonable and logical interpretation of the criteria. However, no change was made in response to these comments regarding the definition of "common ownership or control." The applicability criteria encompass fleet owners or controlling parties with combination fleets operated under common ownership or control totaling more than 50 vehicles to maintain a level playing field with other regulated parties who own their trucks and compete for the same business, and because they are positioned to have visibility and control over the fleet as a whole that the owner-operators of these vehicles do not have. It is necessary to specify that the applicability criteria apply to the total fleet of vehicles, not just the California fleet, because total fleet size is an indicator of financial means to make the capital investments needed. The purpose of the definition of “common ownership or control” is to define it as being owned or managed on a day-to-day basis by the same person or entity. Vehicles managed by the same directors, officers, or managers, or by distinct corporations that are controlled by the same majority stockholders are under common ownership or control, even if their titles are held by different business entities or they have different taxpayer identification numbers. Furthermore, a vehicle is under an entity’s control if the vehicle is operated using that entity’s state or federal operating authority or other registration. Vehicles owned by different entities but operated using common or shared resources to manage the day-to-day operations using the same motor carrier number, displaying the same name or logo, or contractors whose services are under the day-to-day control of the same entity are under common ownership or control. Common ownership or control of a federal government vehicle shall be the primary responsibility of the governmental agency that is directly responsible for the day-to-day operational control of the vehicle. Common ownership or control includes relationships where the controlling party has the right to direct or control the vehicle as to the details of when, where, and how work is to be performed or where expenses for operating the vehicle, such as fuel or insurance, are shared. Common ownership or control does not include agreements for individual loads that are competitively bid and issued to the lowest qualifying bid.

i) Definition of Configuration

Comment Summary: The commenters ask for an expansion of the "configuration" definition, proposing that it includes not only the primary function but also other features such as capacity, off-road capability, 4x4 drive, ground clearance, GVWR, refueling speed, operating run time, PTO, and specialized specifications. They request that the definition incorporates the Clean Air Act's definition of "complete vehicle" and the related definition from 40 CFR § 1037.801, as well as adding "and operation" after "primary intended function." They provide specific redlines for section 2015(b), suggesting to add: "'Configuration' means a unique combination of basic vehicle inertia weight, axle ratio and spacing, cargo body type, payload capacity as applicable, and is designed to achieve a specified performance output."

Commenter: [015-WT1, 210-45d, 261-45d, 326-45d]

Agency Response: Changes were made in response to these comments. The definition of “configuration” was modified to simplify the definition to mean the primary intended function for which a complete vehicle is designed, or as determined by the body permanently attached to the chassis of an incomplete vehicle. Reference to equipment integrated on the body was removed to prevent unintentionally including auxiliary or equipment for secondary uses in the definition. Examples were included to specify terms commonly understood by those directly affected by the Regulation that would exemplify the defined term, and examples of commonly understood equipment terms that would not be included in the definition were provided.

j) Definition of Designated Contact Person

Comment Summary: The commenters suggest that CARB define "designated contact person" as the individual to whom all notifications are sent, ensuring that entities can respond to CARB contacts in a timely manner. They provide an example of audit notices being sent to both the registered vehicle owner and the designated contact person to highlight the importance of having a clear point of contact.

Commenter: [207-45d]

Agency Response: No changes were made in response to these comments. The purpose of the requirement for the fleet to provide the designated contact person's information is to allow CARB to communicate with the fleet about assistance with compliance, reporting issues, exemption requests and making clarification or corrections to errors or incomplete information. While CARB enforcement personnel are aware of the commenter's request for the designated contact person to be included on all notifications, the contact may or may not be used by enforcement when sending audit requests or other enforcement actions. However, it might be helpful to know that a records request is not the first contact CARB enforcement makes with a fleet during an audit; CARB enforcement will make contact with the fleet using contact information found in DMV records, TRUCRS, or on a company's website, using whatever information is available to verify the appropriate person will be contacted before sending a records request.

k) Definition of Emergency Event

Comment Summary: The commenters suggest modifying the definition of "emergency event" to allow public agency general managers or ranking officers to declare such events, include responses affecting public health and safety or governed by other regulatory orders, and base the duration on immediate threats to public safety. They recommend considering the Stationary and Portable Airborne Toxic Control Measures for modeling types of emergencies and defining "emergency" and "emergency vehicle" within ACF. They also request broadening the definition to include non-Governor and public official declared events. They also state that the CARB Executive Officer should not be the entity that decides when an emergency is over because the duration of emergency situations is based on "immediate threat to public safety," which may require cleanup and repair activities.

Commenter: [014-45d, 207-45d, 210-45d, 269-45d, 309-45d]

Agency Response: No changes were made in response to these comments. The language does not specify that the Executive Officer would decide when such events end. The dates specified by the declaring body or the contract with the responsible emergency management entity would determine the end date. It is necessary to specify that emergencies must be declared events by the U.S. President, a State Governor, or other local governing body because those are the entities that have authority to declare such events. The duration of each declared emergency is unique and cannot be predicted in advance and the period of time vehicles need to be used to respond to emergencies is established in the declaration or in supporting contracts in response to the declaration. CARB's Executive Officer doesn't make the decision when a declared emergency event has ended; whoever declared the emergency event would be the one to end it. The intent of provisions relying on this definition is to alleviate immediate threats to public safety while establishing a specific time period when the emergency operation has ended for each unique event.

l) Definition of Emergency Operations / Emergency Support Vehicle

Comment Summary: The commenters request changes to the "emergency operations" definition, including operations of emergency support vehicles at the request of first responders and clarifying "routine operations" to include "planned maintenance or construction." They disagree that "routine operation to prevent public health risks" should not constitute emergency operation and propose aligning the definition with the In-Use Off-road Diesel-Fueled Fleet Regulation. The commenters request the definition include vehicles dispatched by a local, State, federal, or other responsible emergency management agency or public utility during any emergency and to prevent an emergency. Some commenters recommend that the definition of emergency support vehicle be modified to add: "or by a utility to restore utility service disrupted by a declared emergency event" to the definition. Some commenters state the definition should allow for non-emergency operation if time critical to prevent future or near-term emergencies.

Commenter: [207-45d, 210-45d, 226-45d, 229-45d, 310-45d, 291-45d, 342-45d]

Agency Response: No changes were made in response to these comments. This definition is necessary to set forth the circumstances during which authorized emergency support vehicles, in addition to vehicles claiming exemptions for emergency use, can provide emergency response services. It is necessary to limit operations to alleviating immediate threats to public health or safety and only when responding to declared emergency events because many fleets have emergencies, they routinely respond to within their normal service territories and are activities that are part of the normal daily operation and how the fleet is managed. The intent of this definition is to limit operations to extraordinary circumstances to enable nimble response to major declared emergencies, not to cover issues that fleets deal with on a daily basis, nor to cover routine maintenance prevention activities. There is no reason a ZEV could not be appropriately dispatched to support a routine maintenance or repair activity within the fleet. The list of event types points to existing California Government Code definitions for various conditions of emergency for simplicity and to align with existing definitions. Events that occur routinely, or are scheduled maintenance activities to prevent potential emergencies, are not included because they are planned daily operations that are part of normal business practices or services and should not be exempt due to foreseeable occurrences. The definition of an “Emergency support vehicle” does allow for those that have been dispatched by a local, State, or federal agency that is used in emergency operations. Routine operations to prevent public health risks do not constitute emergency operations. This is consistent with other in-use on-road CARB Regulations, and the off-road Regulation’s definition of emergency operations also excludes routine maintenance or construction to prevent public health risks.

m) Definition of Fleet Owner

Comment Summary: The commenters ask for adjustments to the "fleet owner" definition regarding leased vehicle ownership, aligning with the ACT definition regarding assignment of fleet ownership to lessees if their lease agreements contain terms of at least one year; that for entities that lease at least 50 vehicles pursuant to “full service” or “operating” leases, the fleet owner for purposes of compliance should be the entity that operates such vehicles under its own motor carrier authority; is responsible for operational DOT-related safety obligations; is responsible for operating said vehicles in accordance with all State and federal laws (e.g., hours of service, commercial driver’s license requirements, etc.); or has control over the use and operation of the vehicle (i.e., the lessee). Commenter suggests modifications to the "High Priority" definition (by which it appears they mean “fleet owner” based on the context of the comment) to exclude small operators with service clients that have revenues over $50 million.

Commenter: [008-45d, 150-45d, 169-45d]

Agency Response: No changes were made in response to these comments. The original proposal already specified that the lessee is considered the "fleet owner" if the lease agreement is for one year or more, as it is in the fleet information reporting requirement of the ACT Regulation. This could be the case even for the lease of fewer than 50 vehicles if the fleet owners own, operate, or direct the operation of at least 50 vehicles in total, and whether under a "full service" or "operating" lease, or not. A determination was made that lease agreements of one or more years indicated sufficient control over the vehicle by the fleet owner. Additionally, the original proposal already specified in the definition of "common ownership or control" that vehicles owned by different entities but operated using common or shared resources to manage the day-to-day operations using the same motor carrier number, displaying the same name or logo, or contractors whose services are under the day-to-day control of the hiring entity are under common ownership or control. Therefore, the "fleet owner" would be the person who demonstrates such common ownership or control. However, even small operators with $50 million or more in total gross annual revenue fall under the established threshold for companies that have the financial means to make the capital investments in ZEVs and associated infrastructure in the early transition. Therefore, being a small operator does not, in and of itself, change the designation of fleet ownership. The complete rationale for Scope and Applicability and Fleet Applicability is discussed in Sections 2015(a)(1) and 2015(a)(1)(A-D) of Appendix H-2 to the ACF ISOR.

n) Definition of Heavy Front Axle

Comment Summary: The commenters state that Class 8 solid waste collection vehicles would meet the definition of heavy front axle but that they are excluded from front axle weight limits specified in CVC subsection 35551.5(b), and commenter is unsure if CARB intends solid waste collection vehicles to be included in ZEV Milestones Option Group 3 specialty vehicles because they have heavy front axles as the Regulation defines.

Commenter: [310-45d]

Agency Response: No changes were made in response to these comments. Any Class 8 vehicle with a heavy front axle, as defined in the Regulation, would be included in the "specialty vehicle" definition. If a Class 8 refuse truck has a heavy front axle, regardless of the exclusion from axle weight limits specified in CVC subsection 35551.5(b), it would be included.

o) Definition of Minimum Useful Life

Comment Summary: The commenters request reworking the "minimum useful life" definition to align with upcoming U.S.EPA sliding scale definition. Some commenters suggest changing the minimum useful life definition from "the model year that the engine and emissions control system in a vehicle was first certified for use by CARB or U.S. EPA" to "from the model year that is listed on the emission control label of the engine" because the current definition can be misinterpreted to mean that the useful life is based on the model year standard the engine was certified to meet. Commenter requests allowed useful life miles are extended to one million miles.

Commenter: [053-45d, 125-45d, 127-45d, 130-45d, 238-45d, 247-45d]

Agency Response: No changes were made in response to these comments. California law as set forth in SB 1 sets the minimum useful life of commercial vehicles, including the engine model year to which it applies. The Regulation is consistent with the requirements of SB 1.

p) Definition of Near-Zero-Emissions Vehicle

Comment Summary: The commenters request a complete and clear definition of NZEVs in ACF instead of pointing to other California code references. Some commenters state that the current NZEV definition is limited to "vehicles powered by an ICE and a battery-electric powertrain capable of operating like a ZEV for 'a limited time'," yet other technologies, like mobile carbon capture, can potentially provide equivalent or more emissions reductions than NZEVs, and requests that these technologies be appropriately accounted for and incentivized in ACF.

Commenter: [207-45d, 275-45d, 342-45d]

Agency Response: No changes were made in response to these comments. The NZEV definition in the Regulation is aligned with existing requirements for California's GHG Phase 2 Regulation and the ACT Regulation and was selected to ensure continued improvement and advancement towards full ZEVs. The purpose is not to include all vehicles that could operate with less emissions than a typical ICE vehicle. The definition was selected because of PHEV technology's potential to operate with zero-emissions for some or most of the time the vehicle is operated which results in the needed criteria and GHG reductions and as a bridging technology to full ZEVs. Including ICE with carbon-capture technology on board would not reduce criteria pollutants and is speculative at this time.

q) Definition of Near-Zero-Emissions Vehicle – Lower All-Electric Range Requirement

Comment Summary: The commenters state that minimum all-electric range requirements should align with customer and fleet operator needs, as higher range requirements may increase costs without providing additional benefits.

Commenter: [030-WT1, 120-OT1]

Agency Response: No changes were made in response to these comments. The NZEV definition in the Regulation is aligned with existing requirements for California's GHG Phase 2 Regulation and the ACT Regulation and was selected to ensure continued improvement and advancement towards full ZEVs. Higher electric range requirements help advance development of battery-electric systems. Nothing in the Regulation prevents fleets from purchasing NZEVs with lower all-electric range if they are utilizing the ZEV Milestones Option and are meeting their ZEV Milestones, though the vehicles would not count toward the fleet's compliance obligation.

r) Definition of Renewable Natural Gas Vehicle

Comment Summary: The commenters request adding a definition for biomethane vehicles, which includes criteria such as: fleet owners must use these vehicles for organic waste, solid waste, and recyclable materials collection; vehicles that exclusively use biomethane for fueling; and vehicles operating or contracting with California biomethane production facilities. Commenters also state the ICE vehicle definition should exclude vehicles powered by SB 1383 compliant biomethane, and they advocate discouraging ICE vehicles running on diesel, gasoline, or fossil natural gas.

Commenter: [175-45d, 304-45d]

Agency Response: No changes were made in response to these comments. Biomethane powered vehicles are CNG vehicles that use biomethane as a fuel. These are still powered, by definition, with ICEs. The Regulation language already includes a Waste and Wastewater Fleet Option with appropriate criteria for vehicle, fleet, and fuel inclusions that cover most of the commenter's suggested edits.

s) Definition of Vehicle Purchase

Comment Summary: The commenters seek clarification on the term "immediate delivery" in the definition of "vehicle purchase," pointing to a potential conflict with page 92 of the ACF ISOR, which acknowledges that Class 4 and above vehicles are typically manufactured in stages and that the process can take up to a year or more.

Commenter: [310-45d]

Agency Response: No changes were made in response to these comments. The inclusion of "immediate delivery" means as soon as the manufacturer is able to assemble the vehicle and the term is to ensure fleet owners are making a good faith effort to place ZEVs in service as soon as possible. The purpose is to close a loophole where an owner can place an order on paper but with an intentionally delayed delivery date. The board recognizes that it can take several years to receive a vehicle that is ordered for immediate delivery and accounts for that in the Vehicle Delivery Delay Extension.

t) Definition of Specialty Vehicle

Comment Summary: The commenters request that ready-mix concrete trucks and solid waste collection vehicles be consistently categorized, asking for their inclusion in the specialty vehicle definition. They suggest modifying the "Specialty vehicle" category to encompass vehicles with complex specifications unique to the service area, such as medium/heavy-duty Class 4 through 8 booms for aerial/overhead work, extended duty cycle PTO-driven equipment, augers, cranes, water filtration, vacuum equipment, fumigation sprayers, and communication devices.

Commenter: [015-WT1, 170-45d, 261-45d, 310-45d]

Agency Response: No changes were made in response to these comments. The specialty vehicle definition includes any Class 8 vehicle with a heavy front axle, or a Class 8 vehicle designed to carry cargo and configured to perform work that can only be done while the vehicle is stationary and the auxiliary mechanism to perform that work is an integral part of the vehicle design. Vehicles meeting that definition include cement trucks, solid waste collection vehicles, drilling rigs, among many others. No changes were made to address the specific inclusions of booms, PTO equipment, augers, cranes, water filtration, vacuum equipment, sprayers, or communication devices, because including others would undermine the objectives of the Regulation and would introduce a large loophole in the Regulation because of how expansive the suggested change is. Other exemptions and extensions address situations where ZEVs of certain configurations are not available to purchase or cannot meet a fleet's daily usage needs. For example, the ZEV Purchase Exemption allows fleets to purchase a new ICE vehicle when ZEVs are not available in the needed configuration, and the Daily Usage Exemption allows fleets to purchase a new ICE vehicle if available ZEVs cannot meet the duty cycle for the same truck configuration.

8. 100 Percent ZEV Sales Issues

a) 100 Percent ZEV Sales Requirement and Fleet Size Applicability Thresholds

Comment Summary: Commenters are suggesting moving the 100 Percent ZEV Sales requirement to 2036, lowering the HPF fleet size applicability threshold below the originally proposed 50 trucks down to 10 tractors, and moving all tractors from ZEV Milestones Group 3 to Group 2, or otherwise earlier than originally proposed. The commenters support adopting Alternative 2 of the ACF ISOR which would simultaneously lower the fleet size threshold, accelerate the ZEV Milestones timelines for tractors, and move up the 100 Percent ZEV Sales requirement to 2036. They state these changes will make the Regulation more stringent, create more jobs, provide economic, health, and air quality benefits, while protecting against driver misclassification.

Commenter: [005-WT1, 008-WT1, 008-OT1, 011-WT1, 012-OT1, 013-WT1, 016-WT1, 017-WT1, 018-WT1, 019-WT1, 020-WT1, 023-WT1, 025-OT1, 026-WT1, 027-OT1, 028-WT1, 029-45d, 029-OT1, 031-OT1, 031-WT1, 032-OT1, 035-WT1, 036-OT1, 036-WT1, 038-WT1, 039-OT1, 040-45d, 040-WT1, 043-45d, 043-OT1, 044-OT1, 045-OT1, 046-OT1, 048-OT1, 049-OT1, 052-OT1, 055-OT1, 056-OT1, 058-OT1, 059-OT1, 060-OT1, 061-OT1, 064-OT1, 066-OT1, 067-OT1, 069-OT1, 070-OT1, 071-OT1, 074-OT1, 075-OT1, 100-45d, 104-OT1, 106-OT1, 107-OT1, 108-OT1, 110-OT1, 111-OT1, 112-OT1, 114-OT1, 117-OT1, 119-45d, 119-OT1, 122-OT1, 122-45d, 123-45d, 123-OT1, 125-OT1, 126-OT1, 128-OT1, 131-45d, 131-OT1, 133-OT1, 137-OT1, 146-OT1, 149-OT1, 152-OT1, 154-OT1, 160-OT1, 162-OT1, 163-OT1, 183-45d, 186-45d, 199-45d, 209-45d, 212-45d, 213-45d, 231-45d, 240-45d, 242-45d, 244-45d, 262-45d, 273-45d, 296-45d, 327-45d, 328-45d, 332-45d, 338-45d, 350-45d]

Agency Response: Changes were made in response to these comments. The Board approved shifting the 100 percent sales requirement for ZEVs to 2036 reflected in the ACF 15-day changes. This modification reflects the Board's intent to expedite the transition to ZEVs, to achieve criteria pollutant reductions, GHG benefits, and meeting targets established by executive orders.

The fleet size for tractors was not lowered to 10 because the initial upfront cost to purchase ZEVs is higher than for ICE vehicles. The approximately 4,000 smaller fleets impacted typically have limited access to capital and are more likely to purchase used vehicles. Additionally, retail infrastructure for ZEVs is currently limited in availability. The Board decided the timing for bringing in smaller fleets requires additional study. Once a robust secondary market for ZEVs is established by the end of this decade, smaller fleets will be better positioned to transition to ZEVs.

No changes were made to accelerate HPF Milestone Schedule for Group 3 to start in 2027. The ZEV market for Group 3 vehicles is expected to take the longest to develop, and tractors in this category are more likely to be involved in regional or long-haul operations that rely on an extensive regional and interstate ZEV fueling and charging network that needs time to develop. However, BEV technology is rapidly improving and NZEVs are available in this category that have a range of about 1,000 miles. NZEVs count as ZEVs up until model year 2035. The Board already adopted the State Implementation Plan that includes a Zero-Emissions Truck Measure that is due to be considered by the Board in 2028. This measure will evaluate various strategies that could facilitate a smoother and more equitable transition to ZEVs for these truck owners. The Board will be evaluating the most effective proposals as part of the 2028 SIP. For more information, please refer to the February 10, 2023, Memorandum to the Board.[172]

b) Implement 100 Percent ZEV Sales Four Years Earlier

Comment Summary: The commenters suggest moving the Regulation's timeline four years earlier to protect children's health. Commenter: [035-WT1]

Agency Response: Changes were made in response to these comments. Staff interpret this comment to apply to the 100 percent sales requirement. The initially proposed Regulation was modified by shifting the 100 percent sales requirement for ZEVs to 2036 instead of 2040 as reflected in the ACF 15-day changes.

c) Require 100 Percent ZEV Sales by 2035

Comment Summary: Commenters are requesting to move the proposed 100 Percent ZEV Sales requirement to 2035.

Commenter: [082-OT1, 271-45d]

Agency Response: Changes were made in response to these comments. The initially proposed Regulation was modified by shifting the 100 percent sales requirement for ZEVs to 2036 instead of 2040 as reflected in the ACF 15-day changes. This is directionally the same as the suggestion.

d) 100 Percent ZEV Sales Requirement for Out-of-State Vehicle Purchases

Comment Summary: The commenters state that the 100 Percent ZEV Sales requirement lacks clarity regarding the treatment of out-of- state vehicle purchases that are brought into California and how the ACF Regulation would apply to third-party sales.

Commenter: [207-45d]

Agency Response: Changes were made in the response to these comments. Language was modified to include the requirement to purchase new California certified engines when exemptions are granted. Also, when adding ICE vehicles to the California fleet under the ZEV Milestones Option the engines must be 2010 to 2023 model year, and any additions of 2024

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[172] CARB, Advanced Clean Fleets Regulation High Priority Fleet Size Analysis, 2023 (web link: https://ww2.arb.ca.gov/sites/default/files/2023-02/HPF%20Fleet%20Size%20Board%20Memo_ADA.pdf, last accessed March 2023).

model year or later engines must be California certified. The 2010 or newer requirement was selected to remain consistent with the requirements of the Truck and Bus Regulation. CARB is not regulating fleets operating outside of California, however, any fleets intending to conduct business in California must adhere to California laws and Regulations for the vehicles they will operate as part of their California Fleet to reduce the emissions that occur here.

9. Drayage Truck Requirements Issues

a) Drayage – Add Near-Zero-Emissions Vehicles and Plug-In Hybrid Electric Vehicles

Comment Summary: The commenters request specific flexibilities for NZEVs or PHEVs to be included in the drayage fleet. Commenters specifically request CARB provide credits for NZEVs or PHEVs to meet the drayage truck requirement, like the high priority or government requirements. The commenters state that NZEVs should also be able to generate ZEV credits in the drayage section of the Regulation to reduce costs and achieve greater near-term air quality benefits. Finally, to allow post 2010 low-NOx engines retrofitted with batteries to become PHEVs or NZEVs and be permitted for drayage operation and implementing zero-only operation in defined zones at or near the applicable seaport or railyard location.

Commenter: [076-OT1, 114-45d, 181-45d, 284-45d]

Agency Response: No changes were made in response to these comments. Additional NZEV or PHEV flexibilities are not needed in the drayage sector due to the phase-in of ZEV requirements. Introducing a crediting mechanism would introduce unnecessary complexity to the Regulation as PHEVs and NZEVs are bridging technologies and would not be allowed in the drayage sector beyond 2035. In addition, the drayage truck requirements provide fleets with the flexibility to continue to utilize legacy combustion trucks as they transition toward ZEVs. Furthermore, allowing NZEVs would delay the emissions benefits of the drayage requirements since they would be allowed to operate through their SB 1 useful life limits or until 2035, whichever comes first. The Regulation includes an accelerated timeline for transitioning drayage trucks to ZEVs to help reduce the high cumulative exposure burdens of toxic air contaminants and criteria air pollutants that communities nearby seaports and railyards experience.

b) Drayage – Alternative Analyses

Comment Summary: The commenters state that additional analyses are needed before moving forward with drayage truck requirements. Two unique analyses requested by the commenters include limiting the drayage truck requirements for the seaport to near-dock rail operations only and analyzing the impacts on different drayage fleet sizes.

Commenter: [282-45d, 341-45d]

Agency Response: No changes were made in response to these comments. The requested additional analyses would not provide information that would result in changes to the Regulation. The drayage truck requirements are part of a comprehensive strategy that would accelerate the widespread adoption of ZEV in the heavy-duty truck sector and eliminate the health impacts associated with emissions from these trucks, including eliminating exposure to diesel PM, a toxic air contaminant. It requires drayage fleets to deploy ZEVs starting in 2024 and would establish a clear end date for heavy-duty ICEs operating in the drayage sector by 2035. As discussed in Chapter VIII.E.2. of the ACF ISOR, overall costs to an example small business drayage truck owner-operator subject to the drayage truck requirements were modeled. The commenters suggested analyses would not provide additional information that would achieve the same health protective benefits.

c) Drayage – Cost of the Regulation

Comment Summary: The commenters state the high cost of ZEVs, and the drayage truck requirements will negatively impact seaport businesses and increase the costs to consumers. Commenters state the cost of the Regulation is too high, and CARB analysis on the TCO is incorrect due to faulty assumptions regarding the LCFS program, and there will be negative consequences for the economy, businesses, or the transportation system. Specifically, that the higher costs will result in some companies going out of business, and job losses along the entire supply chain.

Commenter: [023-OT1, 036-45d, 073-45d, 162-45d, 163-45d, 187-45d, 274-45d, 284-45d, 341-45d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in sections "Costs – Costs of the Regulation," "Costs – Passthrough to the California Economy," "Costs – LCFS Assumptions," and "Drayage – Supply Chain Issues," "Costs – Supply Chain Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses." As described in those responses, CARB performed a thorough analysis in accordance with State law to evaluate the economic impact of the ACF Regulation. When factoring in upfront costs including vehicles and infrastructure, operating costs including fuel and maintenance, and other miscellaneous costs this analysis found the Regulation is expected to result in a cumulative net savings to the State of $48.0 billion from 2024 to 2050, with the drayage portion by itself expected to save $7.4 billion. Note that these cost savings do not include the $28.5 billion in expected health savings to 2050.

These cost savings are due to a combination of factors. While ZEVs are expected to cost more upfront due to higher vehicle and infrastructure costs, there is an expected decrease in operating costs due to lower fuel costs, decreased maintenance expenses, and revenue from California's LCFS Regulation. This results in a lower TCO for ZEVs versus their ICE counterparts. As ZEV costs will decline over time, the savings ramp up. CARB also prepared numerous sensitivity analyses to assess the impact of different assumptions would have on the cost of the Regulation.

CARB's cost analysis included the direct costs of the Regulation to businesses directly affected by the Regulation as well as macroeconomic impacts of the Regulation on the overall California economy. This analysis included the impact of cost passthrough associated with both costs and cost savings. Broadly, CARB estimates the Regulation would be unlikely to have a significant impact on the California economy. Overall, the change in the growth of jobs, state GDP, and output is projected to not exceed 0.2 percent of the Baseline. Overall, the Regulation would result in a cost savings, and cost passthrough to consumers should be beneficial since the overall economic impact to trucking fleets is positive.

As described in more detail in section “Costs – LCFS Assumptions” in “Cost Comments” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses,” the costs did not assume fleet owners relying on retail charging or refueling would receive LCFS credits. CARB modeled only fleets using the own infrastructure installed at depots will be able to generate LCFS credits.

d) Drayage – Cost of the Regulation – Small Business Owners

Comment Summary: The commenters state that drayage fleets are small, family-owned businesses, and the cost of ZEVs and infrastructure will be too much and will cause them to go out of business. In addition, the commenters state that the costs to deploy ZEVs will put a disproportionate burden on small fleets that cannot afford ZE equipment, and that ZEVs are not currently affordable for many small companies and individuals even with the incentives being offered.

Commenter: [009-45d, 017-45d, 078-45d, 126-45d, 166-45d, 205-45d, 206-45d, 274-45d]

Agency Response: No changes were made in response to these comments. CARB’s analysis evaluated the impact of the Regulation on small fleets who would be affected by the drayage truck requirements of the ACF Regulation.

The drayage truck requirements are phased in over 11 years and allow drayage owners to continue using legacy combustion trucks as drayage trucks for the length of their useful life or until 2035. This ensures that legacy vehicles can continue to operate as ZEVs are phased-in over time.

The analysis in Chapter VIII the ACF ISOR and the ACF SRIA evaluated the direct costs to a drayage truck owner-operator subject to the Regulation’s requirements. This analysis assumed no incentives or grants for the owner-operator and that the owner-operator would rely on retail fueling and would not receive any LCFS credits. This analysis found that over the analysis period, the costs to the drayage owners transitioning to ZEVs as a result of the Regulation would be lower than in the baseline scenario operating a diesel vehicle. When factoring in new programs such as the IRA and various incentive programs at the state and local level available for small fleets, the cost to purchase and operate these ZEVs may be even lower than modeled in the ACF ISOR.

Numerous opportunities exist to defray these upfront costs and capture operational savings. HVIP and other commercial technology incentive programs aim to increase market penetration by reducing incremental costs, and therefore purchase price, while recognizing the long-term cost savings of operating a ZEV and stretching the benefits of State resources. However, CARB recognizes that circumstances vary by fleet and vehicle type, and we are continuously reassessing incentive amounts or mechanisms. CARB welcomes fleets to collaborate with us through our annual public process on funding. Simultaneously, truck financing models are evolving to better suit the ZEV market, and new business models such as truck-as-a-service are appearing which minimize the upfront investment needed. These models allow fleets to operate ZEVs with a similar monthly payment to existing ICE vehicles by amortizing the upfront costs over time and capturing operational savings. California has committed substantial funding solely for ZE drayage. Through HVIP, more than $150 million remains in the drayage set-aside while the Governor’s January Budget proposal for fiscal year 2023-24 allocates an additional $165 million for drayage trucks.

Additionally, the VW Environmental Mitigation Trust currently has over $70 million in funding to replace compliant Class 8 freight and drayage trucks, dump trucks, waste haulers and concrete mixers MY 2012 and older with new ZE Class 8 trucks. All vehicles eligible for HVIP funding are also eligible in VW, and recent program changes will allow stacking VW funding with other funding programs, including HVIP, that do not claim NOx reductions.

e) Drayage – Daily Usage Exemption

Comment Summary: The commenter requests a daily use exemption for drayage trucks with longer routes. For example, a Daily Usage Exemption is needed because some drayage trucks currently travel four hundred miles or more round-trip route and back on a daily basis.

Commenter: [282-45d]

Agency Response: No changes were made in response to these comments. A daily use exemption for drayage trucks that have longer routes is not needed due to the flexibilities for drayage fleets to phase-in ZEVs. The drayage truck requirements allow fleets to continue to use legacy combustion drayage trucks within their useful life for longer routes as ZEV technology and statewide ZEV fueling infrastructure continues to develop. As discussed in Chapter I.E.4. of the ACF ISOR, approximately 33,500 drayage trucks service California's seaports and intermodal railyards annually, of which 28,700 are trucks that visit California's seaports and intermodal railyards an average of two or more times per week.[173] As of December 31, 2022, at the sunset of the previous Drayage Truck Regulation, there were over 140,000 compliant drayage trucks with 2010 or newer model year engines registered in the CARB DTR. These legacy trucks will likely continue to operate in the drayage sector, which should provide enough trucks to serve both the seaports and railyards.

f) Drayage – Definition – "Marine or seaport"

Comment Summary: The commenter requests to refine the "Marine or seaport" definition specifically to remove "or passengers" and "or surrounded by" in the current definition.

Commenter: [082-45d]

Agency Response: No changes were made in response to these comments. The "Marine or seaport terminals" definition minimizes loopholes for drayage trucks that operate at facilities within the boundaries or jurisdiction of a marine or seaport terminal. This definition is also consistent with the previous CARB Drayage Truck Regulation and provides consistency with those requirements.

g) Drayage – Expand the Drayage Truck Definition

Comment Summary: The commenter requests that the definition of a drayage truck be expanded to include additional vehicle types, specifically auto-carriers.

Commenter: [037-OT1]

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[173] Proposed Advanced Clean Fleets Regulation Staff Report: Initial Statement of Reasons (ca.gov) 2023, (weblink: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/acf22/isor2.pdf).

Agency Response: No changes were made in response to these comments. Auto-carriers are covered under the HPF requirements, which align more closely with the suitability of auto-carrier duty cycles and can address auto-carrier activities that occur both in and outside of California's seaports and railyards.

h) Drayage – Exemption – Non-Repairable Vehicle

Comment Summary: The commenter requests an exemption be added for trucks that experience a catastrophic engine failure or accident that could render existing drayage trucks useless, despite remaining useful life protection.

Commenter: [341-45d]

Agency Response: Changes were made in response to these comments. A provision was added for drayage truck owners to request and obtain an extension if a vehicle is non-repairable due to an accident or other circumstance beyond the drayage truck owner's control that damages the vehicle such that it is not repairable. This would allow a drayage truck owner to purchase and add to the CARB Online System a used vehicle with an ICE of the same or newer model year to replace a vehicle that is non repairable. The used vehicle would be able to operate until the end of the minimum useful life of the original vehicle.

i) Drayage – Exemption – Combustion Vehicles Ordered Pre-2024

Comment Summary: The commenter states that the January 1, 2024, deadline for drayage should allow for the registration of combustion vehicles purchased prior to the deadline that are not delivered until after the deadline.

Commenter: [001-45d]

Agency Response: No changes were made in response to these comments. The Regulation allows combustion trucks to be added to the CARB Online System as part of the legacy fleet until December 31, 2023. Allowing combustion trucks to be added beyond that circumvents the intent of the rulemaking of transitioning the drayage fleet toward ZEVs by 2035. In addition, the high concentration of drayage trucks operating at seaports and railyards results in higher levels of exposure of diesel toxics to nearby communities, so transitioning the drayage fleet to ZE operations as soon as possible accelerates the drayage ZEV fleet transition and related health benefits. Allowing additional combustion engines to be added after the end of 2023 and expanding the current combustion drayage fleet would only further delay much needed and overdue health benefits to these communities.

j) Drayage – Incentives

Comment Summary: The commenter requests that CARB describe specific measures it will implement to assist drayage truck owners to afford compliance with the Regulation.

Commenter: [274-45d]

Agency Response: No changes were made in response to these comments. The 2021 and 2022 State budgets include a total investment of $10 billion over six years to reduce carbon dioxide emissions from the transportation sector by supporting ZEVs and ZEV infrastructure. This funding will be administered by CARB, CEC, the Caltrans, and GO-Biz. This funding builds on ZEV infrastructure investments made by the State for more than a decade. These investments focus on an equitable ZEV transition by continuing to find ways to support disproportionately impacted communities. Specific details about the currently available funding programs can be found on the ACF Fact Sheet web page.[174] These funding programs are available to support the use of advanced technologies, and because funding programs only pay for early adoption not for compliance, more funding opportunities exist for those fleets that act early. Please see additional responses to issues raised in section "Drayage – Costs of the Regulation" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

k) Drayage – Infrastructure Availability

Comment Summary: The commenters state the lack of ZEV fueling infrastructure makes the drayage rule infeasible. The commenters state that the lack of charging infrastructure will cause delays in drivers making appointment times and long lines at the seaports, resulting in companies losing money. The commenter states that there currently isn't any infrastructure in Baja, California, to address drayage vehicles that cross the border to enter the seaport. Commenter states that the scale of the charging infrastructure necessary would be 65 to 160 MW.

Commenter: [026-OT1, 076-45d, 078-45d, 098-45d, 293-45d]

Agency Response: Changes were made in response to these comments. Infrastructure delays are accounted for in the drayage truck requirements, and an expanded infrastructure delay compliance extension was provided to account for potential delays in the completion of infrastructure installation projects. The Regulation is phased in over 11 years, and CARB is collaborating with other State agencies including CEC, CPUC, and GO-Biz, along with IOUs and POUs to actively plan for this transition.

In addition, other infrastructure efforts are ongoing to provide balanced charging and fueling opportunities for affected fleets. For example, faster chargers with speeds up to 350 kW are being deployed in the field today and work is underway to develop and demonstrate chargers that exceed one MW that would allow even the largest vehicles to recharge in well under an hour. PG&E has an EV Fast Charge program that is designed to enable public fast charging and complements State and privately funded initiatives within their territory. The $22 million program runs through 2025 and aims to install approximately 50 plazas for direct-current fast charging in corridor and urban sites. PG&E would pay for and build the infrastructure from the electric grid to the fast-charging equipment.

Furthermore, as described in Chapter I.G.1.1. of the ACF ISOR, the infrastructure issues at ports of entry at the Southern border are similar to those in all areas of California with the exception of the potential for availability on the Mexican side of the border. The drayage truck requirement phase-in approach provides drayage fleets time to continue utilizing the legacy trucks while ZEV fueling infrastructure develops.

Please see responses to issues raised in section "Infrastructure Availability – General" in "Infrastructure and Grid Concerns" of the "45-Day Comment Period and First Board Hearing

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[174] Advanced Clean Fleets Regulation Summary | California Air Resources Board 2023, (weblink: https://ww2.arb.ca.gov/resources/fact-sheets/advanced-clean-fleets-Regulation-summary last accessed March 2023.

Public Comments with Agency Responses" for a more detailed response to the general infrastructure concerns.

l) Drayage – Infrastructure Availability – Utility Delay

Comment Summary: The commenter states there is a long utility backlog for installing power for infrastructure.

Commenter: [163-45d]

Agency Response: Changes were made in response to these comments. The Infrastructure Delay Extension was expanded from one-year to two-years for construction related delays, allowing for a total of three years from the date a construction permit was obtained to delay ZEV deployments due to circumstances outside a fleet owner's control during site construction. Additional criteria were added to the extension to address site-specific circumstances due to utility delays that cannot be supported by existing site power due to delays in obtaining grid power from the utility before construction starts. This type of delay could receive an initial extension of up to three years and could be extended another two years if delay conditions persist. Eligibility would be based on the date the fleet owner either executes a contract with the utility to build out the infrastructure project or the utility attests they will proceed with the project. The rationale for why this extension was expanded can be found in the description of changes to Chapter B.(C)., section 2014.2, in the ACF 15-Day Notice.

m) Drayage – Infrastructure Availability – Retail

Comment Summary: The commenters state that public or retail infrastructure is not ready, and the majority of the drayage fleet will rely on public-facing infrastructure. They state that the retail infrastructure is not sufficiently available, will take too long to install, might not be in the necessary locations along common drayage routes, or there isn't space at the seaports for charging infrastructure, specifically related to the drayage truck requirements, and will not be ready with Regulations starting in the 2024 timeline which will result in congestion or cargo delays, so should delay or not adopt Regulation until sufficient public infrastructure is available. Commenter states that drayage trucks need more flexibility, including infrastructure, because some park on public streets and cannot install chargers at home.

Commenter: [023-45d, 032-45d, 034-45d, 035-45d, 036-45d, 073-45d, 089-OT1, 111-45d, 112-45d, 115-45d, 116-45d, 118-45d, 126-45d, 145-45d, 151-45d, 156-OT1, 163-45d, 166-45d, 171-45d, 178-45d, 205-45d, 206-45d, 274-45d, 288-45d, 311-45d, 341-45d]

Agency Response: No changes were made in response to these comments. CARB expects the development of public or retail fueling infrastructure to be able to meet consumer demand at the same pace as the drayage truck ZEV requirements. Larger fleets will likely have access to on-site charging or refueling infrastructure at their facilities as business models shift toward ZE technology. For vehicles that do not have access to overnight parking facilities, there are several third-party infrastructure providers currently developing public retail charging infrastructure. The drayage truck requirements include compliance extensions to address delays in development of ZEV fueling infrastructure at these overnight parking and public retail charging facilities. In the near-term, owner-operators and smaller fleets will be able to continue using their combustion drayage trucks through the end of their useful life.

In addition, California has made, and continues to make, significant investments in medium- and heavy-duty ZEV infrastructure, including roughly $2 billion over the past two fiscal years. This includes investments through the EnergIIZE block grant with multiple funding lanes to address various vehicle and vocation segments. Funding opportunities have also supported planning blueprint creation, transit agencies, drayage trucks, public retail stations, and other innovative use cases. In addition, some of California's major seaports and some third-party infrastructure providers are currently developing public retail charging infrastructure. Please see additional responses to issues raised in section "Infrastructure and Grid Concerns - Publicly Accessible" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

n) Drayage – Less Stringent Regulation

Comment Summary: The commenters request that CARB make the drayage truck requirements less stringent by pushing out the regulatory deadlines or aligning with the HPF Regulation or to push out the ZEV entry standard for drayage trucks until there is a sufficient supply of infrastructure.

Commenter: [032-45d, 053-45d, 073-45d, 077-45d, 108-45d, 110-45d, 150-45d, 185-45d, 206-45d, 274-45d, 311-45d]

Agency Response: No changes were made in response to these comments. The drayage truck requirements are phased in between 2024 through 2035. The transition allows the legacy combustion drayage trucks to continue to operate until they meet the limits of the useful life provision. The drayage truck requirements include infrastructure delay provisions to provide additional time for fleets when infrastructure development is delayed. In addition, due to the high volume and concentration of drayage trucks operating at California's seaports and railyards, which results in higher levels of cumulative toxic exposure to communities living nearby, an accelerated transition of drayage trucks to ZE operations is a critical component of the ACF Regulation in reducing the toxic diesel exposure to those communities.

o) Drayage – One Visit Requirement

Comment Summary: The commenters state concerns about the impact of the one visit per year requirement on the State's ability to handle cargo throughput and recommend removing it to add flexibility during unanticipated cargo surges. In addition, the requirement could negatively impact the transport of break-bulk material through the seaport because the drayage trucks that transport these materials are largely out-of-state trucks that utilize our day pass system.

Commenter: [082-45d, 089-OT1, 282-45d]

Agency Response: No changes were made in response to these comments. The annual visit requirement is necessary to ensure trucks that that regularly visit seaports and railyards can continue to operate, while minimizing the impact of additional combustion trucks being added to circumvent the intent of the drayage truck requirements. The legacy trucks that visit at least one time per year will remain registered in the CARB Online System and will be allowed to continue operations throughout their useful lives.

As discussed in Chapter I.E.4. of the ACF ISOR, approximately 33,500 drayage trucks service California's seaports and intermodal railyards annually. As of 12/31/2022, at the sunset of the previous Drayage Truck Regulation, there were over 140,000 drayage trucks with 2010 or newer model year engines registered in the previous CARB DTR. These additional or supplemental trucks are expected to support the drayage fleet during cargo surges at California's seaports or railyards if they visit at least once per year and do not exceed the useful life limitations.

p) Drayage – Out-of-State Trucks

Comment Summary: The commenter states that out-of-state drayage trucks are not provided relief in the drayage truck requirements, which will lead to inefficiencies in drayage operations and negatively impact consumers.

Commenter: [284-45d]

Agency Response: No changes were made in response to these comments. The drayage truck requirements apply equally to all drayage trucks that enter and operate in California's seaports and railyards. The drayage truck regulatory requirements are not anticipated to create a competitive advantage or disadvantage for out-of-state trucks that would result in inefficiencies or negatively impact consumers.

q) Drayage – Railyards

Comment Summary: The commenter states they are concerned that the Mira Loma railyard is excluded from the Regulation because it is in one of the most highly polluted areas in the State.

Commenter: [155-OT1]

Agency Response: No changes were made in response to these comments. Assuming that the commenter is referring to the Union Pacific Mira Loma Railyard, this railyard is included in the drayage truck requirements as an intermodal railyard.

r) Drayage – Reporting

Comment Summary: The commenters state concerns with reporting requirements. Commenter requests an alternative reporting requirement like the CARB HD I/M Regulation process to avoid having to check compliance manually causing unnecessary terminal gate delays for terminals that do not have automated systems. In addition, they also request that terminals report to CARB directly, not through the seaport authority.

Commenter: [082-45d, 099-OT1]

Agency Response: Changes were made to address the comments on manual compliance checks. A change to the drayage reporting requirements in Section 2014.1(a)(7)(B) was added as an alternative reporting option to provide additional flexibility to seaport and marine terminals and intermodal railyards that do not have automatic reporting systems. This section was added to address stakeholder concerns that smaller seaports and railyards or specific terminals may be burdened by the reporting requirements.

No changes were made in response to the comments to change the requirements for terminals report directly to CARB, and not through the Seaport Authority. This requirement provides transparency for the seaport or railyard authorities on compliance, throughput, and drayage truck activities at the respective facilities.

s) Drayage – Regulation Not Feasible

Comment Summary: The commenters state that solutions for compliance are not available or that the drayage truck requirements are not feasible due to the state of the ZEV technology and infrastructure. Commenters state that the drayage truck requirements will destroy drayage trucking jobs and businesses. Commenters urge CARB to halt the Regulation, stating that previous seaport congestion will pale in comparison to what will happen if the industry cannot replace trucks after January 1, 2024.

Commenter: [072-45d, 075-45d, 077-45d, 079-45d, 080-45d, 089-OT1, 099-45d, 108-45d, 110-45d, 121-45d, 126-45d, 132-45d, 138-45d, 139-45d, 145-45d, 163-45d, 166-45d, 205-45d, 206-45d]

Agency Response: No changes were made in response to these comments. The drayage truck requirements are phased in through 2035. The operational characteristics and the availability of ZE Class 7 and 8 drayage trucks, and the Regulation's phase-in approach provides drayage fleets time to transition toward ZE technologies, while continuing to utilize the legacy fleet for longer moves as the ZEV technology and infrastructure develops. In addition, the drayage truck requirements provide flexibility through extensions for both a vehicle delivery and infrastructure delays to ensure that the technology and infrastructure is rolled out concurrently.

A list of currently commercially available heavy-duty Class 7 and 8 ZEVs may be found on CALSTART's Zero-Emission Technology Inventory website.[175] In addition, Chapter I.F. of the ACF ISOR provides an overview for both the current and anticipated availability of Class 7 and 8 ZE trucks and includes details for make, type, and commercial availability.

t) Drayage – Supply Chain Issues

Comment Summary: The commenters state the drayage truck requirements will negatively impact the drayage trucking industry and the overall supply chain, and subsequently raise the cost of goods. Commenters state that the drayage truck requirements could cause a mode shift from rail to trucks causing more diesel trucks to be on the road.

Commenter: [023-OT1, 025-45d, 032-45d, 067-45d, 070-45d, 071-45d, 073-45d, 076-45d, 077-45d, 166-45d, 171-45d, 205-45d, 274-45d, 288-45d, 341-45d]

Agency Response: No changes were made in response to these comments. CARB disagrees with the speculative assumption that the Drayage Regulation will cause supply chain disruptions as commenters suggest. The drayage truck requirements are not anticipated to create supply chain issues as trucks transition to ZEVs.

The Drayage Regulation phases in ZEVs over the next 11 years and the requirements are designed to align with technological feasibility. The regulatory structure ensures that existing legacy drayage trucks can continue to operate for their useful life and ZEVs are gradually introduced into the fleet. In addition, the Regulation contains numerous provisions such as the ZEV Delivery Delay Extension, and the Infrastructure Construction Delay Extension, which ensure the requirements are feasible and provide flexibility for events outside of a fleets

[175] CALSTART, Zero-Emission Technology Inventory, 2021 (web link: https://globaldrivetozero.org/tools/zero-emission-technology-inventory/, last accessed August 2022).

control. This regulatory structure ensures goods can continue moving through California without disruption.

Currently, manufacturers and other suppliers are making significant domestic investments to bolster the supply chain in part due to the recently passed IRA. The IRA strengthens domestic supply chains by incentivizing production of materials and components critical to decrease the United States' carbon emissions in line with declared goals. These investments are already occurring at the same time manufacturers are identifying ways to produce key components with less or no use of critical materials. This current trajectory is expected to continue, which alleviates raised concerns regarding supply chain disruptions due to the transition to ZEVs. Please see additional responses to issues raised in section "Cost – Supply Chain Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

It is speculative to assume that the Drayage Regulation will drive freight from trucks to rails given the expected lower costs. However, even if this was true, the recently adopted In-Use Locomotive Regulation will ensure that goods movement by train is significantly cleaner.

u) Drayage – Support

Comment Summary: Commenter is supportive of the process, stakeholder engagement, or actions in the rulemaking.

Commenter: [119-OT1]

Agency Response: No changes were made in response to these comments. Thank you for your comment.

v) Drayage – Truck or Driver Shortage

Comment Summary: The commenters state that drayage truck drivers are in shortage already as a result of labor issues with the recent Truck and Bus Regulation requirements and the addition of the drayage regulatory requirements could result in truck or driver shortages or force seaport drivers to seek employment outside California with fewer trucks available to serve the seaports and or railyards.

Commenter: [166-45d, 274-45d]

Agency Response: No changes were made in response to these comments. As discussed in Chapter I.E.4. of the ACF ISOR, approximately 33,500 drayage trucks service California's seaports and intermodal railyards annually, of which 28,700 are trucks that visit California's seaports and intermodal railyards an average of two or more times per week.[176] As of December 31, 2022, at the sunset of the previous Drayage Truck Regulation, there were over 140,000 compliant drayage trucks with 2010 or newer model year engines registered in the CARB DTR. These legacy trucks will likely continue to operate in the drayage sector, which should provide enough trucks to serve both the seaports and railyards.

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[176] Proposed Advanced Clean Fleets Regulation Staff Report: Initial Statement of Reasons (ca.gov) 2023, (weblink: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/acf22/isor2.pdf).

w) Drayage – Useful Life

Comment Summary: The commenters state that CARB has not considered the back end of the useful life protection by requiring all drayage vehicles to be heavy-duty ZEVs starting in 2035. The commenter proposes that diesel trucks that are 12 years or older and have more than 800,000 miles should be stopped and checked for diesel particulate filters at the seaports. In addition, the commenter states that CARB is not properly accounting for the useful life requirements, since the proposal says that all drayage vehicles will need to be heavy-duty ZEVs starting in 2035. The commenter provided example: a 2022 engine would reach its initial useful life threshold in 2035 but should still have protection until that engine reached 18 years old in 2040 or the vehicle hit 800,000 miles.

Commenter: [140-45d, 341-45d]

Agency Response: No changes were made in response to these comments. Drayage trucks will be subject to the end of their useful life provision, as defined by SB 1, which defines a truck's useful life as the later of: (1) Thirteen years from the model year the engine and emission control system are first certified for use in self-propelled commercial motor vehicles by the State board or other applicable State and federal agencies, or (2) when the vehicle reaches the earlier of either 800,000 vehicle miles traveled or 18 years from the model year the engine and emission control system are first certified for use in self-propelled commercial motor vehicles by the State board or other applicable State and federal agencies. Accordingly, the drayage truck requirements that allow existing drayage trucks to be used until they reach the above defined useful life period is consistent with State law. Drayage trucks 12 years and older would be required to report their mileage annually and may not exceed their minimum useful life to remain in the CARB Online System. Only a small number of legacy drayage trucks are expected to be operating at the end of 2034. These trucks will no longer be eligible to conduct drayage activities but can continue to operate in California in other capacities.

The proposal that diesel trucks that are 12 years or older and have more than 800,000 miles should be stopped and checked for diesel particulate filters at the seaports would not provide similar emission benefits or meet the overall goals of the Drayage Regulation and the HD I/M or Clean Truck Check Regulation will check the operations of diesel particulate filters.

x) Drayage – Useful Life in 2025

Comment Summary: The commenter states that there is no clear determination from CARB on the population of vehicles who will run out of useful life protection once DTR reporting begins in 2025.

Commenter: [341-45d]

Agency Response: No changes were made in response to these comments. As discussed in Chapter III.C. of Appendix F to the ACF ISOR, the average age by which a typical drayage truck accrues 800,000 miles is approximately 15 years old, as determined from DMV registration and California Vehicle Inventory and Use Survey.[177] Although a portion of the 2010-2012 MY trucks will be subject to the useful life limitations, the remaining legacy trucks will be eligible to continue to operate in the drayage sector, which should provide a sufficient number of trucks to serve both the seaports and railyards.

y) Drayage – Vehicle Exemptions for Auto Transports

Comment Summary: The commenters state concern about the vehicle exemption for auto transport vehicles.

Commenter: [155-OT1, 316-45d]

Agency Response: No changes were made in response to these comments. Auto-carriers are covered under the HPF requirements, which align more closely with the suitability of auto-carrier duty cycles and can address auto-carrier activities that exist outside of drayage service.

z) Drayage – Zero-Emissions Vehicle – Mileage is Not Feasible

Comment Summary: The commenters state that there are currently no ZEV models that can make a round trip shipment to the seaports. Commenter states that the extra charging time needed as a result will cause significant delays in deliveries.

Commenter: [023-45d, 024-45d, 025-45d, 032-45d, 034-45d, 036-45d, 053-45d, 067-45d, 074-45d, 076-45d, 077-45d, 078-45d, 079-45d, 099-45d, 101-45d, 102-45d, 105-45d, 106-45d, 107-45d, 138-45d, 139-45d, 151-45d, 177-45d, 182-45d, 205-45d]

Agency Response: No changes were made in response to these comments. As discussed in Chapter I.E.4. of the ACF ISOR, drayage trucks are typically part of a dedicated fleet that primarily moves cargo to and from seaports and intermodal railyards to near-dock, local, or regional transloading facilities or warehouses to be stored or re-packaged before the cargo moves to the next destination and travel a limited number of miles daily and then return to a home base. Motor carrier facilities will likely provide on-site charging or fueling as drayage trucks begin to transition towards ZEV technology.

In addition, according to the I-710 Project Key-Performance Parameters for Drayage Trucks CALSTART 2013 survey, approximately 81 percent of drayage trucks that visit California's seaports report most trip distances under 60 miles.[178] This is consistent with other studies that have found that most drayage trucking companies being located within 10 miles of the port complex with operators typically completing three roundtrips per day, and 85 to 90 percent reporting only one shift per day. [179]

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[177] Proposed ACF Regulation - Appendix F: Emissions Inventory and Results Advanced Clean Fleets Regulation (ca.gov) 2023, (weblink: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2022/acf22/appf.pdf).

[178] CALSTART, Performance Parameters for Drayage Trucks Operating at the Ports of Los Angeles and Long Beach, 2013 (web link: https://calstart.org/wp-content/uploads/2018/10/I-710-Project_Key-Performance-Parameters-for-Drayage-Trucks.pdf, last accessed August 2022).

[179] Port of Long Beach, Fueling the Future Fleet: Assessment of Public Truck Charging and Fueling Near the Port of Long Beach, 2021 (web link: https://polb.com/download/379/zero-emissions/12744/final-polb-charging-study-12-sep-2021.pdf, last accessed August 2022).

A list of currently available heavy-duty Class 7 and 8 ZEVs, that can meet the requirements of these drayage duty cycles, may be found on CALSTART's Zero-Emission Technology Inventory website.[180] In addition, Chapter I.F. of the ACF ISOR provides an overview for both the current and anticipated availability of Class 7 and 8 ZE trucks and includes details for make, type, and commercial availability.

aa) Drayage – Zero-Emissions Vehicle Technology

Comment Summary: The commenters state that ZEV technology will not be ready in 2024. The ZEV technology will not be ready for drayage applications due to limited range and load capabilities, number of trucks not available at scale or in a used market, availability of ZEV infrastructure, or the availability of ZEV service technicians.

Commenter: [023-45d, 024-45d, 032-45d, 034-45d, 078-45d, 082-45d, 099-OT1, 116-OT1, 134-45d, 141-45d, 142-45d, 144-45d, 149-45d, 166-45d, 205-45d, 206-45d, 274-45d, 284-45d, 311-45d, 341-45d]

Agency Response: No changes were made in response to these comments. The drayage truck requirements allow fleets to continue to use legacy combustion drayage trucks within their useful life limitations as the ZEV technology and statewide ZEV fueling infrastructure continues to develop. In the near-term, it is anticipated that the legacy drayage truck fleet will meet the demands of heavier loads or longer routes as the technology improves and the used ZEV market matures.

In addition, the drayage truck requirements include several flexibilities, such as the vehicle delivery delay and infrastructure extensions and the 11-year phase-in approach, which allows legacy trucks to continue operating until they exceed the useful life requirements while transitioning to a fully ZE drayage fleet by 2035.

As discussed in Chapter I.F. of the ACF ISOR, the technology developments as well as the number of participating manufacturers, for BEVs and FCEVs have rapidly progressed over the last decade, which has led to the market introduction of ZEVs in every weight class, including drayage applications. A list of currently available heavy-duty Class 7 and 8 ZEVs, that can meet the requirements of these drayage duty cycles, may be found on CALSTART's Zero-Emission Technology Inventory website.[181] In addition, Chapter I.F. of the ACF ISOR provides an overview for both the current and anticipated availability of Class 7 and 8 ZE trucks and includes details for make, type, and commercial availability.

Furthermore, in 2020, major multinational truck manufacturers acknowledged the science-based need to decarbonize their products fully by 2040 and have individually asserted substantial midterm targets in 2030 to reach their 2040 targets. For example, Volvo Trucks stated a 50 percent target in 2030 globally with Daimler committing to 60 percent by 2030 and 100 percent by 2039; and Navistar committed to 50 percent by 2030 and 100 percent by

[180] CALSTART, Zero-Emission Technology Inventory, 2021 (web link: https://globaldrivetozero.org/tools/zero-emission-technology-inventory/, last accessed August 2022).
[181] CALSTART, Zero-Emission Technology Inventory, 2021 (web link: https://globaldrivetozero.org/tools/zero-emission-technology-inventory/, last accessed August 2022).

2040[182]. Furthermore, Ford has announced that their entire commercial vehicle lineup in Europe will be ZE capable – all-electric or PHEV – by 2024, and entirely battery-electric by 2030.[183,184,185]

CARB agrees that there is a need statewide for additional skilled and trained technicians to support ZEV and other clean transportation technology adoption in the medium- and heavy-duty market as it expands. The technology is generally the same as in light-duty vehicles and can be planned for to the support the ZEV market expansion. There are multiple efforts already underway which are working to address the commenters' concerns. This includes training and certification for EVITP given legislative mandates pursuant to AB 118. Workforce training and development projects are being funded by CEC and CARB that are promoting skill building, upskilling, retraining, and an expansion of the workforce across the clean transportation sector, including EV charging and fueling infrastructure. One specific example is the Inclusive, Diverse, Equitable, Accessible, and Local ZEV Workforce Pilot Project. This project also has a focus on preparing dislocated, unemployed, and new workforce entrants for ZEV careers to further broaden the scale and impact of the clean transportation workforce statewide, with a specific focus on low-income and disadvantaged communities.

bb) Drayage – Zero-Emissions Vehicle – Weight Impacts

Comment Summary: The commenters state drayage ZEV weight will impact payload capability, resulting in more trucks on the road to do the same work and increased costs.

Commenter: [032-45d, 166-45d, 205-45d, 284-45d]

Agency Response: No changes were made in response to these comments. As discussed in Chapter I.H.5. of the ACF ISOR, AB 2061 allows ZEVs and NZEVs to exceed California maximum weight limits by 2,000 pounds which addresses some of the vehicle weight and payload capacity concerns of ZEV technology for weight limited loads. However, weight may only be an issue for about 10 percent of the largest trucks on the road and may only affect about two percent of the most common dry van tractor trailer combination at maximum weight.[186] Additionally, weight is less of a concern for FCEVs as they have comparable range to combustion vehicles and weigh less than long-range BEVs with bigger batteries.[187] The

[182] Navistar, Vision And Strategy, 2023 (web link: https://www.navistar.com/about-us/vision-strategy. last accessed February 2023).
[183] Ford, F-150® Lightning™, 2023 (web link: https://www.ford.com/trucks/f150/f150-lightning/2022/, last accessed February 2023).
[184] Ford, E-transit, 2023 (web link: https://media.ford.com/content/fordmedia/fna/us/en/products/evs/e-transit/2022-ford-e-transit.html, last accessed February 2023).
[185] Ford, Ford's new science-based, Interim Carbon-Neutral Targets Highlight First Integrated Sustainability, Financial Report, March 31, 2021 (web link: https://media.ford.com/content/fordmedia/fna/us/en/news/2021/03/31/ford-integrated-sustainability-financial-report.html, last accessed January 2023).
[186] North American Council for Freight Efficiency, Lightweighting, 2021 (Web link: https://nacfe.org/technology/lightweighting-2/, last accessed August 2022).
[187] North American Council for Freight Efficiency, Making Sense of Heavy-Duty Hydrogen Fuel Cell Tractors, 2021 (Web link: https://nacfe.org/wp-content/uploads/2020/12/NACFE-Guidance-on-Hydrogen-Fuel-Cell-Tractors-FINAL-121620.pdf, last accessed August 2022).

different available ZEV technology options, BEV or FCEV, allow for fleet owners to select the technology that best fits the range and weight requirements of a fleet's operations.

10. High Priority Fleet Issues

a) High Priority Fleets – Adjust $50 Million Threshold

Comment Summary: The commenters request adjusting or removing the HPF revenue threshold and suggest redefining "High Priority Fleets" to include only fleets with gross revenues over $100 Million.

Commenter: [218-45d, 314-45d]

Agency Response: No changes were made in response to these comments. For rationale why $50 Million was selected as an appropriate threshold for the HPF Regulation's applicability, see section 2015(a) of Appendix H-2 to the ACF ISOR. For the same reasons, no definition for "High Priority Fleets" specifying only fleets with gross revenues over $100 Million was added to the Regulation.

b) High Priority Fleets – Add Credit Averaging, Banking, and Trading

Comment Summary: The commenters suggest including an ABT mechanism in the Regulation, allowing fleets to trade credits generated by purchasing ZEVs. Some commenters request CARB to focus on ZEV Milestones for Group 1 vehicles and use crediting and incentive mechanisms for Group 2 and 3 vehicles. Some commenters state that NZEVs should be granted an ABT crediting framework, providing credit proportionally less than the value of a full ZEV.

Commenter: [038-OT1, 082-OT1, 200-45d, 212-45d, 236-45d, 282-45d]

Agency Response: No changes were made in response to these comments. ABT credit trading systems, such as those included in the ACT Regulation, are complex to implement and track; this approach made sense for the ACT Regulation because only a small number of manufacturing entities with dedicated regulatory compliance staff were included in that Regulation and annual vehicle sales are in the thousands. However, the ACF Regulation would affect thousands of fleets with relatively small number of trucks that may not have staff dedicated to compliance. ABT systems at the fleet level would be difficult to understand, would increase the cost and burden of compliance tracking and reporting for fleets. For the same reasons, no changes were made to provide such a crediting mechanism for NZEV vehicles in the Regulation.

c) High Priority Fleets – End of Useful Life Zero-Emissions Vehicle Conversions

Comment Summary: The commenters propose allowing fleets to convert vehicles to ZEVs instead of requiring retirement at the end of their useful life and affirm that such conversions do not constitute tampering with emissions equipment.

Commenter: [247-45d]

Agency Response: No changes were made in response to these comments. The Regulation already allows for ZEV conversions. The Model Year Schedule language specifies that ICE vehicles must be removed at the end of the vehicle's minimum useful life; however, if an ICE vehicle is converted to a ZEV, it is no longer an ICE vehicle, and the requirement to remove it from the fleet no longer applies. A conversion to a ZEV would be treated the same as a ZEV in the ZEV Milestones Option and as a ZEV purchase under the SLG purchase requirements. Legacy CARB anti-tampering requirements applicable to aftermarket parts and fuel conversions would still need to be met.

d) High Priority Fleets – Backup Vehicle Mileage Adjustments

Comment Summary: The commenters suggest updating the HPF backup vehicle provision by increasing the mileage threshold, applying the mile limitation only within California's borders, or implementing a tiered limit based on public agency service area size.

Commenter: [007-45d, 143-45d, 170-45d, 207-45d, 210-45d, 248-45d, 282-45d, 310-45d]

Agency Response: No changes were made in response to these comments. The provided threshold of 1,000 miles annually is reasonable for reasons described in Section 2015.3(a) of Appendix H-2 of the ACF ISOR and is consistent with other CARB Regulations. A tiered approach based on geographic service area would be difficult to implement and would increase complexity of the Regulation and implementation. A simple threshold is easier to implement and enforce, and the threshold selected is sufficient to provide backup vehicles flexibility for limited operations consistent with the intent of the exemption. Applying the mileage limitation to only within California borders would also add increased complexity in reporting, recordkeeping, tracking, and enforcement. Other provisions such as the 5-Day Pass were added to the Regulation to address vehicles that operate briefly within California's borders.

e) High Priority Fleets – Add Engine Hours Option

Comment Summary: The commenter suggests addition an hours-of-operation in California option in the definition of backup vehicles.

Commenter: [170-45d]

Agency Response: No changes were made in response to these comments. The backup vehicle exemption is intended to address vehicle operating limited mileage, not just limited operations within California's borders. A range limitation ensures that backup vehicles would have minimal emissions impact while ensuring simpler implementation and enforcement, and the addition of engine hours may compromise these traits. Fleets that need to operate temporarily within California may choose to utilize the 5-Day Pass provision for temporary mileage unrestricted operation within the state.

f) High Priority Fleets – Burden on Postal or Other Brokerage Operations

Comment Summary: The commenters state that ACF will burden brokerage operations in the transportation of mail due to the lack of equivalent ACF Regulations outside California and insufficient national charging infrastructure. They assert that brokers will be forced to contract with non-existent ACF-compliant fleets, small fleets, or owner-operators not subject to HPF requirements (resulting in reduced transportation capacity, increased costs, and inefficiencies), or transportation companies that have not invested in lower-emission technologies. The commenters also express concern that ACF will disrupt the surface transportation network of the U.S. Postal Service and hinder the mail flow as contractors within this network will be required to electrify as early as 2027 under HPF requirements.

They argue that out-of-state suppliers may cease entering the state, reroute to out-of-state destinations, or transfer trailers outside of California, disrupting interstate transportation of mail and interstate commerce.

Commenter: [025-WT1, 105-OT1, 256-45d]

Agency Response: No changes were made in response to these comments. The Regulation phases-in the ZEV requirements over two decades providing truck owners and brokers the ability to transition to ZEV fleets gradually. This time may allow technology and infrastructure availability to improve for long-haul applications. ZEVs have an expected favorable TCO, and fleets will need to transition to ZEVs to remain competitive. Federal support through various legislative packages and Regulations, including the IIJA, IRA, and national CTP will support and incentivize this interstate build-out and encourage other states to transition to ZEV technologies. Manufacturers have announced efforts to install interstate ZEV fueling networks, including hydrogen fueling, in multi-state regional shipping corridors. Finally, the ACT Regulation requiring manufacturers to sell increasing portions of their annual sales as ZEVs has been adopted by at least six other states already, and several states have expressed interest in adopting an ACF Regulation. This indicates a clear shift outside California toward ZEV technology.

g) High Priority Fleets – Competitive Disadvantages

Comment Summary: The commenters express concerns about fairness in the Regulation, arguing that it puts certain businesses at a competitive disadvantage. They state that the $50 million gross revenue threshold and the 50-truck threshold for High Priority Fleets unfairly affect non-transportation sector businesses with less than 50 trucks whose revenue comes from multiple service sectors. The commenters also claim that the Regulation is biased against local, service-sector businesses, as their entire fleet of 34 trucks sit idle more often than they operate. Furthermore, they argue that the definition of high priority fleets based on the number of vehicles or amount of revenue creates a disadvantage for regulated fleets, which will have to rent more capable diesel vehicles from non-regulated fleets. They express concerns about the Regulation not covering brokers and load-board operations, as it creates a competitive disadvantage against large freight brokers and digital load boards. Finally, they point out that California-registered fleets are forced to adopt ZEVs, while out-of-state fleets are not, which also puts them at a competitive disadvantage in long-haul transport.

Commenter: [018-45d, 048-45d, 058-45d, 064-45d, 083-45d, 085-45d, 104-45d, 146-45d, 218-45d, 239-45d, 264-45d, 282-45d, 284-45d, 346-45d]

Agency Response: No changes were made in response to these comments. For discussion about why the applicability thresholds were selected, see Appendixes H-1 and H-2 of the ACF ISOR. The Regulation does not differentiate between business types, whether they are transportation or service sector, and instead focuses only on the vehicles and fleets that are best positioned to begin transitioning their vehicles to ZEVs. For additional information on why the current fleet size thresholds were selected, please see the Executive Officer's February 10, 2023, memo to the Board, sections Fleet Size Methodology, Fleet Size and Number of Fleets Regulated, and Other Considerations.

ZEVs can perform similar to ICE vehicles in many applications. The capabilities of ZEVs are expected to improve over time as the market matures. The Regulation requires increasing percentages of ZEVs so renting ICE vehicles from non-regulated fleets would not help regulated fleets comply.

Brokers that direct the day-to-day operation of vehicles in California are included in the Regulation, but it would be inappropriate to place the burden of compliance on brokers or load-board operators that simply offer loads on a one-time basis, which may contract with a truck owner for a single day or single load.

Analysis shows ZEVs compare favorably with ICE vehicles in several applications including TCO and this is expected to continue to improve over time. All fleet owners will eventually need to transition to ZEVs and away from ICE vehicles to remain competitive.

Out-of-state fleets that operate or control the operation of vehicles in California are in fact subject to the Regulation if they meet the same applicability criteria as in-state fleets, so any businesses competing in California will need to transition to ZEVs for their California fleet.

CARB disagrees that the ACF Regulation unfairly imposes obligations on affected fleets. As discussed in the ISOR, existing trucks are significant emitters of criteria and toxic air contaminants and GHGs, and the ACF Regulation appropriately places the burden of reducing these emissions on the entities that are best suited to use ZEVs.

Finally, the Board approved the 2022 SIP where the Board has committed to implement ZE Trucks to transition the remainder of the California medium- and heavy-duty vehicle fleet to ZEVs, which would ensure all fleets in California are transitioning to ZEVs.

h) High Priority Fleets – Allow Near-Zero-Emissions Vehicles to Replace Zero-Emissions Vehicle

Comment Summary: The commenters state that CARB should permit NZEVs for ACF-regulated fleets through 2035, regardless of ZEV availability, to maintain consistency with ACT and provide the flexibility needed for purchasing decisions involving operational requirements, costs, and infrastructure.

Commenter: [115-OT1, 329-45d]

Agency Response: Changes were made in response to these comments. The commenter incorrectly states the HPF Regulation required regulated entities to buy NZEVs only when ZEVs were not available. However, the SLG Regulation previously required public fleets to purchase ZEVs first and only to purchase NZEVs when ZEVs were not available. This was changed to give public fleets the flexibility to purchase NZEVs until 2035 to meet their needs as part of the ACF 15-day changes and is consistent with the ACT Regulation in this regard.

i) High Priority Fleets – Clarify Applicability

Comment Summary: The commenters ask for clarification on HPF applicability, request that exempt vehicles be explicitly excluded from fleet counts, and that applicability total fleet vehicle counts should be based on vehicles operating in California rather than outside the state.

Commenter: [207-45d, 337-45d]

Agency Response: Changes were made in response to these comments. However, not all requests were accommodated. As part of the ACF 15-day changes, the Regulation language in section 2015(a) has been updated to include additional clarification on revenue threshold and timeframe. The applicability remains unchanged with the same fleet size threshold to ensure a level playing field for comparable fleets and financial means to make the capital investments. The ZEV requirements only apply to the trucks operated in California.

j) High Priority Fleets – Keep 50 Vehicle Threshold

Comment Summary: The commenters state that lowering the threshold from 50 trucks down to 10 would only exacerbate many issues with ZEVs.

Commenter: [147-OT1]

Agency Response: No changes were made in response to these comments. The 50-truck threshold remains in the scope of the Regulation.

k) High Priority Fleets – Driver Misclassification

Comment Summary: The commenters highlight the issue of misclassified truck drivers working long hours to pay for their trucks and urge the Board to prevent misclassification within large fleets. They advise CARB to consider the exploitation of truckers when deciding on the Regulation.

Commenter: [074-OT1, 075-OT1]

Agency Response: No changes were made in response to these comments. The ACF Regulation clearly defines who is responsible for compliance with applicable provisions to ensure emissions benefits are realized. The Regulation clearly defines "fleet owner," "controlling party," and "common ownership and control" to ensure parties controlling the operation of vehicles under common ownership or control are treated the same as other large fleets that own all their vehicles. AB 5 established California law which requires businesses to classify their workers as employees or independent contractors. The ACF Regulation does not change AB 5 requirements. Any burdens due to AB 5 implementation are outside the scope of the Regulation.

l) High Priority Fleets – Extend Class 7 and 8 Tractor Timeline

Comment Summary: The commenters request that CARB include an alternative extended compliance timeline under the ZEV Milestones Option consistent with SB 1 and Section 43021 of the California Health and Safety Code (allowing full useful life) for Class 7 and 8 tractors involved in long-haul interstate transportation.

Commenter: [256-45d]

Agency Response: No changes were made in response to these comments. The Model Year Schedule already provides a full useful life. Fleets that would like the flexibility to plan when and how to introduce ZEVs into their operations may choose to comply with the ACF Regulation requirements using the ZEV Milestones Option. It is not possible to combine useful life with the ZEV Milestones Option without creating a loophole by which a fleet owner could delay purchases until right before 2030, then enjoy another 18 years of useful life from the vehicles, which would not achieve the goals of the Regulation nor the Governor's Executive Order N-79-20.

m) High Priority Fleets – Remove Health and Safety Code Waiver Requirement from Milestones

Comment Summary: The commenters state that the SB 1 useful life rights relinquishment as part of the ZEV Milestones Option should be removed from ACF.

Commenter: [207-45d, 253-45d, 256-45d, 337-45d]

Agency Response: No changes were made in response to these comments. High Priority Fleets must comply with the Model Year Schedule which is consistent with SB 1 useful life criteria. Starting 2024 any vehicle added to the fleet must be a ZEV and any vehicle in the fleet that exceeds its useful life must be removed from the California fleet. Alternatively, fleet owners can elect to use the ZEV Milestones Option to phase in ZEVs as a percentage of the California fleet. Compliance with this option provides flexibility to continue purchasing new or used ICE vehicles after 2024 so long as ZEV milestones are met. Staff expect this option to be selected by fleet owners if they determine it is a more cost-effective compliance strategy. This option is likely to be advantageous for fleets that normally replace vehicles well before end of minimum useful life or keep some specialized vehicles a long time. The commenter's suggestion was rejected because adding a useful life criterion for each truck on top of the ZEV Milestones Option for the entire California fleets would create an unworkable contradiction and would either create a giant loophole or would completely eliminate the flexibility it currently provides.

n) High Priority Fleets – Federal Fleet Obligations

Comment Summary: The commenters state that the ACF Regulation's requirements for federal fleets, including the U.S. Postal Service, to have the same compliance obligations as for-profit private fleets overlook their multiple statutory objectives, including the following, due to the scale of ZEV rollout that must take place or the retirement of ICE vehicles to comply with the ACF Regulation:

- The need for maximum degree of effective and regular postal services to rural areas where post offices are not self-sustaining.
- No small post offices be closed solely for operating at a deficit.
- Effective postal services be insured [sic] to residents of both urban and rural communities.

Commenter also states that the existing exemption and extension options would not be a good fit due to scale of the changes needed. Commenter also state that these obligations are contrary to CARB's own interests without stating what these interests would be.,

Commenter: [228-45d]

Agency Response: Changes were made in response to these comments. The ACF Regulation includes federal fleets because federal fleets are numerous and operated by various subdivisions. These vehicles contribute to Californian air pollution, climate pollution, and have outsized impacts in disadvantaged communities. Federal fleets are also able to lead the initial transition to ZEVs due to operating on fixed routes with frequent stops in neighborhoods. Federal fleets, under the Clean Air Act, section 118, are to be treated the same as the general vehicle population. For additional discussion about why federal fleets are included in the scope of the ACF Regulation, please see section 2015 in Appendix H-2 of the ACF ISOR package. It is the objective of the ACF Regulation to reduce emissions from vehicles in scope of the Regulation.

Staff have greatly expanded the exemptions and extensions under the ACF Regulation to reduce burden on fleets. The ZEV Purchase Exemption now allows fleet specific applications for vehicle configurations that are not already approved in the list of unavailable vehicles maintained by the Executive Officer. Staff have also added a Vehicle Delivery Delay Extension in the event an ordered ZEV will not be delivered to the fleet in time. Additionally, the Infrastructure Delay Extension now includes an increased timeframe for delays if necessary and a provision if a utility determines that a site cannot be electrified in time to the extent needed by a fleet to reach compliance.

The Daily Usage Exemption has also been expanded to include all vehicles weight classes. While it may be difficult for a typical mail truck to qualify for this exemption while using the ZEV Milestones Option, other vehicle configurations utilized by the postal service may qualify under the expanded exemption.

Additional discussion regarding exemptions and extensions may be found in other sections of the FSOR.

o) High Priority Fleets – Hiring Requirement

Comment Summary: The commenters suggest that hiring entities should not be responsible for verifying compliance, and instead, the rental agency should provide documentation or a signed statement confirming non-applicability to the Regulation.

Commenter: [238-45d]

Agency Response: No changes were made in response to these comments. Hiring entities have direct control over the types of fleets and vehicles hired and therefore have the responsibility of ensuring that the fleets and vehicles hired for their fleet operations are compliant. This requirement is consistent with several existing CARB fleet Regulations such as the Truck and Bus Regulation. The requirement to verify compliance keeps ACF consistent with the same type of requirements in other Regulations. In this way, the hiring entity can keep using the same method and website to verify compliance whether the hired fleets are subject to the ACF Regulation, the Truck and Bus Regulation, or other fleet rules. If this requirement were to be removed, it would be difficult for the hiring entity to know whether to check compliance because the hiring entity would not necessarily know to which Regulation the hired fleet is subject.

p) High Priority Fleets – Increase Fleet Size Threshold for Bus Fleets

Comment Summary: The commenters request that the definition of "High Priority Fleets" be revised to include only those bus fleets with over 100 buses.

Commenter: [314-45d]

Agency Response: No changes were made in response to these comments. Please see section 2015(a)(1) in Appendix H-2 of the ACF ISOR package for a detailed explanation of why the 50-vehicle threshold was chosen. Buses, like any other vehicle, contribute to Californian air pollution, climate pollution, and have outsized impacts in disadvantaged communities. It is the objective of the ACF Regulation to reduce emissions from all vehicle types, including buses.

q) High Priority Fleets – Additional Time for Mergers

Comment Summary: The commenters propose allowing additional time for fleets to comply with Regulations after mergers.

Commenter: [143-45d, 282-45d]

Agency Response: Changes were made in response to these comments. Modifications were made allowing up to one year after a merger to comply with the requirements of the Model Year Schedule or ZEV Milestones Option. The single year period was determined to be sufficient time to finalize the merging of fleet vehicles, assess compliance needs, place orders for needed ZEVs, and/or adjust the fleet composition to remain in compliance.

r) High Priority Fleets – Excluding Exemptions in Milestone Calculations

Comment Summary: The commenters request that the ZEV Milestone calculation be based on the number of non-exempt ICE vehicles in a fleet, rather than the total number of ICE and ZEV vehicles.

Commenter: [342-45d]

Agency Response: No changes were made in response to these comments. Exemptions under the ZEV Milestones Option are granted when ZEVs cannot be placed anywhere within the fleet. Due to the nature of how exemptions are granted in the ZEV Milestones Option, excluding exempt vehicles in the fleet vehicle count would result in fleets permanently decreasing ZEV obligations in the long run, effectively resulting in a double exemption for fleets. To provide fleets with certainty regarding vehicles acquired through exemptions, the ZEV Milestones Option allows vehicles acquired through exemptions to be used to their full useful life under SB 1 to guarantee that fleets will not be burdened with having to replace relatively new vehicles in order to meet any milestone requirement.

s) High Priority Fleets – Exclude Mechanic Trucks from Group 1

Comment Summary: The commenters request that mechanic trucks based in rural and remote locations be excluded from the first phase-out proposed for Group 1.

Commenter: [159-OT1]

Agency Response: No changes were made in response to these comments. Staff interpret the term "mechanics truck" to mean trucks with a service body designed to transport tools and maintenance equipment to the job site and is not a van, bus, or box truck. Mechanics trucks fall under the work truck definition and would therefore be subject to the Group 2 schedule under the ZEV Milestones Option, which has later a compliance date compared to Group 1. The schedule is the same for the California fleet and does not vary by whether the fleet operates in a rural or urban location.

t) High Priority Fleets – Relax Group 1 Milestone Requirements

Comment Summary: The commenters request adjustments to Group 1 ZEV Milestone dates as follows: 10 percent by 2031, 25 percent by 2033, 50 percent by 2036, 75 percent by 2039, and 100 percent by 2042.

Commenter: [282-45d]

Agency Response: No changes were made in response to these comments. The goals outlined in Executive Order N-79-20 and CARB Resolution 20-19 requires that a 100 percent ZE last mile delivery fleet be achieved by 2035. These last mile delivery vehicles are categorized primarily within Group 1. To achieve the 2035 goal in a reasonable period, it is necessary begin the Regulation as early as possible, hence the 2025 start date for Group 1 vehicles. Pushing any milestone date back in Group 1 would fail to achieve this date. Delaying the milestone dates would also be contrary to the objectives of this Regulation while being less sufficient in meeting other objectives as outlined in the ISOR. Additional discussion for the timetable in the ZEV Milestones Option is provided in section 2015.2(a) of the rationale in Appendix H-2 of the ACF ISOR package.

u) High Priority Fleets – Exclude Transitory Interstate Vehicles from Zero-Emissions Vehicle Milestones

Comment Summary: The commenters argue that fleets using the ZEV Milestone pathway should not include transitory interstate vehicles in the fleet's total, as it places an excessive burden on interstate fleets for compliance reporting and ZE turnover targets and offers no path for IRP registered vehicles to be removed from the California fleet mid-year.

Commenter: [230-45d]

Agency Response: Changes were made in response to these comments. Transitory vehicles, or vehicles that operate in California for less than five consecutive days once per year, will now be exempt from the ZEV Milestones Option under the newly added 5-Day Pass provision.

v) High Priority Fleets – Motorhome Requirements

Comment Summary: The commenters ask about excluding motorhomes from the ZEV Milestones Option or request that CARB amends the "ZEV fleet milestone" section to offer a compliance option for motorhome fleets similar to specialty vehicles.

Commenter: [220-45d, 224-45d]

Agency Response: No changes were made in response to these comments. Motorhomes, while varying in their configuration, are typically bodies fitted to chassis cabs or vans with the exception of Class A motorhomes, which are similar to bus chassis, hence their inclusion in the ACF Regulation and the ZEV Milestones Option under Group 2. This is different from specialty vehicles under the ACF Regulation, which are vehicles that are typically produced in low volumes, on custom chassis, have heavy front axles, and may have significant power needs while stationary. Motorhomes are not always produced with unique/custom chassis and not all motorhomes will need significant power while stationary. As such, motorhomes do not necessarily belong in the specialty vehicle category.

w) High Priority Fleets – Reduce Flexibility Between Zero-Emissions Vehicle Milestone Groups

Comment Summary: The commenters suggest removing the option to procure ZEVs between tier categories, especially for Milestone Groups 2 and 3 vehicles, as they contribute disproportionately to emissions. This would prevent the exclusive deployment of cheaper, lighter-duty vehicles over higher-polluting, heavier-duty vehicles.

Commenter: [038-OT1, 102-OT1, 236-45d]

Agency Response: No changes were made in response to these comments. The flexibility to use any ZEV to comply with requirements is necessary to allow fleets to electrify in whatever order is best for their operations. The Board determined that the flexibility to manage the fleet was important to allow for a smooth transition and agreed this approach is the best balance between complexity and enforceability. The ability for some fleets to substitute lighter vehicles for heavier ones may result in an initial front-loading of lighter ZEVs in some fleets in the early years, but the balance will normalize over time as fleets complete conversion to ZEVs. It is important to note that any removal of an ICE vehicle with a ZEV results in an emissions benefit. The Board also recognized that several fleets are fairly homogenous, such as freight hauling tractor fleets or waste haulers where all of the vehicles they operate are Group 2 or Group 3 vehicles and the ZEV deployed in the early stages of the transition will simply be heavier trucks.

Additional discussion of the reason for allowing any ZEVs to count for compliance is provided in section 2015.2(c) of the rationale, Appendix H-2 of the ACF ISOR package. Additional information on why this flexibility to use any ZEV to comply with the requirements of the ZEV Milestones Option, please see responses to issues raised in section "High Priority Fleets – Reduce Flexibility Between Zero-Emissions Vehicle Milestone Groups" in "High Priority Fleet Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

x) High Priority Fleets – Remove Near-Zero-Emissions Vehicle Sunset Date

Comment Summary: The commenters request flexibility in the Regulations, allowing the addition of new or used NZEVs as an optional alternative to ZEVs without a sunset.

Commenter: [010-WT1]

Agency Response: No changes were made in response to these comments. The ACF Regulation recognizes NZEVs as a bridge technology. As the ZEV market matures, it is expected that ZEVs and ZEV infrastructure will have advanced to the point of being able to fulfill a fleet's needs. The 2035 model year cutoff was selected to be consistent with the NZEV crediting provisions of the complementary ACT Regulation, which also sunsets after 2035. For additional information on the 2035 NZEV sunset provision, please see section 2015(e) of the rationale, Appendix H-2 of the ACF ISOR package.

y) High Priority Fleets – Only Allow Near-Zero-Emissions Vehicle if No Zero-Emissions Vehicle is Available

Comment Summary: The commenters request permitting NZEV purchases only if a fleet genuinely cannot purchase and deploy ZEVs.

Commenter: [038-OT1, 236-45d]

Agency Response: No changes were made in response to these comments. The ACF Regulation recognizes NZEVs as a bridge technology, and NZEVs offer flexibility to businesses that may have duty cycles or business models with extended range, high auxiliary power, or minimal refueling downtime which may not be entirely suitable in the early stages of the transition to ZEVs. Additionally, allowing fleets to count NZEVs towards compliance as a ZEV helps reduce the number of suitability or availability exemptions that might be needed and requested because NZEVs can be refueled like conventional vehicles and ensures progress can be made in applications that may not be fully suitable for ZEVs until the market develops further. For additional information on the NZEV flexibility provision, please see section 2015(e) of the rationale, Appendix H-2 of the ACF ISOR.

z) High Priority Fleets – Accelerate Near-Zero-Emissions Vehicle Sunset Date

Comment Summary: The commenters recommend sunsetting the NZEV provision no later than 2030.

Commenter: [212-45d]

Agency Response: No changes were made in response to these comments. NZEVs offer flexibility for fleets as a bridge technology to introduce and experiment with ZE technology until the state of the ZEV market has advanced to the point of fulfilling the needs of their fleet. Forcing fleets to transition solely to ZEVs too early may be counterproductive in certain market segments as fleets may begin applying for additional exemption requests, delaying the introduction of ZE technology into their operations. The Board decided the 2035 model year sunset for NZEVs was appropriate because it is consistent with the NZEV crediting provisions of the complementary ACT Regulation, which also sunsets after 2035. For additional information on the 2035 NZEV sunset provision, please see section 2015(e) of the rationale, Appendix H-2 of the ACF ISOR package.

aa) High Priority Fleets – Credit for Hybrids or Electric Power Take-Off

Comment Summary: The commenters request that hybrid EVs or ePTOs be considered as compliance options for all fleets, or for truck sectors that are challenging to fully electrify in the near-term. They propose including ICE vehicles capable of ePTO or any vehicle eligible for California's HVIP in the definition of NZEVs or allowing non-PHEV hybrids meeting model year 2027 Phase 2 GHG standard early to be a compliance option.

Commenter: [233-45d, 263-45d, 291-45d, 329-45d]

Agency Response: No changes were made in response to these comments. The goal of the ACF Regulation is to achieve criteria and GHG emissions reductions by accelerating the widespread adoption and usage of ZEVs in the medium- and heavy-duty truck sector and light-duty vehicles used in mail and package delivery. While the Board recognizes there are benefits with the use of ePTO on ICE vehicles, perpetuating ICE vehicle usage is counter to the overall goal to achieve zero tail pipe emission everywhere feasible. Funding programs already support ePTO and do not need to be included in the Regulation. Conventional hybrids have been commercially available on the medium- and heavy-duty market for over a decade and, without ZE capability, they are not sufficient to meet the Regulation's goals. As such, the ACF Regulation will not currently consider conventional hybrids or ICE vehicles with ePTO to be compliance options.

bb) High Priority Fleets – Add Offramps

Comment Summary: The commenters suggest that the Regulations include language allowing CARB, in collaboration with independent entities, to make future adjustments as needed, sending a signal to the regulated community and vehicle markets that CARB is willing to modify requirements.

Commenter: [292-45d]

Agency Response: No changes were made in response to these comments. A built-in off-ramp is a subjective condition that may cause uncertainty for fleets while failing to meet OAL requirements. The ACF Regulation, while providing specificity as to requirements, also contains flexibility and fleet specific provisions that aim to address a variety of circumstances if needed. CARB will aim to work with fleets to successfully implement the Regulation. If offramps become necessary, the Board has a long history of supporting amendments to Regulations if rule adjustments are needed. Staff will be back in front of the Board multiple times over the next few years with analysis on many of the same topic issues as ACF for other ZE Regulations and funding programs.

cc) High Priority Fleets – Allow Fleets to Switch Between Compliance Options

Comment Summary: The commenters state that, for consistency with other Board-passed Regulations, the Regulation should not deny fleet owners the ability to switch between compliance options.

Commenter: [337-45d]

Agency Response: Changes were made in response to these comments. The Board approved changes as part of the 15-day changes that specify that fleets may switch between compliance options until January 1, 2030, provided the fleet owner is in compliance with both compliance options before switching.

dd) High Priority Fleets – Remove ZEV Fleet Recognition

Comment Summary: The commenters request the removal of Section 2015 (p) "ZEV Fleet Recognition" as it unfairly favors larger fleets over smaller, locally owned, and operated companies.

Commenter: [310-45d]

Agency Response: No changes were made in response to these comments. The ZEV fleet recognition provision is intended to help hiring entities and others to voluntarily prioritize the use of fleets recognized as ZEV fleets. Larger fleets are not favored as small fleets that do not fall into the scope of the ACF Regulation may voluntarily become recognized as ZEV Fleets by voluntarily reporting fleet ZEV composition. Additional discussion on why ZEV fleet recognition is needed may be found in section 2015(p) of the rationale, Appendix H-2 of the ACF ISOR package.

ee) High Priority Fleets – Regulation Disadvantages Small Businesses

Comment Summary: The commenters state that the ACF timeline disadvantages small business operators, disproportionately impacting low-income truck drivers and drivers of color.

Commenter: [313-45d]

Agency Response: No changes were made in response to these comments. The commenter’s assertions are incorrect. The HPF Regulation does not directly target small businesses. The scope includes federal fleets, entities with $50 million or more in gross annual revenues, entities that own, operate, or direct 50 or more trucks including vehicles operated under common ownership and control. This means that the ZEV requirements do not affect small businesses or individual drivers unless they are under common ownership and control as part of a large fleet.

11. State and Local Government Issues

a) State and Local Government – Delay Start Date

Comment Summary: The commenters ask for a delay in the start date of the SLG requirements, suggesting a range of delayed start dates and conditions, or a later timeline for the 100 percent purchase requirement due to the time needed for budgeting, procurement cycles, infrastructure installation, and technology improvement.

Commenter: [014-45d, 032-WT1, 037-WT1, 063-OT1, 091-OT1, 095-OT1, 207-45d, 226-45d, 227-45d, 233-45d, 277-45d, 285-45d, 291-45d, 333-45d]

Agency Response: No changes were made in response to these comments. According to the analysis in Chapter IV. of the ACF ISOR, and to meet the Governor's goals and other emissions reduction requirements, it is necessary to achieve these reductions as soon as possible; delaying the start date of the SLG requirements is in direct conflict with these goals and requirements. A myriad of exemptions and extensions have been included to address concerns raised by some government fleets. As discussed in Chapter II.A. of the ACF ISOR, transitioning to ZE, especially for the on-road sector, has been signaled over the past decade through legislation and a variety of planning documents. The time to transition to ZE is now.

b) State and Local Government – Competition for Limited Vehicles

Comment Summary: The commenters express concern that public fleets will compete for limited vehicle stock of available ZEV models, risking noncompliance even when trying to comply due to insufficient supply.

Commenter: [014-45d]

Agency Response: No changes were made in response to these comments. The ACT Regulation requires OEMs to sell ZEVs as an increasing percentage of their annual sales into California's market and it is in their interests to maximize ZEV sales. The default ZEV purchase requirement for SLG fleets does not require any vehicles to be replaced so a fleet owner would not be out of compliance if a ZEV purchase takes longer to arrive. However, the fleet owner may be able to use the ZEV Purchase Exemption if ZEVs are not available in the needed configuration provided the conditions to receive an exemption are met. For example, if OEMs are not taking orders for the next two model years of a given vehicle type, that vehicle configuration would not be considered to be available to the fleet owner and would qualify for an exemption if needed for the fleet owner to remain in compliance. Lastly, SLG fleets can opt into the ZEV Milestone Schedule which will give them a longer phase-in for more specialized vehicles. Also, if a manufacturer cancels an order, the SLG fleet remains in compliance and has up to one year to repurchase another ZEV.

c) State and Local Government – Credit for Light-Duty Zero-Emissions Vehicles

Comment Summary: The commenters request that credits be given for vehicles purchased in lower classes, below the 8,501 pounds threshold, to meet regulatory requirements.

Commenter: [156-45d]

Agency Response: No changes were made in response to these comments. The commenter is requesting compliance "credits" for light-duty vehicles as part of this Regulation. A high-priority or federal fleet must include light-duty package delivery vehicles under 8,500 pounds as part of their fleet and can get credit for purchasing ZEVs. However, other light-duty trucks and cars at or below the 8,500 pounds regulatory threshold would not be eligible to count towards a SLG fleet's ZEV purchase requirement. Light-duty sales are already expected due to existing Regulations. Counting them in ACF would either undermine the objective of achieving new emissions reductions and would be double-counting actions that are already expected to occur.

d) State and Local Government – Clarification on Early or Excess Zero-Emissions Vehicle Additions

Comment Summary: The commenters request that CARB provide additional guidance for public agency fleet managers on the options for using Early or Excess ZEV additions, including (1) How will early/excess additions be reported, and when should documentation be submitted? (2) Are all new purchases made prior to 2024 countable towards future compliance years once? (3) Are all new purchases during 2024-27, that exceed the 50 percent requirement, countable towards future compliance years?

Commenter: [014-45d]

Agency Response: No changes were made in response to these comments. A fleet owner taking early actions to replace ICE vehicles with a ZEVs or to purchase ZEV in excess of the requirements would get credit for a future ZEV purchase requirement — once. Reporting takes place in March. Guidance on how to comply with this Regulation will be provided on CARB's website well in advance of any compliance deadline.

e) State and Local Government – Expand Designated Low Population Counties

Comment Summary: The commenters suggest that the low-population county delay should be granted to other counties with similar conditions, such as limited ZEV infrastructure and fewer air quality challenges.

Commenter: [245-45d]

Agency Response: Changes were made in response to these comments. The Board recognized that more flexibility should be provided to small public agencies. The 15-day changes now exempt small agencies with 10 or fewer trucks until 2027 and counts NZEVs as ZEVs until the 2035 model year. These changes provide enough time for depot and public ZEV infrastructure along major travel corridors to get built. California's air quality challenges are disproportionate across the state as pollution disperses and settles unequally, and the Board determined that all public agencies have a duty to improve the air for all Californians.

f) State and Local Government – Special Consideration for Rural Public Fleets

Comment Summary: The commenters suggest that rural public fleet operators face more challenges with ZEV deployments due to limited infrastructure and longer distances compared to urban fleets and should be given special consideration.

Commenter: [180-45d]

Agency Response: Changes were made in response to these comments. The Board recognized that more time should be provided for public agencies in low population "designated counties" and approved the ZEV exemption until 2027 which was included in the original staff proposal. Furthermore, as part of the 15-day changes, the Regulation treats NZEVs the same as ZEVs until the 2035 model year. NZEVs have the same fueling and operating characteristics as ICE vehicles and have lower electricity demand than ZEVs. This should provide enough time for public ZEV infrastructure along major travel corridors to get built. However, the Board recognizes the challenges facing rural counties in building ZEV infrastructure and has issued a joint Statement of Intent to collaborate with sister agencies ensuring equity in infrastructure development and deployment.

g) State and Local Government – Hiring Requirement

Comment Summary: The commenters request the removal of the requirement to hire compliant fleets.

Commenter: [233-45d]

Agency Response: No changes were made in response to these comments. Without the requirement to hire compliant fleets, non-compliant fleets can offer their services at a discount to those who invested to comply, which will result in unequal conditions and an economic incentive for non-compliance. This requirement enhances the enforceability and effectiveness of the Regulation by providing another enforcement tool to ensure that hiring entities do not hire non-compliant fleets. Additionally, many CARB fleet Regulations have historically had this requirement, including the Truck and Bus Regulation, and keeping this requirement consistent for all CARB fleet rules means the hiring entity will be able to verify compliance at a single place on the CARB website regardless of the rule to which the fleet owner is subject. If the requirement was not applied consistently, then the hiring entity would have a hard time knowing whether they had to check a fleet's compliance status.

h) State and Local Government – Competition on Infrastructure

Comment Summary: Commenter states that until infrastructure is ready, public utilities would be in competition with private fleet operators and the public to recharge vehicles and, to work effectively, public utility EVs have to be readily charged for everyday use and emergencies.

Commenter: [226-45d]

Agency Response: Changes were made in response to these comments. Most fleet owners are expected to install the infrastructure at their depots necessary to support the ZEVs in their fleets especially during the early transition. In this case, BEVs would likely be fully charged at the beginning of each workday. Public fleet data reported as part of the LER shows that the daily mileage of public fleet vehicles is low, and it is unlikely a public fleet with depot charging will need to charge at a retail location. If fleet owners experience delays installing ZEV fueling infrastructure due to circumstances beyond their control they may request the ZEV Infrastructure Delay Extension. The extension was expanded as part of the 15-day changes. Small agencies with 10 or fewer trucks and those operating in designated low population counties are exempt from the ZEV purchase requirement until 2027. SLG fleets are not required to replace existing vehicles and can keep as long as they want. SLG fleets also have earlier access to the Mutual Aid Exemption to purchase new ICE vehicles instead of ZEVs for part of the fleet. Mileage in service of declared emergencies can be subtracted from the odometer readings which allows backup ICE vehicles to operate beyond the 1,000 annual milage limit. As approved, the Regulation provides considerable flexibility for SLG fleets to comply while retaining their ability to respond to declared emergencies.

i) State and Local Government – Allow Alternative Vehicle Purchases When Manufacturer Cancels ZEV Orders

Comment Summary: The commenters suggest that the Regulation be modified to allow for alternative purchases when ZEV orders are delayed or canceled due to high demand or manufacturer issues.

Commenter: [235-45d]

Agency Response: No changes were made in response to these comments. The Regulation already allows for alternative vehicle purchase if a ZEV order is cancelled. If a manufacturer cancels an order for a ZEV due to circumstances beyond the control of the fleet owner, the fleet owner is permitted up 180 calendar days after the cancellation, except for government fleet owners who are permitted up to one year after the cancellation, to establish a new purchase agreement for a ZEV. If no other ZEV is available in the needed configuration, the fleet owner may request the ZEV Purchase Exemption, if applicable, and could purchase any ICE vehicle if granted the exemption.

j) State and Local Government – Allow ZEV Milestones Option

Comment Summary: The commenters request that CARB allow public fleets to opt into a ZEV milestone compliance pathway, similar to the pathway and associated exemptions in the HPF Regulation.

Commenter: [010-OT1, 233-45d, 291-45d, 305-45d]

Agency Response: Changes were made in response to these comments. SLG fleets are permitted to opt into the ZEV Milestones Option.

k) State and Local Government – Treat NZEVs the same as for High Priority Fleets

Comment Summary: The commenters request clarification on NZEV purchases when ZEVs are not suitable and suggest that NZEVs be treated the same as ZEVs until 2035 or have the same treatment in SLG as in HPF. They ask that ACF allow unrestricted NZEV purchases through 2035.

Commenter: [014-45d, 233-45d, 274-45d, 291-45d, 305-45d]

Agency Response: Changes were made in response to these comments. The Board approved modification reflected in the 15-day changes to make the changes the commenter is seeking.

SLG fleets complying with the ZEV purchase requirements may decide whether to purchase a ZEV or NZEV when making additions to the fleet. This change was made to give fleet owners more flexibility in purchasing vehicles that meet their needs. Another change made now gives SLG fleets the ability to opt into the ZEV Milestone Schedule which would give them a longer phase in for some types of vehicles, such as specialty vehicles. This option also treats NZEVs the same as ZEVs until the 2035 model year.

l) State and Local Government – Uncertainty of Vehicle Additions

Comment Summary: The commenters state that using "vehicle additions" instead of "vehicle purchases" in Section 2013(d) of the SLG Regulation creates uncertainty and could lead to discretionary interpretation by CARB staff during enforcement actions.

Commenter: [006-WT1, 291-45d, 321-45d]

Agency Response: Changes were made in response to these comments. In section 2013(d), “vehicle additions” was changed to “vehicle purchases.” This change was made as rule requirements are based on vehicle purchases which is a defined term. The change ensures there is only one reasonable and logical interpretation of the criteria.

m) State and Local Government – Allow Vehicle Delivery Delay

Comment Summary: The commenters state that there should be a vehicle delivery delay for public fleets. This would ensure that public agencies are not found out of compliance due to delays caused by the ZEV manufacturer or distributor, something a public agency has no control over.

Commenter: [210-45d]

Agency Response: No changes were made in response to these comments. SLG fleets have a purchase requirement and compliance is based on ZEV purchases for the California fleet, not when vehicles are delivered. Therefore, any delays of a vehicle delivery would not cause a fleet to be out of compliance. Additionally, SLG fleets have the option to use the ZEV Milestones Option, which gives them flexibility to manage their fleet and the ability to opt into the same exemptions and extensions under the ZEV Milestones Option that are listed in the HPF Regulation including the Vehicle Delivery Delay Extension.

12. Provisions, Reporting, and Recordkeeping Issues

a) Hiring Requirement – Hired Fleet Documentation

Comment Summary: The commenters request that CARB require compliant fleets to submit documentation to the hiring entity when hired, rather than requiring the hiring entity to collect such documentation from the fleet.

Commenter: [014-45d]

Agency Response: No changes were made in response to these comments. A hiring entity should verify each fleet it hires or dispatches is a compliant fleet. Fleets can print a Certificate of Reported Compliance if the compliance and reporting requirements in the TRUCRS database have been met and provide it to the hiring entity or hiring entity can look the fleet up in the TRUCRS database to verify the compliance. Alternatively, for each calendar year that an entity hires a fleet to operate in California, it must obtain a signed statement from the fleet stating the fleet is not subject to the HPF Regulation of title 13, CCR section 2015 through 2015.6, the SLG Regulation of title 13, CCR section 2013 through 2013.4, or the Drayage Truck Requirements of title 13, CCR section 2014 through 2014.2

b) Recordkeeping – Audit Timing

Comment Summary: The commenters request that CARB extend the right of entry and audit request timeframes to 10 business days, as the current deadlines are considered unrealistic and burdensome, especially for smaller public agencies with limited resources and staffing hours.

Commenter: [014-45d, 207-45d, 291-45d]

Agency Response: No changes were made in response to these comments. Fleet owners are required to keep records or documentation related to compliance with the Regulation and need to provide documentation in an electronic or paper format as upon request or make them available to the Executive Officer within 72 hours of a request. Seventy-two hours provides a fleet owner with a reasonable amount of time to make records available to CARB staff while ensuring timely delivery and responsiveness to expedite enforcement activity. CARB has enforcement discretion if a fleet cannot reasonably comply within the required timeframe and needs to ensure timely implementation and enforceability.

c) Recordkeeping – Contracts

Comment Summary: The commenters propose revisions to the recordkeeping provision for hiring compliant fleets, suggesting that only relevant excerpts of contracts pertaining to regulatory compliance be made available to protect proprietary information.

Commenter: [143-45d]

Agency Response: No changes were made in response to these comments. The Regulation requires hiring entities that are subject to the Regulation to keep relevant information in case of audit. This is necessary for CARB to verify and audit any records used by the entity to verify their hired fleets' compliance with CARB Regulations. Upon audit CARB will ask for the appropriate records and will work with hiring entity to identify what documentation is needed. Nothing in the Regulation language compels CARB to ask for whole contract if not needed to verify compliance. CARB is required to protect confidential business information.

d) Recordkeeping – Remove Operator Documentation from State and Local Government Requirements and Align with Information on Shipment Bills of Lading

Comment Summary: The commenters request that CARB eliminate the unrelated "operator documentation" recordkeeping requirement in section 2013.3(b) and ensure that HPF operator documentation requirements align with the information found on a shipment's bill of lading while allowing the use of electronic forms.

Commenter: [282-45d, 291-45d]

Agency Response: No changes were made in response to these comments. The Regulation requires fleet owners to keep and provide documentation that identifies the entity that is responsible to pay the driver who is not a State and local government agency employee and any applicable shipping documentation or other documentation that identifies the origin and destination of the cargo and the pickup and termination destination of the cargo. The operator documentation is necessary for staff to verify the fleet owner or controlling party of a non-compliant vehicle for enforcement purposes in an audit to the extent that it is applicable to the fleet subject to the requirements. If the requirement is not applicable to the fleet owner, the information would not need to be kept because it would not be relevant.

e) Regulation Provisions – Funded Zero-Emissions Vehicle Compliance

Comment Summary: The commenters propose that trucks purchased with incentives should count towards compliance or that trucks bought with funding before the Regulation's start should be considered compliant.

Commenter: [008-45d, 143-45d, 147-45d, 230-45d, 233-45d, 282-45d]

Agency Response: No changes were made in response to these comments. The Regulation encourages early market purchases with California State provided incentive funds and ensure compliance credit for vehicles added before January 1, 2024. Beginning January 1, 2024, if a fleet owner receives California State-provided incentive funding for ZEVs or NZEVs and the funding program guidelines specify the vehicle cannot be used to count toward determining compliance with the general requirements, the vehicle will not be counted as a compliant vehicle during the funding contract period.

f) Regulation Provisions - Hiring Requirement

Comment Summary: The commenters recommend that CARB not require hiring entities to check hired fleet compliance or exclude those that "hire and operate or hire and direct the operation of" from the requirement to verify compliance. They ask CARB to clarify that the requirement to hire compliant fleets does not extend to subcontractors and suggest modifying the Verification of Compliance Section to include "After CARB has completed the issuance of all Certificates of Reported Compliance." The commenters also request language specifying that fleet owners are responsible for validating compliance only for contractors they directly hire, not for subcontractors hired by those contractors. Moreover, they recommend that the hiring addendum should not have to be provided.

Commenter: [200-45d, 207-45d, 229-45d]

Agency Response: No changes were made in response to these comments. This requirement is consistent with the other CARB Regulations. These requirements are needed to ensure all entities involved in the operation of trucks are complying. This assurance is needed to ensure the benefits of the Regulation are actually achieved. The Regulation requires anyone who operates or directs the operation of any vehicle subject to the Regulation must verify that each hired company is in compliance with the Regulation. This requirement applies to any in-state or out-of-state motor carrier, California broker, or any California resident including but not limited to contractors, public agencies, and developers. A California broker is any person or entity, physically located in or outside of California, who arranges for the transportation of goods or property into or within California by motor carriers with vehicles subject to the Regulation. The requirement does not apply to receivers or other parties that do not hire, and do not direct the operation of any vehicle that is subject to the Regulation. If an entity contract with a broker to get more trucks to a job, but ultimately deal directly with the sub-haulers and pays them for their services, then the entity needs to verify the compliance. And if an entity has an arrangement with another broker where the other broker hires and pays the sub-haulers when the entity need them, then the other broker is responsible to verify compliance of the sub-haulers that the other broker hires, and the entity is not because the entity does not determine who the other broker hires. The requirement to hire compliant fleets is needed to ensure fleets are complying with the many different provisions and requirements of the Regulation, ensure enforceability, and prevent loopholes.

g) Reporting - 60 Days for Changes

Comment Summary: The commenters suggest extending the reporting requirements from 30 to 60 days for larger fleet sizes, to better accommodate the process of adding and deleting vehicles.

Commenter: [238-45d]

Agency Response: No changes were made in response to these comments. This section is necessary to ensure that compliance with the Regulation can be verified in the field or essential information is available for any enforcement action. The requirement that changes to the fleet must be reported within 30 days provides a reasonable timeframe for a fleet owner to report any vehicle additions or other changes that might affect the compliance status.

h) Reporting - Allow Aggregate Reporting

Comment Summary: The commenters state that annual reports with aggregated fleet reporting should be enough to confirm ZEV usage in California, instead of requiring detailed reporting on each truck.

Commenter: [247-45d]

Agency Response: No changes were made in response to these comments. It is not possible to verify information in aggregate. CARB must be able to verify accuracy of information provided and that is impossible without vehicle specific information and would not be enforceable and could not be verified in the field. The level of detail in the reporting requirements are all to ensure fleets are complying with the many different provisions and requirements of the Regulation, ensure enforceability, and prevent loopholes.

i) Reporting - Allow Other CARB Reports

Comment Summary: Commenters state that reporting from other CARB programs should be accepted in lieu of a separate ACF report if they contain the same information, and that CARB in general should provide one reporting template for all programs to minimize reporting burden. Some commenters request a consolidated compliance reporting system to streamline fleet reporting, stating that fleets often report to CARB through systems such as TRUCRS, DTR, and ARBER, reporting the same information multiple times (e.g., company/contact information) and, in many cases, which cover or will cover (HD I/M, ACF) the same vehicle.

Commenter: [230-45d, 282-45d, 291-45d]

Agency Response: No changes were made in response to these comments. The Regulation specified that the fleets subject to the Regulation will report in the TRUCRS database, which is being used for the Truck and Bus Regulation and the Solid Waste Collection Vehicle

Regulation. CARB agrees with minimizing duplication and will consider using the TRUCRS database for drayage, but CARB will use the system that is best given other factors CARB need to consider in implementation. The information required by ACF was determined to be necessary to implement and enforce the ACF Regulation.

j) Reporting - Due Date April 1

Comment Summary: The commenters recommend changing the compliance reporting due date to April 1 each year, allowing facilities more time to complete accurate reporting and meet other regulatory deadlines.

Commenter: [238-45d]

Agency Response: No changes were made in response to these comments. This is necessary to establish the annual reporting start date, annual deadline, and end date for the reporting period. February 1, 2024, as a start date is necessary because the Regulation begins January 1, 2024, and CARB would need information about the composition of the fleet reported to determine compliance. CARB selected February 1 as the reporting time frame for the HPF and SLG reporting date is April 1. Other Regulations require reporting during other months of the year, and stakeholders requested staff spread out reporting dates to help mitigate impacts of concurrent reporting due dates.

k) Reporting - State and Local Government - Delay Reporting Start Date

Comment Summary: The commenters suggest that SLG reporting should start in 2028 for designated counties and 2025 for non-designated counties, aligning with the purchase requirement start dates for most public agencies.

Commenter: [291-45d]

Agency Response: No changes were made in response to these comments. April 1, 2024, as a start date is necessary because the Regulation begins January 1, 2024, and CARB would need information about the composition of the fleet reported to determine compliance and which fleets are exempt from ZEV requirements. CARB can use the information to identify missing fleets and provide information and assistance with planning for their compliance date. Fleets with 2027 compliance dates should begin planning for compliance as soon as possible and may benefit from acting early to have more flexibility later. April 1 was selected for the reporting because other Regulations already require reporting during other months of the year, and stakeholders requested that reporting date should be spread out to help mitigate impacts of concurrent reporting due dates.

l) Reporting - State and Local Government - No Reporting Changes Within 30Days

Comment Summary: The commenters propose requiring a single, comprehensive annual report for SLG fleets, rather than reporting changes within 30 days, to minimize the reporting burden and associated costs.

Commenter: [014-45d, 094-OT1, 207-45d, 233-45d, 235-45d, 282-45d, 291-45d]

Agency Response: No changes were made in response to these comments. The Regulation requires fleets to report their fleet information during initial reporting and then fleets only reporting changes within 30 days to the fleet whenever they add new vehicle or remove one from the fleet. Fleet owners need to report real time information to ensure accurate implementation and enforcement of the regulation. Annual reporting will only require checking if the account is up to date and reporting mileage for backup vehicles. Realtime information is needed to be able to verify accuracy of reporting in the field and during audits.

m) Reporting - State and Local Government - Only Report Changes

Comment Summary: The commenters request that SLG fleet owners only report changes to their existing fleets that occurred during the prior calendar year, to reduce duplicate reporting.

Commenter: [291-45d]

Agency Response: No changes were made in response to these comments. The Regulation requires fleets to report their fleet information during initial reporting in the TRUCRS database and then fleets are only reporting changes within 30 days to the fleet whenever they add a new vehicle or remove one from the fleet. Fleet owners need to report real time information to ensure accurate implementation and enforcement of the regulation. Annual reporting will only require checking if the account is up to date and reporting mileage for backup vehicles. Realtime information is needed to be able to verify accuracy of reporting in the field and during audits.

n) Reporting - State and Local Government - Only Require Date Purchased

Comment Summary: The commenters argue that reporting both the purchase date and date a vehicle was "added" to the California fleet is duplicative for SLGs and recommend changing "added" to "placed in service."

Commenter: [291-45d]

Agency Response: No changes were made in response to these comments. The Regulation requires date vehicle purchase and date vehicle was added to the California fleet for the vehicle information reporting in the TRUCRS database. Date added is effectively the date placed in service in California which is typically not the same day or year the order is placed. The purchase date is necessary to determine compliance of the purchase requirements. They are based on the purchase date and exemptions that require the purchase date to determine eligibility. Date added is needed because it will show when the vehicle was placed in the California fleet and may not be same as purchase date. Fleet owners only need to report the information one time when they receive the vehicle.

o) Reporting - Too Onerous

Comment Summary: The commenters express concerns that VIN level reporting on cargo origin and destinations, as well as daily usage reports, will be difficult to track for large entities. They emphasize the need for sufficient lead time to develop tracking systems before the January 1, 2024, start date. Commenters also urge CARB to ensure that ACF reporting is less onerous than the Truck and Bus Regulation, which required extensive validations for simple reporting changes, and allow fleet owners to report vehicle types without CARB staff intervention.

Commenter: [247-45d, 337-45d]

Agency Response: No changes were made in response to these comments. Large fleets reported in Truck and Bus for over 15 years without issues. Telematics systems make it easier. Much of the information required is already required to be tracked by fleets to comply with other local, State, federal Regulations and requirements.

p) Reporting - Too Onerous-Only Require for Min 90 Days in California

Comment Summary: The commenters propose reporting only vehicles that are in California for a minimum of 90 days, due to the burden of collecting information and lack of oversight for transient vehicles operating in the state for shorter timeframes.

Commenter: [170-45d]

Agency Response: No changes were made in response to these comments. The Regulation requires that no ICE vehicle can be added to the California fleet after initial reporting. Field enforcement will cite any truck found in California that is not reported by an affected fleet owner. This is necessary to ensure that compliance with the Regulation can be verified or essential information is available. It will be impossible to enforce without ability to do real time check and would affectively be a giant loophole for out of state fleets at the expense of in state fleets. The requirement that changes to the fleet must be reported within 30 days provides a reasonable timeframe for a fleet owner to report any changes to that might have an effect on the compliance. Fleet owner will be only reporting changes to their fleets after the initial reporting.

13. Exempt Vehicles or Fleets

a) Exempt Various Vehicles, Industries, or Sectors from the Regulation

Comment Summary: The commenter suggests including blanket exemptions from the Regulation for sets of vehicles, fleets, or industry sectors for assorted reasons.

Commenter: [004-WT1, 007-45d, 017-OT1, 024-WT1, 026-OT1, 058-45d, 078-OT1, 080-OT1, 083-OT1, 118-OT1, 137-45d, 220-45d, 224-45d, 237-45d, 239-45d, 245-45d, 261-45d, 292-45d, 326-45d, 334-45d, 335-45d]

Agency Response: No changes were made in response to these comments. Changes to exclude groups of vehicles or industries would not achieve the goals of the Regulation to reduce emissions and transition the California fleet to ZEVs where feasible. Excluding vehicles or industries without compelling reason would not achieve the goals of the Regulation or meet the Governor's Executive Orders. Given the built-in flexibility and exemptions and extensions in the Regulation, there is no apparent reason to exempt such fleets and vehicles. When ZEVs are not available, the ZEV Purchase Exemption would provide fleets relief. When ZEVs cannot meet the fleet's daily usage needs, the Daily Usage Exemption would provide fleets relief. The ACF ISOR establishes the need for incorporating the vehicles and sectors that are included in the Regulation and provides data to support these inclusions. Manufacturers are bringing more ZEV and NZEV products to the market every year.

b) Exempt Motor Homes from the 100 Percent ZEV Sales Requirement and Fleet Requirements

Comment Summary: The commenters request motorhomes be exempted from the 100 Percent ZEV Sales requirement in section 2016(d), arguing that the cost impact may lead to motorhomes being nearly abandoned as a recreational lifestyle. Additionally, the commenters state that motorhomes should be exempt from the ACF requirements.

Commenter: [220-45d, 224-45d]

Agency Response: No changes were made in response to these comments. Motor homes are regularly operated and parked at places with electricity supply and can be charged, so in some cases it may be an ideal application, or provide an advantage to fuel where they park, compared to ICE vehicles. As all trucks transition to ZEVs and infrastructure expands, motor homes can charge or refuel at the same places other trucks do as they do now. Analysis shows that by the 2040 timeframe, ZEVs will be at or less than ICE counterparts in upfront cost.

The Regulation also does not apply to small fleets or individual recreational purchases, so individual motor home customers are unlikely to be affected by the ACF requirements until 2036.

c) Exempt Heavy Equipment Rental Fleets

Comment Summary: The commenters state that the Regulation should exclude rental, service, and transportation vehicles serving the construction, agricultural, military, and critical service industries. They request that CARB consider exempting heavy-duty rental, heavy-duty equipment repair vehicles, and private not-for-hire heavy equipment transportation vehicles from the ACF Regulation because they operate in remote locations with limited infrastructure and vehicles are not available and will not meet their needs.

Commenter: [024-WT1, 058-45d, 080-OT1, 239-45d, 326-45d]

Agency Response: No changes were made in response to these comments. Beyond the rationale for why a blanket exemption for vehicles and fleets are not appropriate, commenter raises concerns about capability of heavy-duty equipment rental fleets to be able to service their industries, which are used in remote locations with limited infrastructure. Although some vehicles in the fleet may be more challenging to electrify, the Regulation has flexibility that allows fleet owners to begin the transition to ZEVs by focusing on the trucks in their fleet that are most suitable and deferring ZEV adoption for the vehicles and duty cycles that are more challenging until a later time when ZEVs capabilities are improved and retail infrastructure is widely available. The Regulation also counts NZEVs the same as ZEVs for compliance until 2035, and they have the same fueling and operating characteristics as conventional vehicles. NZEVs could provide additional compliance relief beyond the Regulation's built-in flexibility and exemptions for lack of vehicle availability or inability to achieve the fleet's daily usage needs. The ZEV Milestones Option allows for the continued purchase of used or new ICE vehicles and has a later timeline for day cab or work trucks starting in 2027 under the ZEV Milestones Option. Additionally, specialty vehicles and sleeper cabs would not need to start transitioning to ZEVs until 2030. Finally, military tactical vehicles are already exempt from the Regulation pursuant to section 2015(c).

d) Exempt Class 8 Construction Vehicles; Concrete Pumps Meet Heavy Crane Definition

Comment Summary: The commenters request an exemption for Class 8 construction vehicles, such as concrete mixers, pumps, and powder trucks, until 2039, citing infrastructure, safety, and capability challenges, and arguing that concrete pumps meet the definition of a heavy crane.

Commenter: [261-45d, 334-45d]

Agency Response: Changes were made in response to these comments. Safety considerations were included in the updated ZEV Purchase Exemption where the fleet owner can cite specific safety laws that would be violated by operating otherwise available ZEVs. Class 8 specialty vehicles already are on the latest ZEV Milestones timeline, starting in 2030, when it is reasonable to expect ZEV availability and infrastructure availability are improved. The definition of Heavy Crane also includes that the on-road single engine crane is required to be operated by a licensed crane operator. This is not a requirement for concrete pump trucks; therefore, concrete pump trucks do not meet the definition of heavy crane as set forth in the Regulation.

e) Exempt Non-Return-to-Base, Depot-Charging, Small Weight Class Vehicles

Comment Summary: The commenters suggest that the ACF Regulation should focus on feasibility by requiring only vehicles best suited for the transition to zero-emission, which commenter states are smaller weight class, return-to-home base trucks with the ability to depot charge overnight.

Commenter: [026-OT1]

Agency Response: No changes were made in response to these comments. The statement this commenter made is substantially similar to an alternative discussed in the ACF ISOR. See rationale for why this approach was rejected in Chapter IX.B.6. of the ACF ISOR.

f) Exempt Motor Coach Industry

Comment Summary: The commenters request an exemption for the motor coach industry due to the high gross vehicle weight of the buses and the need for luggage space.

Commenter: [017-OT1]

Agency Response: No changes were made in response to these comments. Buses are widely available as ZEVs already, including motor coaches. They have a delayed phase in schedule under the ZEV Milestones Option starting in 2027 to allow additional time for such vehicles. The Daily Usage Exemption would address daily usage concerns, to the extent buses have high daily mileages. In addition, if there is no motor coach available to purchase as a ZEV (or NZEV until 2035) that meets the primary intended function of the vehicle (e.g. transporting passengers and their luggage), the ZEV Purchase Exemption could be used to receive an exemption to purchase an ICE motorcoach if all of the available ZEVs do not have a usable luggage compartment. We expect technology and availability of more capable models will improve over time.

g) Exempt Postal Contractors if Postal Service is Exempt

Comment Summary: The commenters request that if an exemption for the postal industry from the ACF Regulation is granted, Highway Contractor Routes suppliers should also be included as they are essential in the postal industry.

Commenter: [025-WT1]

Agency Response: No changes were made in response to these comments. The mail and package delivery industry are one of the most suitable to transition to ZEVs today. An exemption was not granted to the postal industry, so the commenter's conditional request is not relevant.

h) Exempt or Allow Alternative Requirements for Solid Waste Collection Vehicle

Comment Summary: The commenters suggest that CARB should allow the solid waste sector additional time to test ZEVs and propose suitable levels of electrification for their fleets, effectively as an exemption.

Commenter: [078-OT1, 292-45d]

Agency Response: No changes were made in response to these comments. Beyond the rationale for why a blanket exemption for vehicles and fleets are not appropriate, the commenter provided no criteria for how suitable levels of electrification would be determined for each fleet, the proposed concept would be subjective with no apparent objective criteria to use. An open-ended concept where each fleet can pick its own timeline to comply is essentially business as usual and would not achieve any of the objectives associated with the purpose of the Regulation. No emissions reductions would be expected and could not be included in the SIP. Only measures that result in real emissions reductions and are enforceable may be included in the SIP. The Regulation already has a number of provisions to address ZEV availability and daily usage needs based on objective criteria that ensures ZEVs would only be required to comply when they are suitable to replace an ICE truck in the fleet.

i) Exempt Remote Construction Vehicles

Comment Summary: The commenters state that an exception should be made for situations where electric fleets cannot be reasonably be utilized for remote roadway construction or renovation projects due to the lack of available infrastructure.

Commenter: [118-OT1]

Agency Response: No changes were made in response to these comments. The Regulation has flexibility for fleet owners to begin placing ZEVs where they are most suitable for the fleet's operation. The ZEV Milestones Option gives fleet owners the flexibility to purchase ICE vehicles as needed as long as the ZEV milestones are met. In addition, NZEVs (until model year 2035) count the same as ZEVs in the Regulation and would not have the same infrastructure or range concerns as full ZEVs in the near-term of the Regulation. Where NZEVs are not available, mobile, temporary, and off grid fueling and generation solutions are available today and are expected to be more common and more robust in the future to address a fleet owner's resilience concerns.

j) Exempt Unique – Drilling Vehicles, Support Vehicles, Power Take-Off Vehicles, Environmental Remediation Vehicles, Membrane Interface Vans

Comment Summary: The commenters request specific exemptions for their vehicles and equipment, including drilling rigs, well development, environmental remediation vehicles, support trucks, power-takeoff equipment and vehicles, and specialized membrane interface vans with built-in equipment not designed for product transportation.

Commenter: [007-45d]

Agency Response: No changes were made in response to these comments. Beyond the rationale for why a blanket exemption for vehicles and fleets is not appropriate, the commenter provides no compelling reason these vehicles cannot be transitioned to ZEVs over the next two decades. Some vehicles are exempt from the Regulation like two engine vehicles, including two engine drill rigs as defined in the Regulation. For vehicles that are not excluded, the Regulation has built in exemptions or extensions to address situations where ZEVs are not available to purchase, they cannot meet a fleet's daily usage needs, or extensions where infrastructure installations are delayed. Finally, the ZEV Milestones Option would allow fleets to defer requirements based on existing vehicle's suitability, with specialty vehicle requirements deferred to start in 2030.

k) Exempt Intermittent Snow Removal Vehicles

Comment Summary: The commenters request that intermittent snow removal vehicles be granted a delay, more vehicle types be added, or the definition be adjusted, arguing that the current draft ACF Regulation lacks an accurate understanding of snow removal fleets and their multi-purpose vehicles.

Commenter: [007-OT1, 263-45d, 291-45d]

Agency Response: Changes were made in response to these comments. An intermittent snow removal vehicle provision was included in the SLG Regulation to allow purchases of such vehicles as ICE until 2030. A similar provision was added to the HPF Regulation for fleet owners utilizing the ZEV Milestones Option to exclude existing and purchased intermittent snow removal vehicles from the Milestone compliance calculations until 2030. A definition was added to the Regulation to define "intermittent snow removal vehicles" and was drafted in coordination with owners of intermittent snow removal vehicles. The definition was limited to only those vehicles that have a plow or blower mount and control system because these features are necessary to perform significant snow removal work. Vehicles without these key features would not be eligible even if used to plow snow with a temporary blade attachment. See more rationale for why the definition was selected and why the provision and definition do not go further in Chapter C.(A).18., section 2015(b), and Chapter C.(C).23., 2015.2(f)(9), of the ACF 15-Day Notice.

l) Exempt Transit Agencies

Comment Summary: The commenters state that ACF should not apply to transit agencies, citing concerns about the cost burden on these agencies to comply with both ICT and ACF requirements.

Commenter: [299-45d]

Agency Response: Changes were made in response to these comments. Language was added to the SLG Regulation to exempt transit agencies and their trucks until 2030 as part of the 15-day changes. Vehicles subject to ICT are already exempt from the ACF Regulation.

m) Exempt Manufacturer Test Fleets

Comment Summary: The commenters request that ACF exempt manufacturer demonstration, test, or experimental fleets.

Commenter: [030-WT1, 100-OT1, 120-OT1, 147-45d, 255-45d]

Agency Response: Changes were made in response to these comments. Manufacturer test fleets were defined and added to the list of vehicles that are exempt from the HPF Regulation as part of the 15-day changes.

n) Exempt Vehicles Subject to Off-Road Regulations

Comment Summary: The commenters recommend that ACF include clear exemptions for vehicles already regulated under other emissions reduction programs, such as PERP, In-Use Off-Road Diesel, Portable Engine ATCM, Off-Road Large-Spark Ignition Regulations, and for vehicles participating in voluntary local emissions reductions programs.

Commenter: [004-WT1]

Agency Response: No changes were made in response to these comments. The Board recognized that the Regulation has some overlap with other existing CARB Regulations and the vehicles were intentionally included. The scope of the ACF Regulation includes on-road vehicles and off-road yard trucks because ZEV technology is available for these vehicles, they are suitable for electrification and the Board needs to reduce emissions everywhere feasible. On-road vehicles include those originally designed to operate on-road at highway speeds whether or not they are registered to drive on road. Trucks, vans, buses, or chassis that were originally manufactured to operate on road are included in the Regulation including vehicles that are used as ground support equipment or are subject to other Regulations if the vehicle falls under the vehicle definition and is included in the vehicle scope as laid out in the Regulation. There is no need to mention the Regulations that do not include vehicles within the scope of the Regulation.

14. Exemptions and Extensions – General

a) Emergency Response and Essential Services – Master Response

Comment Summary: The commenters express concern about the ACF Regulation's unintended consequences on public utilities and their ability to provide essential services, particularly during emergency events. Some commenters argue that the Regulation lacks necessary exemptions for their heavy equipment rental business type, impairing their ability to assist in responding to emergencies and service needs crucial to heavy equipment and emergency systems operation. Some commenters suggest exempting all emergency response or essential service provider vehicles or fleets. Some commenters mention that the SLG Regulation could adversely impact public safety infrastructure.

Commenter: [021-WT1, 024-WT1, 056-45d, 151-OT1, 164-45d, 170-45d, 180-45d, 233-45d, 237-45d, 297-45d, 310-45d]

Agency Response: No changes were made in response to these comments. The Regulation is gradually phased-in over two decades and provides flexibility for fleet owners to select which vehicles to be purchased as ZEVs. SLG fleet owners meeting the purchase requirements can continue to purchase new ICE vehicles until 2027 for half their purchases and can keep existing ICE vehicles as long as they want. ZEVs are as capable as ICE vehicles in almost all cases and are expected to improve over time. Infrastructure availability will improve as the Regulation is phased in. Additionally, the Regulation has a number of exemptions and extensions provisions, including: a mutual aid emergency response exemption which allow fleets to retain up to a quarter of the fleet as ICE vehicles; backup vehicles are allowed unlimited mileage during emergency operations; exemptions for when specialized emergency response vehicles are not available to purchase; extensions for when infrastructure installations are delayed; exemptions to bring in out of state vehicles responding to emergencies; exemptions for when ZEVs cannot meet a fleet's daily usage needs, which was modified in the ACF 15-day changes to allow for fleets with mutual aid agreements to use mileage reports from the last five years to recognize major emergencies that do not occur annually; exemptions for specialized two-engine vehicles and heavy cranes that may be used to respond to emergencies; and exemptions for emergency response vehicles defined in the CVC section 165. All of these are in recognition of edge cases where incorporating ZEVs into fleets may be more challenging to provide flexibility to fleets. Blanket exemptions for all fleets or vehicles responding to emergencies are not appropriate and would not achieve the goals of the Regulation.

Comment Summary: The commenters emphasize that public agencies need flexibility to respond to emergencies during Enhanced Powerline Safety Shutoffs, which differ from PSPS events, as Enhanced Powerline Safety Shutoffs have no advanced warning and weren't considered in the ACF ISOR.

Commenter: [180-45d]

Agency Response: Though Enhanced Powerline Safety Shutoffs events may not have been explicitly discussed, sufficient flexibility is included in the Regulation to allow fleets to manage their fleet purchases and to respond to emergency events such as Enhanced Powerline Safety Shutoffs. In addition, ZEVs have advantages other trucks don't have like being able to keep the power on while repairs are being made.

b) Include Out of State Vehicle Flexibility

Comment Summary: The commenters suggest the Regulation should include flexibility for vehicles making temporary, short trips to or through California, proposing a 90-day exemption for out-of-state vehicles temporarily operating within the state. They request a temporary pass for one-time access to California roads for HD I/M compliant vehicles and an exemption similar to the Truck and Bus Regulation's Low Use Exemption for temporary operations.

Commenter: [025-WT1, 105-OT1, 145-OT1, 170-45d, 207-45d, 248-45d, 256-45d]

Agency Response: Changes were made in response to these comments. The 5-Day Pass provision was added to the Regulation to address temporary trips into California for a limited period of time and is consistent with other in-use vehicle Regulations such as the Truck and Bus Regulation. Providing 90 days would be too long of a time frame to allow vehicles to operate, would be a loophole for out-of-state fleets, and would be inconsistent with the goals of the Regulation to reduce vehicle emissions. The pass is not tied to compliance with HD I/M to increase flexibility for fleets to qualify for the provision, though that Regulation would simultaneously apply to all vehicles subject to it. Additionally, this pass provides more flexibility than the Truck and Bus version of the pass, because instead of being limited to a single vehicle per fleet per year, each vehicle in a fleet could qualify for a pass per year, providing flexibility to fleet owners to manage the fleet of vehicles sent to operate in California.

c) Allow Pickups to Qualify for All Exemptions and Extensions

Comment Summary: The commenters request that pickup trucks in all configurations be addressed the same as the Regulation addresses trucks over 14,000 pounds GVWR and allow their inclusion for all exemptions in the Regulation.

Commenter: [002-OT1]

Agency Response: No changes were made in response to these comments. Please see rationale for why pickup trucks are excluded from exemption or extension provisions in the relevant sections of 2015.3 of Appendix H-1 and H-2 to the ACF ISOR.

d) Allow Exemption Applications for Multiple Vehicles at Once

Comment Summary: The commenters suggest that fleets should have a way to file exemptions for multiple vehicles instead of on a vehicle-by-vehicle basis.

Commenter: [207-45d]

Agency Response: No changes were made in response to these comments. The Regulation already provides flexibility to grant exemptions or extensions for a particular vehicle class and configuration, but others require vehicle-specific information which would necessarily not be able to be aggregated; for example, the Daily Usage Exemption would require daily usage information for individual vehicles in the fleet to demonstrate the need for the exemption. Some exemptions, such as the ZEV Purchase Exemption, would exempt a particular vehicle class and configuration, which would be applicable to all vehicles of that type in the fleet if approved. The Non-repairable Vehicle Provision and Backup Vehicle Exemptions are necessarily individualized to specific vehicles in the fleet. Thus, these changes are not necessary and would hinder implementation of the provisions that need vehicle-specific information to qualify.

e) Provide More Flexibility and Clarity for Exemptions

Comment Summary: The commenters request more flexibility in the Regulation, suggesting that exemptions should continue until technology advances sufficiently for medium- and heavy-duty applications, and clearer criteria for exemptions and their processes, which should be standardized and identical for public and private fleets and drayage trucks.

Commenter: [017-45d, 018-45d, 105-OT1, 146-45d, 168-45d, 171-45d, 172-45d, 173-45d, 176-45d, 178-45d, 234-45d, 246-45d, 253-45d, 256-45d, 310-45d, 318-45d, 342-45d, 344-45d, 345-45d, 346-45d]

Agency Response: Changes were made in response to these comments. Additional exemptions and extensions were added to the Regulation to address additional edge-case scenarios, such as when vehicles become non-repairable, or to allow for temporary operations in California for non-compliant vehicles. The exemptions and extensions were reworked, simplified, streamlined, and added clarity in objective criteria and explanation of processes.

Some changes were made to align the drayage truck requirement compliance extensions with other parts of the Regulation, such as including Infrastructure Delay Extensions and provisions for non-repairable vehicles; however, due to the urgency of needed emissions reductions at the ports, more readily available ZEV models, shorter operational ranges, and differences in fleet makeups, some extensions and exemptions were not appropriate to make identical, such as the ZEV Purchase Exemption or Daily Usage Exemption.

f) Include Appeals Process for All Exemptions

Comment Summary: The commenters request an appeal process for all exemptions as an oversight or correction mechanism to ensure consistent application of the Regulation.

Commenter: [015-WT1, 261-45d]

Agency Response: Changes were made in response to these comments. These comments were addressed directionally; rather than include an appeals process, the Regulation was updated to clarify and use objective criteria and streamline the application and approvals process. No appeals process is necessary because the criteria and process updates are sufficient to address exemption issues. Additionally, the criteria were workshopped to the public to allow for stakeholder input in the process and criteria, and changes were made to address stakeholder comments.

g) Include a “Catch All” Exemption for Scenarios Not Contemplated by the Regulation

Comment Summary: The commenters propose a "catch-all" process to delay compliance requirements on a fleet-specific basis for reasons not contemplated by the Regulation, emphasizing the need for flexibility to address complex scenarios when unique needs or circumstances do not fit within simplified exemption criteria.

Commenter: [207-45d, 233-45d, 291-45d, 322-45d]

Agency Response: No changes were made in response to these comments. CARB has attempted to respond to many commentors requests and incorporated a wide range of exemptions/extensions. The commenter has not provided a specific example in which an exemption/extension would not apply, and a catchall would be needed. The existing exemptions and extensions have been reasonably modified to provide additional clarity, flexibility, objectivity, and to address scenarios stakeholders have raised during the public process.

h) Exemptions for Incorrect Cost Predictions and Economic Infeasibility

Comment Summary: The commenters suggest incorporating an exemption for economic infeasibility, allowing fleets to request exemptions if cost estimates of the ACF ISOR are incorrect in the future or off by a certain percentage, such as 20 to 25 percent.

Commenter: [174-45d, 280-45d, 322-45d]

Agency Response: No changes were made in response to these comments. Like other trucks, ZEVs vary in price, have a number of features that differ between similar models, and the retail prices are not consistent among manufacturers. The price of a ZEVs, like other trucks, are also affected by a number of variables that are subject to fluctuation and other variables like inflation. ZEVs have lower fuel costs and maintenance costs that can make the TCO lower than ICE vehicles even if they have a higher upfront cost. For example, fleets often purchase diesel trucks instead of a gasoline version for reasons other than price. The cost estimates as described in Chapter VIII. of the ACF ISOR are estimates of the cost differential in constant dollars and not guarantees of future ZEV prices. The Regulation also provides fleet owners with flexibility to manage and prioritize their purchases as they transition the fleet to ZEVs. Under the commenter's suggested proposal, it would be difficult to base an exemption on unpredictable changes in these variables as well as assess the point in which an exemption would be granted if any ZEVs are available for purchase at a cost in alignment with the ACF ISOR estimates. This proposal would create a loophole by which fleets could indefinitely delay transitioning their fleets if a ZEV that exceeds cost estimates of the ACF ISOR could be afforded, causing the goals of the Regulation to not be met.

i) Exemptions for Zero-Emissions Vehicle Experience Gain

Comment Summary: The commenters generally recommend that CARB allow alternative compliance options until fleets gain more experience with ZEVs.

Commenter: [115-OT1]

Agency Response: No changes were made in response to these comments. Fleets are expected to determine which ZEVs are best suited for their fleet operations through their own analyses and determinations. It would be unreasonable to grant exemptions due to lack of experience with ZE technology as this experience is to be gained through ZEV acquisition by complying with the Regulation. Experience quantification is also not a reasonable nor realistic variable for evaluating exemption criteria.

j) Exemptions for Infrastructure Development

Comment Summary: The commenters generally recommend that CARB allow alternative compliance options until more infrastructure is installed.

Commenter: [115-OT1]

Agency Response: No changes were made in response to these comments. ZEV infrastructure is commercially available today and will continue to expand as the Regulation is phased in over the next 20 years. In most cases, fleets are expected to initially install their own infrastructure and potentially rely on public or retail fueling infrastructure as ZEV deployments expand. The ZEV Infrastructure Delay Extension also provides flexibility to fleets that experience delays due to circumstances beyond their control on a project to install ZEV fueling infrastructure. Granting an exemption specifically until more infrastructure is installed is therefore unnecessary considering these factors. For more discussion about infrastructure installation, please see responses to issues raised in section "Grid Capacity and Resilience – Additional Grid Planning and Analysis Needed" of section "Infrastructure and Grid Concerns" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

k) Exemptions for Mineral Supply Development

Comment Summary: The commenters generally recommend that CARB allow alternative compliance options until more mineral supplies become available.

Commenter: [115-OT1]

Agency Response: No changes were made in response to these comments. CARB's analysis concluded that the ACF Regulation is not anticipated to substantially affect the economic potential or supply of known mineral resources. Industry is rapidly moving to batteries with different chemistries or formats to address concerns with mineral supply chain issues. The recycling of lithium-ion batteries is also increasing to ensure that minerals are recovered and reused instead of discarded. An exemption based on the availability of mineral supplies is, therefore, not necessary in consideration of these factors. CARB evaluated impacts associated with mining for battery materials in the CEQA EA and these concerns are addressed in the EA RTC document, see Master Response 2.

l) Grant Cities Extension for Regulation Planning and Budgeting

Comment Summary: The commenters request an extension be granted if a city has planned and budgeted for infrastructure and ZEVs, instead of being penalized for not complying due to ZEV unavailability.

Commenter: [089-45d, 128-45d, 278-45d, 279-45d]

Agency Response: No changes were made in response to these comments. State and Local Government fleets are not required to retire any trucks from their fleet and can keep operating their existing trucks as long as they want. There is no reason to provide extensions for the act of planning and budgeting for infrastructure and ZEVs, as fleets are expected to do so to comply with the ACF Regulation. Additionally, the ZEV Purchase Exemption is intended to provide flexibility to fleets in circumstances where a vehicle configuration is not available to purchase as a ZEV, or an available ZEV does not meet a fleet's needs, and the infrastructure delay provision would address situations where the planned infrastructure project takes more than one year to complete.

m) Exemption Process is Too Burdensome

Comment Summary: The commenters state that the exemption process is too burdensome on CARB staff or regulated parties to be feasible or efficient.

Commenter: [303-45d, 321-45d]

Agency Response: Changes were made in response to these comments. Language was added to enhance the clarity of criteria for all exemptions and extensions while addressing process-related concerns. The process will not impose an excessive burden on them, as the provisions were specifically designed with both staff resources and fleet owner burden in mind.

n) Unique Redlines Comment 310 to Section 2015.3

Comment Summary: The commenter requests specific redline edits to the Regulation and delete this phrase from Section 2015.3, "if the California fleet complies with the requirements that are in effect, and it would otherwise be impossible to comply with the next upcoming Regulation requirement. Fleet owners requesting or utilizing any exemptions or extensions," and have the section to be revised to say, "Fleet owners may claim or apply for the following exemptions or extensions and must meet applicable reporting and recordkeeping requirements for each exemption or extension."

Commenter: [310-45d]

Agency Response: Changes were made in response to these comments. Language was revised, while still retaining the requirements to protect against loopholes whereby fleets would apply for exemptions that are not necessary when other vehicles in the fleet can be transitioned to ZEV under the ZEV Milestones Option.

o) Allow Alternative Compliance Options Until More ZEVs Available

Comment Summary: The commenters generally suggest CARB allow alternative compliance options until more vehicles become available.

Commenter: [029-OT1, 115-OT1]

Agency Response: Changes were made in response to these comments. The Regulation already has considerable flexibility for fleets to plan their compliance strategies. In addition, there are a number of exemptions in place for fleets to choose from when a suitable vehicle is not available. These exemptions have been designed to provide flexibility and accommodate the unique needs of each fleet, ensuring that they can continue to operate effectively during the transition period.

p) Limit the Amount of Exemptions

Comment Summary: The commenters urge the Board to limit and specify exemptions, clearly stating the emissions reductions and health benefits lost or delayed due to exemptions for both statewide and highly impacted communities.

Commenter: [183-45d]

Agency Response: No changes were made in response to these comments. The flexibility in the Regulation also reduces the need for exemptions. The scope of exemptions is already limited by the specific criteria associated with each one. The exemptions have been carefully designed to balance the need for flexibility in unique circumstances where the fleet owner would not be able to comply for circumstances beyond their control and otherwise achieve the maximum emissions reduction and health benefits.

q) Non-Repairable Vehicle Exemption

Comment Summary: The commenters suggest adding language to the Regulation that permits CARB-reviewed replacement of vehicles requiring immediate replacement due to accidents, mechanical failure, or unforeseen circumstances with ICE vehicles.

Commenter: [032-45d, 210-45d]

Agency Response: Changes were made in response to these comments. Staff has introduced a new Non-repairable Vehicle Provision to the Regulation which allows ICE vehicles which have been totaled or deemed non-repairable to be replaced with a combustion-powered vehicle without changing the compliance date of the original vehicle if using the Model Year schedule. This allows fleets to recover from an unexpected event without needing to purchase a ZEV ahead of the originally expected schedule.

r) Adequate Infrastructure Exemption

Comment Summary: The commenters request that CARB create off-ramps within ACT and ACF Regulations to reduce compliance obligations if adequate infrastructure is not present, linking targets to related electrical generation, transmission, distribution, and infrastructure availability.

Commenter: [147-45d, 270-45d]

Agency Response: Changes were made in response to these comments. Infrastructure delays are accounted for in the Regulation, and additional time and access criteria were provided to account for potential delays in the completion of infrastructure installation projects. No changes to the ACT Regulation were made in response to these comments because changes to the ACT Regulation are out of scope of the ACF rulemaking processes and procedures. Commenters suggestions to change the ACT Regulation is not directed at the ACF Regulation or the process by which it was adopted and therefore CARB is not required to respond.. Notwithstanding this response, providing manufacturers an exemption when a single customer experiences delays in infrastructure installation does not make sense when the manufacturer can make their sale to another customer. Accommodating infrastructure delays in ACF is sufficient; therefore, adding a delay to the ACT Regulation is not needed.

s) Rental Fleet Exemption

Comment Summary: The commenters request a full exemption from the rental fleet average for rental vehicles operating in California for less than 10 consecutive days or no more than 30 days cumulatively in a single year. They express concern that they will never achieve full compliance under the ACF Regulation because they cannot control which vehicles their rental customers bring in from out-of-state. They believe that implementing a 10-day consecutive/30-day cumulative rental vehicle buffer will provide greater flexibility for companies to reach compliance and facilitate a smoother transition to ZE trucks.

Commenter: [008-45d, 282-45d]

Agency Response: No changes were made in response to these comments. The Rental Vehicle Option in the Regulation already addresses the issue of transient trucks and has been specifically designed to facilitate compliance and ease the transition towards ZE trucks. This provision was included in the original proposal and provides rental fleet owners the option to report the average number of rental vehicles operating in California based on quarterly snap shots using data rental fleets already collect, with certain conditions and reporting requirements.

t) Interstate Rental Fleets

Comment Summary: The commenters propose applying the quarterly average approach offered for rental fleets to interstate fleets as well, as it would reduce a motor carrier's initial

ZEV burden by 67 percent or more. They argue that the current Regulation would require more trucks to comply in the earlier years than manufacturers and infrastructure can support. They believe this change would encourage a more gradual but consistent growth of ZEVs within California, promoting the development of a secondary resale market and preventing "legacy" vehicles from remaining on California roads for extended periods.

Commenter: [282-45d, 284-45d]

Agency Response: The commenters incorrectly assume that the Regulation applies to fleets that operate or control the operation of vehicles outside of California. Notwithstanding that response, changes were made in response to these comments. CARB added a 5-Day Pass that allows the fleet owner to exclude individual vehicles from their California fleet for five consecutive days in the calendar year. This change was kept narrow to minimize the potential loophole where an out of state fleet would increase the number of trucks operating in California to delay ZEV purchases and undercut their competitors. However, no other changes were made in response because interstate carriers are in full control of where they direct their trucks and how they manage their assignments. Interstate fleet owners with day cab and sleeper cab tractors have more time with the ZEV Milestones Option than rental companies with box trucks. Interstate fleet owners regularly manage which trucks they direct to California and which trucks will operate in their California fleet. Extending the quarterly average approach to thousands of interstate fleets would also introduce complexities in terms of monitoring and enforcement and would undermine the emission benefits of the Regulation and would be unfair to instate fleets.

u) Establish Independent Exemption Hearing Board

Comment Summary: The commenters state that CARB should establish a hearing board to review exemption requests on a case-by-case basis, emphasizing the need for an independent process with guardrails for technology determination, exemptions, and commercial availability.

Commenter: [207-45d]

Agency Response: No changes were made in response to these comments. The Board determined that using a specified set of criteria they approved was sufficient for the Executive Officer and affected fleets use in making determinations if the specified conditions were met. The Board rejected the notion of delegating its decision-making ability to an unspecified group with different objectives. Each exemption approved in the Regulation includes sufficiently clear, objective, and transparent processes and criteria which eliminates the need for an independent reviewing entity.

v) Establish Independent Extension Hearing Board for Infrastructure Delay Extensions

Comment Summary: The commenters suggest that decisions on extensions under the Infrastructure Construction Delay provision be made by an advisory board comprised of representatives from various stakeholders.

Commenter: [175-45d]

Agency Response: No changes were made in response to these comments. The Infrastructure Delay Extension is sufficiently clear, objective, and transparent for fleet owners to understand if they meet the criteria and for the Executive Officer to evaluate. There is no reason to expect that processes and criteria which eliminate the need for an independent reviewing entity.

w) Establish Independent Hearing Board to Determine Vehicle Delivery Delays

Comment Summary: The commenters request that the ZEV ordering deadline under the Vehicle Delivery Delay Exemption be for a period of time as determined by an independent advisory board.

Commenter: [175-45d]

Agency Response: No changes were made in response to these comments. Assessing exemption requests through a third-party review is infeasible and would significantly delay implementation. The Vehicle Delivery Delay provision establishes sufficiently clear, objective, and transparent processes for fleet owners to understand if they meet the criteria and for the Executive Officer to evaluate. There is no reason to expect that these processes and criteria would need independent review.

x) Exemptions for Zero-Emissions Vehicles with Higher Total Costs of Ownership

Comment Summary: The commenters state that CARB should include exemptions when the TCO for a ZEV significantly exceeds that of a comparable ICE vehicle.

Commenter: [285-45d]

Agency Response: No changes were made in response to these comments. Should a ZEV's TCO significantly exceed that of a comparable ICE vehicle, the fleet owner has the option of purchasing other ZEVs that are more financially viable, so it would be unnecessary to provide an exemption process for these circumstances. The TCO payback period for ZEVs based on individual fleet use cases will also vary by fleet and creating criteria around the TCO for an exemption would, therefore, be infeasible. Fleet owners may also take advantage of funding opportunities to assist in ZEV acquisition, further eliminating the need for this type of exemption.

y) Adjust One Year Advance Action Requirement to Start After Regulation Finalized

Comment Summary: The commenters request that extensions with a one-year advance action requirement begin after the Regulation is finalized, as the current timeframe would require fleets to act before the ACF Regulation is adopted, to qualify for an extension starting January 1, 2024.

Commenter: [316-45d]

Agency Response: Changes were made in response to these comments. Modifications were made to the Model Year Schedule language to make it clear the start date for removing vehicles from the California fleet would be January 1, 2025, instead of earlier and aligns with the Drayage truck requirements. The first ZEV Milestone deadline remains unchanged on January 1, 2025. This change means fleet owners can meet the one-year advance requirement if exemptions or extensions are needed.

15. Exemptions and Extensions – Daily Usage

a) Daily Usage Exemption – Master

Comment Summary: The commenters suggest the need for exemptions when ZEVs are available but not operationally feasible or cannot meet duty cycles. They request clarification and streamlining of the Daily Usage Exemption requirements and propose using follow-up data requests if CARB questions a fleet's application.

Commenter: [004-WT1, 089-45d, 233-45d, 294-45d, 342-45d]

Agency Response: Changes were made in response to these comments. The updated Daily Usage Exemption was modified to remove the GVWR limits that were previously included.

The updated Daily Usage Exemption provision provides energy efficiency estimates for range requirements for all applicable vehicle types, allowing fleets to calculate whether a BEV would meet their needs. Additionally, in lieu of the default range calculations, fleet owners may now utilize energy use data from a BEV and comparable ICE vehicle to justify an exemption. The Executive Officer will verify if the criteria in the Regulation have been met by using good engineering judgement when determining the approval of exemption requests.

b) Daily Usage Exemption – Allow Three Highest Values

Comment Summary: The commenters argue against excluding the three highest values from calculations for Daily Usage Exemption, stating that public fleets need vehicles for worst-case scenarios, and this exclusion would make the exemption unworkable. They suggest striking the language requiring the identification of the lowest mileage readings and exclusion of the three highest readings because it artificially—and falsely—biases the mileage of the subject vehicle(s) lower than actual operating conditions establish. Commenter states that a focus on the lowest mileages understates the work the owner or operator asks of its vehicles and does not provide a basis for determining whether a ZEV could provide an adequate replacement.

Commenter: [261-45d, 291-45d]

Agency Response: No changes were made in response to these comments. Please see section 2015.3(b) in Appendix H-2 of the ACF ISOR package for rationale for the purpose of excluding the three highest values in calculations. The exclusion of the highest values prevents fleets from relying on outliers as a method of dismissing ZEVs that may be a good fit for all of the fleet's daily needs. It is expected that fleets modify, at least to some degree, their daily operations to accommodate and incorporate new technology by placing ZEVs where they would fit into operations and reserving ICE vehicles for the outlier tasks until ZEV technology improves enough to replace ICE vehicles completely.

c) Daily Usage Exemption – Allow All Vehicle Types

Comment Summary: The commenters state that the Daily Usage Exemption should not exclude pickups or other vehicle types.

Commenter: [233-45d, 291-45d, 305-45d]

Agency Response: No changes were made in response to these comments. Please see section 2015.3(b) of Appendix H-2 to the ACF ISOR, for rationale on the purpose of not allowing certain vehicle types to apply for the Daily Usage Exemption.

d) Daily Usage Exemption – Allow Internal Combustion Engine Vehicle Data to Substantiate Exemption Requests

Comment Summary: The commenters request that the Daily Usage Exemption be expanded to allow fleets to substantiate and calculate daily usage from existing ICE vehicles, without requiring the purchase of a ZEV for energy use calculations. They recommend including a method to estimate the corresponding battery size needed based on fuel usage and relative energy density.

Commenter: [233-45d, 263-45d, 291-45d]

Agency Response: Changes were made in response to these comments. The Daily Usage Exemption provision was directionally expanded to address the commenter's concern to allow comparing daily energy and mileage usage reports from ICE vehicles in the fleet's service to the energy capacity of a ZEV that is available to purchase in the same application to justify their exemption request; however, fleet owners must still compare ICE data against available ZEVs, whether that ZEV data is from one purchased by the fleet or if the ZEV data was collected from a ZEV in another fleet but used in substantially similar operations. The commenter's request to only use ICE data is not reasonable because ZEVs use significantly less energy than ICE vehicles during operation due to their energy efficiency, so using ICE data energy to compare against an ICE vehicle would not be a reasonable comparison. ICE vehicles operated while stationary would exacerbate this affect further, as they waste energy while idling between performing work, so the comparison would not be valid.

e) Daily Usage Exemption – Clarify Applicable Exclusions from Ten Percent Requirement

Comment Summary: The commenters request clarity on the required percentage of ZEVs in a fleet to qualify for the Daily Usage Exemption and suggest that it should be similar to the ZEV Milestone Calculation which permits backup vehicles, daily usage exempted vehicles, emergency support vehicles, and unavailable ZEV vehicles to be excluded the percentage calculation. Vehicles that might need to be purchased due to serious vehicle or infrastructure delays, should also be excluded.

Commenter: [310-45d]

Agency Response: No changes were made in response to these comments. The Daily Usage Exemption intentionally does not exclude any vehicles that are part of the California fleet in its calculation of the percentage requirement. The requirement that the fleet already be comprised of 10 percent ZEVs is necessary to ensure progress is being made by every fleet in the transition to ZEVs before exemptions based on duty-cycle are granted. Fleets are expected to make some progress with introducing ZEVs where suitable in their operations. The ZEV Milestones Option also delays the initial ZEV requirements for vehicles that are likely to operate higher daily miles allowing for further technology advancement and more infrastructure build out. For additional discussion on the 10 percent threshold, please see section 2015.3(b) of Attachment H-2 to the ACF ISOR.

f) Daily Usage Exemption – Clarify Regulatory Language Regarding Existing Internal Combustion Engine Vehicle

Comment Summary: The commenters request a minor change for clarity by adding "ICE" between existing and vehicle in the sentence, "Fleet owners shall receive a one-year exemption to purchase a new ICE vehicle and exclude from the ZEV milestone calculation of section 2015.2 if a new ZEV is available, but it cannot be placed anywhere in the California fleet while meeting the daily usage needs of any existing ICE vehicle in the fleet provided the criteria specified in section 2015.3(b) are met."

Commenter: [310-45d]

Agency Response: No changes were made in response to these comments. However, the language the commenter requested to change is no longer in the Regulation language. The Daily Usage Exemption provision under both the Model Year Schedule and the ZEV Milestones Option now references the Exemptions and Extensions section for what a fleet may do in the event an exemption is granted. However, adding "ICE" in that section was not deemed necessary because the components of the Daily Usage Exemption clearly specify that a comparison between the needed vehicle and a commercially available BEV is the basis of requests for said exemption. The intent of the provision is to compare existing ICE vehicles to available BEVs.

g) Daily Usage Exemption – Include Cost, Support, Service, and Repair Feasibility

Comment Summary: The commenters express concerns that the Daily Usage Exemption is unworkable, as it requires the availability of an NZEV or ZEV with specified battery capacities, without considering cost, support, service, and repair feasibility. They suggest adding these considerations to the exemption criteria.

Commenter: [282-45d]

Agency Response: No changes were made in response to these comments. The Regulation is phased in over two decades and has considerable flexibility for the fleet owner to make their own purchase decisions. The ZEV Milestones Option is phased in by truck type and their ZEV suitability. Fleet owners can meet the ZEV milestone requirement with any truck type the fleet owner chooses to upgrade. This reduces the likelihood an exemption is needed. However, if the fleet owner cannot identify a ZEV that meeting the daily range needs of an existing ICE vehicle in the fleet, the owner can identify any remaining ICE truck they wish to receive an exemption to replace it with another ICE vehicle provided the fleet owner qualifies for the exemption. Major manufacturers are required to sell ZEVs as an increasing percent of sales starting 2024 which will increase the number of ZEV or NZEV offerings for fleet owners to select from. Finally, the items the commenter suggests are subjective concepts that are difficult to determine and are almost entirely subject to opinion without well-defined criteria to use.

h) Daily Usage Exemption – Include Power Take-Off Hours

Comment Summary: The commenters argue that the Daily Usage Exemption should consider engine operation hours and PTO usage, in addition to mileage, to address non-motive power needs and long continuous operation times such vehicles that must operate continuously for 12 to 16 hours on a typical day in support of emergency functions.

Commenter: [170-45d, 321-45d]

Agency Response: Changes were made in response to these comments. The updated Daily Usage Exemption provision now allows fleets to submit ICE vehicle daily usage reports as a method to justify their exemption request. For vehicles that operate mostly while stationary, this report may include energy used while stationary and the number of hours such truck mounted or integrated equipment is operated each day, for at least 30 consecutive workdays from within the last 12 months. This addition should address non-motive power needs of fleets, such as PTO or engine operation house.

i) Daily Usage Exemption – Include Additional Usage Factors

Comment Summary: The commenters suggest modifying the daily use exemption criteria to include additional relevant usage factors such as ambient temperature, HVAC usage, route topography, driver efficiency, available usable energy, and battery degradation and chemistry.

Commenter: [282-45d]

Agency Response: Changes were made in response to these comments. A general temperature provision is not necessary as the Daily Usage Exemption now allows fleets to submit ICE total energy usage data to justify exemption requests, which would inherently include the effects of ambient temperature, HVAC usage, route topography, and driver efficiency. Fleets may collect data at for any 30-day period they choose within the past 12 months, including the periods least conducive for BEV operation.

The current Daily Usage Exemption provision does allow fleets to use ambient temperature in conjunction with measured BEV energy use data as a method to determine whether a ZEV can meet the daily usage needs of an ICE vehicle. It is impractical to implement the request for a discrete battery degradation and chemistry provision as this information will vary greatly between different battery chemistries and manufacturers while being unable to be updated given the rapid pace of improvements in battery chemistry as well as the potential availability of new battery types. However, the updated BEV energy use data option accounts inherently account for these factors as the usage data should include these factors in a worst case real-world scenario.

The ZEP Certification Regulation may alleviate some battery concerns as it requires the manufacturer state the capacity of the battery as well as offer a 3-year, 50,000-mile warranty.

j) Daily Usage Exemption – Include Statistical Usage Data

Comment Summary: The commenters state if daily usage reports are retained, CARB should revise the required data to include a more statistically valid treatment of vehicle usage, reporting all vehicle trips, mean, and median values.

Commenter: [305-45d]

Agency Response: No changes were made in response to these comments. The updated Daily Usage Exemption requires fleets to submit information that is a relatively simple, objective, and straight forward way to assess whether an available ZEV is suitable to replace remaining ICE vehicles in the fleet with a single charge for the purposes of determining whether a fleet meets the criteria for the exemption. The fleet mileage or usage data is based on a 90th percentile of the fleet's operation for any month selected by the fleet owner. The Board determined this was an appropriate balance in complexity with the administrative burden on stakeholders.

k) Daily Usage Exemption – Remove Milestones Requirement for All Other Internal Combustion Engine Vehicles to Qualify for Exemptions

Comment Summary: The commenters suggest removing the requirement under the ZEV Milestones Option that to apply for the Daily Usage Exemption, fleet owners must apply for and obtain exemptions for all other ICE vehicles in the fleet, as this would unfairly penalize fleets spread-out over large geographic areas with multiple sites and doesn't consider key differences between vehicles such as remaining useful life or whether a vehicle has a cleaner engine. They provide an example illustrating the impracticality of the current exemption.

Commenter: [207-45d]

Agency Response: No changes were made in response to these comments. Under the ZEV Milestones Option fleets have full flexibility to choose vehicles to upgrade. The schedule is also staged in a way that the most suitable vehicle types would transition to ZEVs first and other vehicle types would be phased in later. Starting 2024, fleet owners are expected to upgrade to ZEVs where most suitable for their operation. Exemptions are intended to be used when a fleet owner makes a good faith effort and is not reasonably able to comply for reasons beyond their control. Fleets with multiple sites have the flexibility to focus their early transition strategy to a narrow set of locations or spread out their ZEV deployments at all locations. It would be a loophole and counter to the objectives of the Regulation to grant exemptions to fleet owners that preferentially pick worst case situation to claim an exemption when nearly all the fleet is suitable for electrification.

l) Daily Usage Exemption – Remove 10 Percent Threshold Requirement

Comment Summary: The commenters ask for the removal of the 10 percent ZEV/NZEV threshold for accessing the Daily Usage Exemption for all fleets, or specifically for fleets with primarily Class 8 sleeper tractors, as a nationwide public infrastructure network is under development.

Commenter: [002-OT1, 015-WT1, 261-45d, 282-45d, 291-45d, 310-45d]

Agency Response: No changes were made in response to these comments. Please see section 2015.3(b) in Appendix H-2 of the ACF ISOR, for the rationale for requiring 10 percent.

m) Daily Usage Exemption – Remove Battery-Electric Vehicle Capacity Sunsets

Comment Summary: The commenters state the Daily Use Exemption should not sunset when vehicles become available with certain energy capacities, or that the sunset capacities should be edited, arguing that the proposed rated energy capacities are arbitrary and do not reflect actual usage considerations. Commenters state factors such as actual ranges of HVIP-funded tractors, non-accessible energy capacity, operator range anxiety, and the physics of the fast-charging curve may reduce the range calculated by CARB by 65 to 90 miles.

Commenter: [233-45d, 282-45d, 291-45d, 305-45d, 342-45d]

Agency Response: No changes were made in response to these comments. Please see section 2015.3(b) in Appendix H-2 of the ACF ISOR, for the rationale on sunsetting BEV exemptions based on capacity availability.

n) Daily Usage Exemption – Remove Requirement for Route Fueling Explanation

Comment Summary: The commenters request that section 2015.3(b)(5) be changed to delete the phrase, "The explanation must include a description of why charging or fueling could not be managed during driver rest periods or breaks during the workday," as it is too burdensome for fleets.

Commenter: [310-45d]

Agency Response: No changes were made in response to these comments. This explanation is a reasonable request if a fleet would like to use this component of the Daily Usage Exemption provision as a basis for exempting a vehicle from the ZEV transition requirement. This section may be as simple or as complex as a fleet deems necessary to justify their position.

o) Daily Usage Exemption – Remove Fuel Cell Electric Vehicle Limit

Comment Summary: The commenters state that the Daily Usage Exemption should not require fleets to purchase FCEVs if available, as this does not consider the sufficiency of available fueling infrastructure for these vehicles along routes.

Commenter: [282-45d]

Agency Response: No changes were made in response to these comments. Fuel cell vehicles were included in this exception because they are expected to have similar range as a conventional vehicle and similar fueling times. As FCEVs come to market, the fueling network will expand to operate these vehicles. To the extent that the daily mileage for the vehicle is high, there would be opportunity to stop near available light-duty stations for lighter trucks. Commenter concerns about specialized vehicle types being available as FCEVs in the near term is unlikely based on available data, and therefore disqualifying that vehicle configuration from applying for a Daily Usage Exemption are less of a concern in the near-term. Additionally, flexibility provided in the Regulation would provide opportunity to select vehicles better suited for electrification, especially if the fleet owner opts into the ZEV Milestones Option. Finally, manufacturers are offering mobile refueling solutions, including for hydrogen vehicles, to address situations where stations are not available in the region being served in the near-term. Please see section 2015.3(b) in Appendix H-2 of the ACF ISOR, for a discussion on the exclusion of FCEVs from the Daily Usage Exemption provision. Regarding hydrogen fueling infrastructure, please see the responses to issues raised in section "Infrastructure Availability – General" in "Infrastructure and Grid Concerns" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

p) Daily Usage Exemption – Remove Gross Vehicle Weight Rating Limit

Comment Summary: The commenters suggest removing "with a GVWR greater than 14,000 pounds" from the Daily Usage Exemption.

Commenter: [024-WT1, 080-OT1, 239-45d, 291-45d, 305-45d, 342-45d]

Agency Response: Changes were made in response to these comments. The GVWR limit has been removed in the updated Regulation language.

q) Daily Usage Exemption – Remove Range Calculation and Report Requirements

Comment Summary: The commenters suggest revisions to streamline and simplify the Daily Use Exemption by removing sections requiring range calculations and daily usage reports, as they are burdensome, unnecessary, and some fleets lack telemetry systems to collect usage reports.

Commenter: [291-45d, 305-45d]

Agency Response: No changes were made in response to these comments. These calculations and reports are the minimum information necessary to justify requests and prevent creation of a loophole for fleets utilizing this component of the Daily Usage Exemption to apply for an exemption.

r) Daily Usage Exemption – Require Available Zero-Emissions Vehicles to Have Twice the Range of Internal Combustion Engine Vehicles

Comment Summary: The commenters state that ZEV range should not be the sole determinant for granting Daily Usage Exemptions due to overly optimistic range estimates and suggests requiring available ZEVs to have a range equal to double the fleet's daily mileage needs to perform necessary duties.

Commenter: [310-45d]

Agency Response: No changes were made in response to these comments. This change would be unreasonable as its inclusion would exempt many fleets from transitioning to ZEVs that would meet or exceed their needs. While it is understood that there are concerns regarding the stated range of ZEVs, manufacturers are incentivized, in general, to produce vehicles that fleets will want to purchase over a long period. The ZEP Certification Regulation will also create consumer protections for stated battery capacity as well as a warranty requirement. It is also expected that as more ZEVs are introduced to California and that as the technology continues to mature for concerns regarding real world versus stated range to be diminished. Finally, the slow introduction of ZEVs into a fleet over an extended period time means that if a model of ZEV does not perform the duties it is expected to, fleets may apply for an exemption under the Daily Usage Exemption with the information they have acquired while operating the ZEV.

s) Daily Usage Exemption – Unique Regulation Redlines from Comment Letter 342

Comment Summary: Redlines for Daily Usage Exemption. Section 2015.1(c)(2): remove "anywhere," add "where it is needed and where supporting infrastructure exists," and change "any existing vehicle" to "an existing vehicle." Section 2015.2(e)(2): remove "anywhere" and add "where it is needed and where supporting infrastructure exists." Section 2015.3(b):add "and the vehicle meets the needed daily mileage and payload capacity," and remove "their good engineering judgement." Remove section 2015.3(b)(3) altogether and renumber section (4) to section (3). Renumbered section 2015.3(b)(3): add "or a representative," change "ICE vehicles" to singular noun, add "(s)" to "vehicle," add "or representative vehicle(s) with the same functional needs," remove "Identify the lowest mileage reading for each day and exclude the three highest readings," and remove "remaining." Renumbered section 2015.3(b)(3)(A): add "typical." Renumbered section 2015.3(b)(4): change "description of the daily assignments or routes used by existing vehicle types" to "description of a typical daily assignment or route used by a representative vehicle type," remove "all," add "payload capacity," add "within the typical work region or range," and remove "at the depot, within one mile of the routes, or where ZEV charging or fueling is available" from "required explanation must include a description of why charging or fueling could not be managed during driver rest periods or breaks during the workday." Remove section 2015.3(b)(6) altogether.

Commenter: [342-45d]

Agency Response: Changes were made in the Regulation language in response to these comments, but not all requests were accommodated.

The updated Regulation language removes "anywhere" and "any existing vehicle" but does not add "where it is needed and where supporting infrastructure exists" or "an existing vehicle" in Regulation section 2015.1(c)(2). This change is made to collect the general requirements of the Daily Usage Exemption provision under one umbrella in Regulation section 2015.3(b). The updated Regulation language also removes "anywhere" but does not add "where it is needed and where supporting infrastructure exists" for similar reasons.

Regulation language section 2015.3(b) was not updated to add "and the vehicle meets the needed daily mileage and payload capacity" and remove "their good engineering judgement." This change was not made due to the subjective nature of some of the information requested, such as ambient temperature and opportunistic charging during the workday, such as breaks. Additional justification is provided in section 2015.3(b) in Appendix H-2 of the ACF ISOR package on the need for the Executive Officer to make a good engineering judgement.

Section 2015.3(b)(3) was not removed as it is necessary to provide a benchmark on projected mileage per kWh of energy stored. As such, section 2015.3(b)(4) was not renumbered.

Section 2015.3(b)(4) did not change "or a representative," change "ICE vehicles" to singular noun, add "(s)" to "vehicle," add "or representative vehicle(s) with the same functional needs," remove "Identify the lowest mileage reading for each day and exclude the three highest readings," or remove "remaining." These changes were not made as not all vehicles of a configuration may have identical duty cycles. While a ZEV may not be a replacement for a typical ICE vehicle in the fleet a route may exist in which ZEVs may fulfill the need. Additional justification is provided in section 2015.3(b) in Appendix H-2 of the ACF ISOR. Changes were not made to section 2015.3(b)(4)(A) for similar reasons.

Section 2015.3(b)(5) did not change "description of the daily assignments or routes used by existing vehicle types" to "description of a typical daily assignment or route used by a representative vehicle type" for the same reason as stated above. For similar reasons, "all" was not removed. "Payload capacity" was not added in this section as fleets have the option to acquire a ZEV in a higher weight class that may be able to meet the needs of payload capacity. The updated Regulation language does not add "within the typical work region or range" for similar reasons as the paragraph above. The updated Regulation language does not remove "at the depot, within one mile of the routes, or where ZEV charging or fueling is available" as this is a reasonable range for fueling to take place. The updated Regulation language did not remove "required explanation must include a description of why charging or fueling could not be managed during driver rest periods or breaks during the workday." This change was not made as fleets may opportunistically charge a ZEV during the workday to make up for gaps in the mileage capability of a ZEV, like how some transit agencies have implemented charging during stops to extend the range of ZE buses.

Section 2015.3(b)(6) was removed but its components were incorporated, with some modifications, into section 2015.3(b)(3). These components are needed for a fleet to justify a Daily Usage Exemption based on energy use instead of range.

16. Exemptions and Extensions – Infrastructure Delays

a) Infrastructure Delay Extension – Master Response

Comment Summary: The commenters propose expanding the infrastructure construction delay exemption to accommodate a wide range of challenges and seek clarification on CARB's review and processing of requests, and decision timelines.

Commenter: [103-OT1, 207-45d, 228-45d, 235-45d, 297-45d]

Comment Summary: The commenters suggest allowing Infrastructure Delays to apply to multiple projects for greater site selection flexibility.

Commenter: [143-45d, 175-45d]

Agency Response: Changes were made in response to these comments. The Infrastructure Delay Extension was expanded to include additional construction-related delays and site electrification delays due to utility upgrades needed beyond the site's meter. The extension was expanded from a single, one-year delay per project to allow multiple projects to qualify for extensions for up to five years at each site. Process and criteria were clarified and made more objective, including a clear 45-day approval or denial notification window after a complete application is received. Clarification was added for construction-related delays to specify that the construction permit date would be used to determine eligibility for the provision; this addresses concerns about the delay starting from the permit approval date rather than the permit application date, which could cut into the approved delay time while awaiting permit approval. Delays in manufacture and shipment of ZEV fueling infrastructure equipment were added as qualifying criteria for the exemption based on stakeholder comments.

b) Infrastructure Delay Extension – Allow More Time for Extension

Comment Summary: The commenters state more time is needed for the Infrastructure Delay Extension due to various factors including delays in upstream utility upgrades or construction related issues. They suggest a range of alternative periods from one additional year to 10 or more years. Some commenters suggest changing the allowed delay timeframes to be tailored to individual projects, effectively as an open-ended delay with no limit on the length of time. Commenters also suggested revising the delay's originally proposed language about allowing fleets to delay delivery of ordered ZEVs to be a period matching the expected infrastructure delay.

Commenter: [008-45d, 015-WT1, 028-OT1, 048-45d, 053-OT1, 058-45d, 082-45d, 104-45d, 143-45d, 145-OT1, 156-45d, 200-45d, 210-45d, 229-45d, 230-45d, 233-45d, 235-45d, 238-45d, 253-45d, 261-45d, 282-45d, 291-45d, 294-45d, 296-45d, 305-45d, 310-45d, 322-45d, 333-45d, 342-45d]

Agency Response: Changes were made in response to these comments. The Infrastructure Delay Extension was expanded from one-year to two-years for construction related delays, allowing for a total of three years from the date a construction permit was obtained to delay ZEV deployments due to circumstances outside a fleet owner's control during site construction. Additional criteria were added to the extension to address site-specific circumstances due to utility delays that cannot be supported by existing site power due to delays in obtaining grid power from the utility before construction starts. This type of delay could receive an initial extension of up to three years and could be extended another two years if delay conditions persist. Eligibility would be based on the date the fleet owner either executes a contract with the utility to build out the infrastructure project or the utility attests they will proceed with the project. The rationale for why this timeframe is appropriate can be found in Chapter C.(D).7., section 2015.3(c), of the ACF 15-Day Notice.

Changes were made to directionally address the commenter's request related to the language allowing fleet owners to "delay the delivery of ordered ZEVs." This language was removed and replaced with language that specifies how the extension would work for fleet owners following the Model Year Schedule and the ZEV Milestones Option. The language now clarifies that fleet owners following the Model Year Schedule could delay replacing an existing ICE vehicle at the site experiencing the delay for the approved delay timeframe, and that fleet owners following the ZEV Milestones Option could count an existing ICE vehicle as a ZEV when determining the fleet compliance calculations for the approved delay timeframe.

No changes were made to extend this timeline further than five years because stakeholder and utility input indicated most delays are on the order of one to four years. A five-year delay is sufficient to cover most cases. While some larger projects could experience five or more years, they are unlikely to affect most projects, so five years is sufficient time for fleets to adjust plans for infrastructure projects if additional time is needed at a particular site. Fleets with multiple sites also have additional options for electrifying other sites that will not take longer than five years if such a delay occurs at one location, and fleets using the ZEV Milestones Option have flexibility to select other vehicles in their fleet to transition to ZEVs that may not be domiciled at that site. Additionally, a balance must be struck between addressing all potential issues and achieving timely emissions reductions; for these reasons, a five-year delay provides appropriate flexibility.

No changes were made to allow for unlimited project-specific delays for multiple reasons. This proposal would create a loophole by which fleets could indefinitely delay transitioning their fleets to ZEVs and would not meet the goals of the Regulation.

c) Infrastructure Delay Extension – Allow Internal Combustion Engine Vehicle Purchases

Comment Summary: The commenters request that the infrastructure extensions provide the ability to purchase a new ICE vehicle to continue operations when infrastructure is unavailable due to factors beyond the fleet owner's control.

Commenter: [310-45d]

Agency Response: No changes were made in response to these comments. The purpose of the extension is to allow sufficient time for ZEV fueling infrastructure to be installed before ZEVs are placed in operation such that the fleet owner would not be out of compliance and that ZEVs would not be stranded assets. The purpose is not to allow ICE vehicle purchases, which would then be able to operate for years after the infrastructure delay was resolved. This would be counter to the goals of the Regulation.

d) Infrastructure Delay Extension – Allow Permit Applications to Qualify

Comment Summary: The commenters propose that fleet owners qualify for Infrastructure Delay Extension with construction permit applications rather than construction permits.

Commenter: [143-45d]

Agency Response: No changes were made in response to these comments. However, clarification was added for construction-related infrastructure delays to specify that the construction permit date would be used to determine eligibility for the extension; this addresses stakeholder concerns about an approved extension timeline starting from the permit approval date rather than the permit application date, which could cut into the approved extension time while awaiting permit approval. See additional rationale for the selection of the construction permit date in Chapter C.(D).8., section 2015.3(c)(1), of the ACF 15-Day Notice.

e) Infrastructure Delay Extension – Allow Construction Start Dates Three Months in Advance to Qualify

Comment Summary: The commenters request revising the Infrastructure Delay Extension requirement for a construction start date that is at least one year before the next applicable compliance period date, down to three months from an anticipated vehicle delivery date, as public fleets are not subject to the HPF Regulation’s compliance dates for fleet milestone requirements, so this requirement does not appear to be relevant, except for those that may be allowed to opt into ZEV Milestones Option.

Commenter: [291-45d]

Agency Response: Changes were made in response to these comments. However, the full request was not accommodated. While HPF Regulation’s ZEV Milestones Option has specific Milestone dates, the SLG Regulation also has compliance dates annually to demonstrate a fleet has purchased either half or all their vehicle purchases that year as ZEVs. Therefore, the reference to an applicable compliance date is relevant. Changes were made to this portion of the exemption language to clarify that the fleet owner must submit documentation showing the executed contract for the ZEV fueling infrastructure installation including a construction permit indicating the permit issuance date is at least one year prior to the next applicable compliance deadline. Rather than using a construction start date which could be delayed, the language now relies on the permit issuance date, which is easier to identify and verify. No change was made to reduce the required amount of time, because the fleet must plan well in advance for infrastructure projects due to the time involved in making such upgrades. If the fleet waits to start construction until three months before the deadline, a delay is all but guaranteed based on timelines submitted by utility stakeholders. This would be counter to the purpose of the extension, which is to address delays outside the control of the fleet owner that is acting in good faith to plan for infrastructure installations.

f) Infrastructure Delay Extension – Allow Alternative Infrastructure Exemption Based on Fleet Plan

Comment Summary: The commenters propose an alternative infrastructure exemption with an interim compliance plan where CARB reviews and verifies infrastructure plans from each regulated fleet, demonstrating their progress on projects. If approved by CARB, the fleet could achieve "Interim Compliance" and delay site-associated vehicle purchases.

Commenter: [230-45d]

Agency Response: No changes were made in response to these comments. Implementing such a proposed plan would be difficult across the number of fleets regulated, as compliance with such plans would have to be tracked continuously, with differing timelines for each site and plan. Additionally, each fleet and site's unique plan and delay situation would have to be considered, and drafting simple, clear, and objective criteria to address every unique scenario would be impossible. This proposal would add unnecessary complexity to the extension.

g) Infrastructure Delay Extension – Include All Construction Delays

Comment Summary: The commenters request that Infrastructure Delay expand the list of "circumstances beyond the fleet owner's control" to include any circumstances that may materially affect construction projects, such as material supply chain shortages or delays in qualified workers at standard rates.

Commenter: [291-45d]

Agency Response: Changes were made in response to these comments. The list of qualifying construction related delays in the extension are reasonable and use criteria that can be easily demonstrated and verified, and that are consistent with other existing CARB Regulations. An open-ended list of any criteria that can delay construction projects would be difficult to implement and becomes subjective when determining how to assess worker quality and what are standard rates referred to in the comment. Supply chain issues are variable over time; changes were made directionally that would address delays in manufacture and shipment of ZEV fueling infrastructure equipment. The extension criteria are carefully balanced to prevent introducing unintended loopholes in the Regulation while addressing Board direction to streamline the administrative process and criteria.

h) Infrastructure Delay Extension – Include Delays in Obtaining Permits

Comment Summary: The commenters state that delays in obtaining permitting should be accounted for in infrastructure delays, proposing the Regulation incorporate a time by which applications for infrastructure projects should be submitted to the relevant oversight agency, with construction deadlines not beginning until all relevant government approvals have been granted. The commenters argue that the infrastructure delay provision should not require issued construction permits before seeking a delay, as permits may be the reason for the delay, and suggest reverting to the originally proposed language.

Commenter: [008-45d, 139-OT1, 207-45d, 322-45d]

Agency Response: Changes were made in response to these comments. However, the requests were not fully accommodated. The exemption criteria were modified to require an approved construction permit with a date at least one year in advance of the next applicable compliance deadline. This change inherently builds in delays in permit approval because the fleet owner must take action sufficiently in advance of a deadline to account for delays in the approval process to qualify for the extension. After the permit is issued, the extension would address delays in actual construction rather than administrative processes that could be addressed by early action from the fleet owner. Permits are necessary to include as criteria for reasons described in Chapter C.(D).10., section 2015.3(c)(1)(B), of the ACF 15-Day Notice and section 2015.3(c), 2015.3(c)(1-4) of Appendix H-2 to the ACF ISOR.

i) Infrastructure Delay Extension – Include Public Safety Power Shutoff Events

Comment Summary: The commenters suggest exemptions for areas impacted by power shutoffs from utilities, with timeline suggested at one week, for events such as P&GE's PSPS events, due to the overburdened grid and potential interruptions to essential services.

Commenter: [156-45d, 245-45d, 260-45d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Grid Capacity and Resilience – Grid Reliability" in "Infrastructure and Grid Concerns" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses" for discussion about PSPS events and how the grid is hardening over time. Such events are temporary, are being addressed by grid planning and hardening efforts, and backup storage, off-grid generation, and temporary mobile fueling are all resiliency measures fleets can take to assure availability of their ZE fuel of choice. Commenter does not provide sufficient detail to understand how a one-week delay would make a difference for a fleet that could be granted extensions for up to five years if qualified, nor a compliance mechanism for how it would work, therefore the comment is not clear.

j) Infrastructure Delay Extension – Include Delays for Electric Panels and Transformers

Comment Summary: The commenters mention supply chain issues causing delays in the delivery of electrical panels and transformers, suggesting these delays be considered in the infrastructure delay provision, considering factors beyond the narrow scope of construction-specific delays.

Commenter: [008-45d, 009-OT1]

Agency Response: Changes were made in response to these comments. The criteria for construction-related delays were updated to include delays in manufacture and shipping of ZEV fueling infrastructure equipment as a qualifying criterion. Electrical panels and transformers are needed infrastructure equipment for fueling ZEVs, so such equipment would be included in the newly added criterion.

k) Infrastructure Delay Extension – Include Delays in Applying for and Obtaining Funding

Comment Summary: The commenters state that Infrastructure Delay Extensions should consider delays in applying for and obtaining grants and disbursements of funds as criteria outside the control of the fleet owner. The commenters state this would accommodate a lack of funding for the cost of infrastructure at the local level to avoid agencies having to raise taxes and rates.

Commenter: [032-WT1, 322-45d]

Agency Response: No changes were made in response to these comments. The Regulation requirements are not predicated on the availability of funding, so it would not be appropriate to include delays due to unavailability of funding for infrastructure. Additionally, it is up to the fleet owner to decide which programs to seek funding if there are any that are available. The quality and completeness of the application is completely within the control of the fleet owner and should be applied for in a manner to improve likelihood of being approved.

l) Infrastructure Delay Extension – Include Delays Resulting from Equipment Failure

Comment Summary: The commenters suggest a compliance delay or mechanism allowing ICE vehicles to count as ZEVs when EVSE equipment fails or is down.

Commenter: [322-45d]

Agency Response: No changes were made in response to these comments. There is no reason to count an ICE as a ZEV for a temporary issue because the compliance status of a fleet does not change if EVSE for a vehicle is temporarily not available. While any device including EVSE can fail or be taken down for maintenance, fleet owners are expected to plan for this foreseeable issue. Fleet owners have a myriad of options like they do when ICE vehicles are down like using rental vehicles while repairs are made. In addition, fleet owners can use other EVSE as backup, or use mobile fueling option to mitigate their fleet resiliency concerns. For these reasons, adding a delay or compliance mechanism for these occurrences would not be appropriate.

m) Infrastructure Delay Extension – Include Delays Due to Real Estate Acquisition, Landlord Negotiation, or Lease Updates

Comment Summary: The commenters request additional flexibility in the Infrastructure Construction Delay provision for real estate acquisition, landlord negotiation, or lease updates when non-owned property is involved, in cases where the process takes longer than expected or necessitates fleet relocation.

Commenter: [008-45d, 282-45d]

Agency Response: No changes were made in response to these comments. Fleet owners are expected to plan in advance in how they comply given their business or fleet situation including if it makes sense to acquire real estate to expand the fleet operation or to install infrastructure. The Regulation phase-in provides sufficient flexibility to select sites if a fleet owner has multiple sites to phase-in ZEVs starting at locations of their choice.

n) Infrastructure Delay Extension – Include Truck-As-A-Service Providers In Extension

Comment Summary: The commenters request that CARB add key parameters to the infrastructure delay provision, ensuring entities contracted with truck-as-a-service providers can access it, and suggest including requirements for multi-year contracts, site control documentation, load hosting capacity studies, and engineering layouts for charger configurations.

Commenter: [316-45d]

Agency Response: Changes were made in response to these comments. The language was updated to state the extensions apply in locations where the fleet owner has entered a contract of one year or longer to charge or fuel their ZEVs at a single location prior to beginning the infrastructure project. This language intends to capture delays experienced by providers of leased ZEV fueling and/or ZEVs if fleet owners have contracts with such providers.

o) Infrastructure Delay Extension – Unique Regulation Redlines from Comment Letter 342

Comment Summary: Redlines for Infrastructure Construction Delay. Section 2015.3(c): change "The Executive Officer will grant an extension per project to delay the vehicle delivery for one year" to "The Executive Officer will grant a single extension for the project to delay the vehicle delivery for one year or longer." Section 2015.3(c)(2): remove "after," include "delays in obtaining materials/hardware (supply chain)," and include "other unforeseen/uncontrollable circumstances" before "or natural disasters." Section 2015.1(c)(3): change "a one-year extension" to "an extension" and remove "for one year."

Commenter: [342-45d]

Agency Response: Changes were made in response to these comments. However, not all the requested changes were accommodated. More time was provided but the extension was not expanded with an unlimited time frame. Removing "after" from the language would result in including obtaining construction permits as a construction delay criterion; this would be counter to the intent of the extension, which is to address delays after construction started, and not to address delays related to fleet planning and administrative processes that are within the fleet owner's control to act well in advance of a compliance deadline. Changes were made to include "delays in manufacture and shipment of ZEV fueling infrastructure equipment" as a qualifying construction-related delay criterion; adding "delays in obtaining materials/hardware (supply chain)" would serve a similar purpose and is not necessary considering the changes made. Additionally, the proposed language is overly broad and could lead to loopholes without limiting the materials or hardware to only those related to ZEV fueling infrastructure equipment.

17. Exemptions and Extensions – Mutual Aid and Exemptions Pursuant to Declared Emergency Events

a) Emergency Provisions – Expand to Non-Declared Emergencies, Remove Mutual Aid Agreements, and Allow Fleets to Set Their Own Internal Combustion Engine Vehicle Cap

Comment Summary: Redlines for emergency response provisions. Section 2015.1(c)(6): change title to "Exemptions Pursuant to Emergency Events," replace "vehicles are needed to provide emergency response services and the conditions described in section 2015.3(f)(2) are met with "fleet(s) qualify per the "Emergency Operations" definition and/ or "Mutual Aid" exemption," add "Fleets may petition the Executive Officer for an alternate ICE percentage allowance based upon the "actual need" that is sufficient to provide reliable emergency operation response capabilities."

Commenter: [342-45d]

Comment Summary: The commenters request that CARB extend the Mutual Aid Assistance exemption eligibility to various utilities even without mutual aid agreements to expand the exemption qualifications to fleets responding to local, non-declared emergency events.

Commenter: [005-OT1, 015-45d, 053-OT1, 156-45d, 207-45d, 233-45d, 245-45d, 291-45d, 305-45d, 333-45d]

Comment Summary: The commenters recommend that CARB revise the Mutual Aid Assistance exemption, allowing the public agency's governing board or the agency itself to determine individual needs and adjust the ZEV threshold and ICE caps through public action.

Commenter: [029-OT1, 233-45d, 297-45d]

Comment Summary: The commenters suggest removing the 25 percent ICE cap for the mutual aid provision or submitting an alternative cap based on individual fleet needs, arguing that a one-size-fits-all cap is unreasonable.

Commenter: [005-OT1, 015-45d, 233-45d, 245-45d, 291-45d]

Agency Response: No changes were made in response to these comments. As described in more detail in sections 2015.3(f)(1) and (2) of Appendix H-2 to the ACF ISOR, the provisions address situations where fleets need to respond to emergencies outside of their normal service territory, or to bring vehicles in from out of state to assist during declared emergency events. These provisions address concerns where the fleet owner needs to send vehicles to areas with uncertain infrastructure availability, and where ZEV range may present a risk to limit the ability to respond to emergency events in a timely manner. ZEVs can perform similar work to ICE vehicles, and in some cases are superior to ICE vehicles. Local emergencies take place in limited geographic regions in the fleet's normal service territory, where ZEV range is less of an issue and infrastructure availability is more within the control of the fleet owner. Other exemptions are available for when available ZEVs cannot meet a fleet's demonstrated daily usage needs. Therefore, the word "declared" was not removed from the title or intent of the provisions. Additionally, mobile, temporary, and off-grid generation and fueling options are currently commercially available to fleets to fuel ZEVs off-grid.

Allowing a fleet owner to petition the Executive Officer, or to be allowed to determine their own alternate ICE caps based on the fleet's needs or a governing board, would open a potential loophole in the Regulation for fleets that could claim such need without an objective and clear mechanism to validate the need. Introducing such a mechanism would introduce unneeded complexity to the Regulation. Based on conversations and input from stakeholders, 25 percent is a sufficient cap on ICE vehicle purchases to balance the need for achieving the Regulation's goals with the need for fleet flexibility in the long-term to respond to emergencies in the unlikely case that ZEVs are not able to respond. In staff conversations with stakeholders, it was rarely reported that more than 25 percent of the fleet was dispatched for mutual aid at any one time, because the bulk of the fleet is needed in the primary service territory to continue local operations.

It is important to note that near-term concerns about ZEV emergency response capabilities are significantly lessened by the flexibility already built into the Regulation; a long phase-in period where the total percentage of ZEVs, allowance to purchase NZEVs that do not have range concerns and count them the same as ZEVs, allowance for public fleets to retain existing ICE vehicles as long as they want, exemptions and extensions for ZEV unavailability, capability in meeting daily usage needs, and infrastructure delays, and unlimited emergency response for backup vehicles all provide sufficient flexibility to fleet owners, among other provisions. Fleets would not have a high percentage of ZEVs until well into the Regulation implementation timeline; for example, a public fleet with 100 vehicles that retains their vehicles for 15 years (typical, based on LER data) would only replace roughly seven vehicles per year. Under the SLG Regulation requirements, only four per year would need to be ZEVs from 2024 through 2026. When 100 percent purchases kick in, only 12 per year would need to be ZEVs from 2027 through 2030, meaning the remaining 88 ICE vehicles would still be conventionally fueled. In 2030, only 40 of the 100 vehicles would be ZEVs, leaving 60 ICE vehicles that are conventionally fueled. Due to the extended phase-in period, and given that ZEV technology and infrastructure availability will improve over this time, fleet owner concerns are unlikely to be present in the future when fleets would be at a higher percentage of ZEVs, while in the near term, fleets would have flexibility to respond with their existing ICE vehicles while the fleet is still a very low total percentage of ZEVs.

b) Mutual Aid Assistance Exemption – Master Response

Comment Summary: The commenters state that CARB should improve access to the mutual aid exemption, expand the mutual aid exemption, or generally rework exemptions related to emergency response to ensure fleets providing emergency support can meet those needs.

Commenter: [004-OT1, 029-OT1, 035-OT1, 103-45d, 148-45d, 283-45d, 342-45d]

Agency Response: Changes were made in response to these comments. In response to Board direction to streamline exemption criteria and process, a number of changes were made to the exemption. The ZEV access threshold for the exemption was lowered significantly from 75 percent of the fleet being comprised of ZEVs down to a phased-in threshold requiring 25 percent in 2024, increasing to 50 percent in 2032 and 75 percent in 2035. This greatly improves access to the provision in the near-term for fleets that would not have a high percentage of ZEVs in the near-term. The GVWR limitation was also removed, improving access to lower weight class vehicles. The criteria and process were streamlined, simplified, and revised for more objective criteria; the number of mobile fueling providers from which documentation is required was lowered from all providers to only three to streamline the application process. Clarification was added about vehicles purchased pursuant to exemptions and how they would count against the 25 percent ICE vehicle cap. These changes all address the Board's direction and commenter's requests.

c) Mutual Aid Assistance Exemption – Clarify Purchasing Vehicles During Declared Emergency Events

Comment Summary: The commenters suggest that sections 2015.1(c)(6) and 2015.2(e)(6) should not reference section 2015.3(f) since section 2015.3(f)(1) is unrelated to the mutual aid provision, leading to confusion for fleets. They argue that acquiring 25 percent ICE vehicles during a declared emergency is unrealistic given the time constraints.

Commenter: [207-45d, 342-45d]

Agency Response: Changes were made in response to these comments. The language specified was altered to directly refer to the Mutual Aid Assistance Exemption, rather than pointing to both that provision and the Exemptions Pursuant to Declared Emergency Events language. The commenter's assertion that the Mutual Aid Assistance Exemption would require purchases during a declared emergency event is incorrect; the exemption is intended to allow for ICE vehicle purchases when an approved exemption is granted to prepare and plan for future mutual aid scenarios, not to allow for purchases at the time of such events. The exemption is intended for fleets to plan ahead for future events and purchase up to a quarter of the fleet as ICE vehicles to be able to send to respond to mutual aid situations. The exemption should be applied for as soon as a fleet owner qualifies to allow for such planning, because the procurement process can take time.

d) Mutual Aid Assistance Exemption – Remove Gross Vehicle Weight Rating and Vehicle Type Limits

Comment Summary: The commenters request the removal of weight class restrictions from section 2013.1(3) and vehicle configuration restrictions from section 2013.1(3) to enable fleets to determine the necessary vehicles for mutual aid and emergency response. They argue that the ACF ISOR's rationale for excluding vehicles based on weight, specific body types, or being NZEVs is flawed, as it does not consider fleet operations in remote areas, or the logistical challenges and additional costs associated with renting vehicles during emergencies. The commenters are concerned that limitations, such as the 14,000 pounds GVWR threshold, hinder public agencies' ability to manage emergency operations.

Commenter: [005-OT1, 207-45d, 233-45d, 266-45d, 291-45d, 342-45d]

Agency Response: Changes were made in response to these comments. The GVWR limitation was removed from the Mutual Aid exemption to follow the Board's direction to streamline the exemption application process for fleets; however, the vehicle type limitations were not removed, as the rationale for excluding such vehicle types remains valid. See rationale for why such vehicles are excluded in Section 2015.3(f)(2) of Appendix H-2 to the ACF ISOR.

Remote operations can be managed by using available mobile ZEV fueling. Alternatively, remote operations can be responded to by the portion of the fleet retained as ICE vehicles allowed by the flexibility of the general requirements of the Regulation, backup vehicles that can be used an unlimited number of miles in emergency operations, or those purchased pursuant to various exemptions included in the Regulation, including up to a quarter of the fleet under an approved Mutual Aid Exemption. Logistics and costs for rental vehicles can be managed by fleets without granting unnecessary exemptions for vehicle types that do not need exemptions, considering the stakeholder-reported infrequency of mutual aid deployments and the limited number of vehicles that are sent to respond to such occurrences.

e) Mutual Aid Assistance Exemption – Mobile Fueling Issues

Comment Summary: The commenters request that CARB clarify and specify parameters for the mobile fueling requirement under the mutual aid exemption. They suggest that the "mobile fueling option" should not require vehicles to be shut down for more than 15 minutes during refueling in emergency conditions. Commenters also ask that documentation requirements be limited to manufacturers and mobile fueling providers that respond to a request for bids, rather than all providers, and seek a definition for the term "mobile fueling provider." They emphasize the need for mobile fueling options that can reach remote job sites and function in extreme weather conditions. The commenters express concern about the burdensome process in section 2013.1(e)(2) for demonstrating that no compatible mobile fueling options can fuel 10 to 80 percent of a ZEV's rated capacity within one hour, as it does not consider the need for multiple refuelings during multi-day dispatches. They recommend clarifications on the mobile refueling options in section 2013.1(e)(2) and allowing fleet owners to qualify for exemption even if a mobile fueling option meeting the specified criteria does not meet their needs.

Commenter: [207-45d, 233-45d, 291-45d, 305-45d]

Agency Response: Changes were made in response to these comments. However, not all requests were accommodated. The documentation requirement was adjusted to lower the number of mobile fueling providers required from all providers to only three providers. Rather than going out for bid, fleet owners now must simply identify available ZEVs in the same weight class and configuration of an ICE vehicle they desire to purchase under the exemption, get information about the vehicles’ fueling systems and capacity, and submit documentation from three mobile fueling providers to show the vehicle could not be refueled within the allotted parameters.

The term mobile fueling provider was defined, but the parameters of being able to refuel a ZEV from 10 to 80 percent of its rated energy capacity within one hour were unchanged. No changes to the refueling time were made because FCEVs can be fueled in under half an hour, depending on the tank size, with some smaller vehicles fueling as quickly as five to 10 minutes. Though BEVs may take longer to fuel in the near-term, updated charging standards including the MW Charging Standard and high voltage systems on the vehicles will enable ICE-comparable fueling of BEVs in the longer-term, when fleets would be at a higher percentage of ZEVs and charge speed is more likely to be an issue. Because hydrogen and direct-current BEV fueling solutions and off-grid generation systems (deployable solar canopies, combustion generators) are already available in mobile fueling packages, including towed, box truck, skid-mounted, and containerized solutions, this requirement is reasonable to hold ZEVs to a similar standard as ICE vehicles that are already refueled in the field with mobile fueling solutions. Because mobile fueling solutions come in a variety of packages and sizes, no change is necessary to anticipate the space and access constraints of every possible emergency scenario, as a solution is likely to be available to fit the fleet's need. An hour to refuel is a reasonable amount of time that could be managed within driver break periods, so lowering the standard to 15 minutes would not be necessary. Finally, there is a range of capabilities for different mobile fueling solutions that a fleet can select from which will improve over time. Refueling the mobile fueling solution itself is doable, as fuel for generators and hydrogen for fuel cells can be brought to the mobile fueler, or the fueler could be driven to the nearest refueling station. Batteries in containerized mobile fuelers can be recharged from off grid generation sources or swapped out with a solution with fresh batteries.

Allowing fleet owners to veto a mobile fueling option if it doesn't meet fleet needs for any reason would be difficult to implement with clear objective criteria, as each fleet situation would be unique. This would introduce unnecessary complexity to the Regulation for the small number of instances where this may or may not occur. Additionally, allowing such a veto would introduce a potential loophole in the Regulation.

f) Mutual Aid Assistance Exemption – Remove Requirement for Manufacturer Statements

Comment Summary: The commenters argue that the mutual aid exemption's required public solicitation should focus on ZEVs with equivalent configurations and duty cycles to the needed ICE vehicle, noting that the originally proposed language and requested statements from vehicle manufacturers or installers are irrelevant for mobile fueling options.

Commenter: [233-45d, 291-45d]

Agency Response: Changes were made in response to these comments. These requirements were removed because they were duplicative of other parts of the Regulation.

g) Mutual Aid Assistance Exemption – Remove Zero-Emissions Vehicle Threshold Requirement

Comment Summary: The commenters state that the 75 percent ZEV threshold in section 2015.3(f)(2) "Mutual Aid Assistance" should be removed or adjusted as it imposes unnecessary stress on fleets to replace vehicles early in the Regulation and disproportionately impacts smaller fleets that must exclusively purchase ZEVs to meet the threshold.

Commenter: [014-45d, 015-45d, 021-WT1, 210-45d, 233-45d, 291-45d, 310-45d]

Comment Summary: The commenter proposes in section 2013.1(e) alternatively to phase in the ZEV threshold over time and suggest the following phase-in milestones that would not constrain operations and fleets' ability to respond to emergency events: • 2029: 25% ZEV; • 2032: 50% ZEV; • 2035: 75% ZEV. The commenter also provided recommended redlines on the text of the section.

Commenter: [233-45d]

Agency Response: Changes were made in response to these comments. However, the full request was not accommodated. The Mutual Aid Exemption access threshold was lowered significantly to allow earlier access to the provision, but it was not eliminated entirely. In the ACF 15-day changes, the threshold was lowered from 75 percent of the fleet being comprised of ZEVs to a phased-in threshold, starting with 25 percent in 2024, increasing to 50 percent in 2032 and 75 percent in 2035. These changes allow fleets to access this exemption sooner while ensuring progress is being made to electrify the fleet. Removing the threshold completely, or starting it at 0 percent until 2029, would not be appropriate as fleets need to gain experience with ZEVs to incorporate them into their fleet. Additionally, providing no threshold to meet would encourage gaming of the provision and could allow fleets to delay taking any action to transition to ZEVs for significantly longer than intended, which would not meet the goals of the Regulation to reduce emissions and achieve health and climate benefits. Additionally, the Regulation design and provisions provide significant flexibility to fleets to operate ICE vehicles in response to emergencies as described in the responses in section “Emergency Provisions – Expand to Non-Declared Emergencies, Remove Mutual Aid Agreements, and Allow Fleets to Set Their Own ICE Vehicle Cap” in “Exemptions and Extensions – Mutual Aid and Exemptions Pursuant to Declared Emergency Events” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.” Smaller fleets already have flexibility added in the ACF 15-day changes to delay any ZEV purchases until 2027, so they have full flexibility to respond to emergencies in the near-term with their existing and any newly purchased ICE vehicles until 2027.

h) Mutual Aid Assistance Exemption – Unique Redlines from Comment Letter 342

Comment Summary: Redlines for Mutual Aid Assistance. Renumber 2015.3(f)(2) to 2015.3(f)(3). Renumbered section 2015.3(f)(3): add" or emergency operation,” remove "The exemption is limited to replacing vehicles with a GVWR greater than 14,000 pounds and does not apply to pickup trucks, buses, box trucks, vans, any tractors, or any vehicle configurations commercially available as NZEVs,” remove "and their good engineering judgement,” and removed "do and." Section 2015.3(f)(3)(B): replace "all" with "relevant,” change "10" to "50,” add "general,” remove "for each available ZEV or NZEV chassis." Add new section 2015.3(f)(3)(E): "A fleet may only qualify for the Mutual Aid Assistance exemption or the Emergency Operations exemption, not both."

Commenter: [342-45d]

Agency Response: Changes were made in response to these comments. However, not all the commenter’s requests were accommodated. The GVWR limitation was removed but not the vehicle type limitations, for reasons described in the responses in section “Mutual Aid Assistance Exemption – Remove Gross Vehicle Weight Rating and Vehicle Type Limits” in “Exemptions and Extensions – Mutual Aid and Exemptions Pursuant to Declared Emergency Events” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.” No changes were made to remove the Executive Officer’s discretion to use their good engineering judgement, which was included in the ACF 15-day changes to the Regulation for reasons described in Chapter C.(D).41., section 2015.3(f)(2), of the ACF 15-Day Notice. Adjustments were made to lower the documentation requirement from mobile fuelers from all to three with compatible fueling options for an available ZEV of the needed configuration. No change was made to increase the mobile fueling speed parameter from “10 to 80 percent” to “50 to 80 percent,” because this would suggest a slower fueling speed which would be counter to the intent to determine whether a fast-enough fueling solution was available. No change was made to specify which exemption fleets may qualify for, because other requests were not made to split the provision and allow non-mutual aid fleets to qualify.

18. Exemptions and Extensions – Vehicle Delivery Delays

a) Vehicle Delivery Delay Extension – Vehicle Delivery and Order Timeline Concerns

Comment Summary: The commenters express concern about fleets being considered non-compliant if ZEV deliveries take longer than a year, suggesting that Regulation requirements should be based on vehicle purchases instead of deliveries. They request adjustments to consider project-specific timelines and allowing ICE vehicle purchases when ZEV deliveries take longer than one year.

Commenter: [145-OT1, 158-45d, 170-45d, 207-45d, 210-45d, 282-45d, 310-45d,]

Agency Response: Changes were made in response to these comments. Fleet owners are now allowed to delay the removal of an ICE vehicle from their fleet until the ZEV has been delivered, as per the Model Year Schedule. Additionally, fleets may consider an ICE vehicle as a ZEV under the ZEV Milestones Option until the ZEV is delivered. The Vehicle Delivery Delay Extension ensures that fleets remain in compliance even if they have not yet received their ZEV, offering more flexibility in transitioning to ZEVs.

No changes were made in response to the comments requesting allowing fleets to purchase ICE vehicles when ZEV deliveries take longer than a year. This suggestion would undermine the objectives of the ACF Regulation and result in a loss of emissions reductions. This suggestion would undermine the objectives of the ACF Regulation and result in a loss of emissions reductions. Additionally, ICE purchases would ensure that ICE vehicles would be operated throughout their SB 1 useful lives, further delaying the fleet's transition to zero-emissions. If a ZEV is unavailable or does not meet a fleet's operational needs, fleets may apply for a ZEV Purchase Exemption or Daily Usage Exemption.

b) Vehicle Delivery Delay Extension – Manufacturer Cancellations

Comment Summary: The commenters recommend in the Vehicle Delivery Delay Extension changing the requirement of 90 days of when a fleet must secure another purchase if a manufacturer cancels a purchase agreement to 180 days.

Commenter: [238-45d, 291-45d, 322-45d]

Agency Response: Changes were made in response to these comments to allow fleet owners up to 180 days, and a full year (365 consecutive days) for government fleet owners, to enter into a new purchase agreement under the Vehicle Delivery Delay Extension if the manufacturer cancels the purchase agreement for reasons outside of the fleet owners' control. The rationale for why this timeframe is appropriate can be found in Chapter A.(A).41., section 2013(l), and Chapter C.(D).25., section 2015.3(d)(2), of the ACF 15-Day Notice.

c) Vehicle Delivery Delay Extension – Allow Fleets to Cancel Orders

Comment Summary: The commenters request a revision to the order cancellation provision, allowing SLG fleets to cancel ZEV orders due to budgetary or operational changes.

Commenter: [207-45d, 291-45d, 227-45d]

Agency Response: No changes were made in response to these comments. If a fleet owner cancels a notice to proceed, a purchase agreement, or a leasing contract for a ZEV at any time before the vehicle is delivered, the purchase will not count towards required ZEV purchases for the California fleet. There are exemptions and extensions in place if the ZEV available does not meet operation needs for the fleet.

d) Vehicle Delivery Delay Extension – Remove Internal Combustion Engine Vehicle Removal Requirement

Comment Summary: The commenters request a change to section 2015.4(g) "Vehicle Delivery Delay Reporting" by deleting the phrase "and to either remove the ICE vehicle from the California fleet or to designate it as a backup vehicle."

Commenter: [310-45d]

Agency Response: No changes were made in response to these comments. This requirement ensures fleets do not continue to operate ICE vehicles granted a compliance extension longer than needed; the vehicle would no longer be needed when the replacement ZEV arrives and would need to be removed from the California fleet. Additionally, this requirement includes compliance relief mechanism by allowing the ICE vehicle granted the extension to then transition into the fleet's backup vehicle fleet if the fleet owner wants to continue operating the vehicle for limited annual mileage.

e) Vehicle Delivery Delay Extension – Remove One Year Limit

Commenter Summary: The commenters argue that setting a one-year ZEV ordering limit under the Vehicle Delivery Delay Extension is arbitrary given the challenges facing the adoption of ZE technology.

Commenter: [175-45d, 238-45d]

Agency Response: No changes were made in response to these comments. The one-year ordering limit reflects a realistic timeframe for vehicle delivery delays, taking into consideration that replacement ICE vehicles experience similar wait times.

19. Exemptions and Extensions – Waste and Wastewater

a) Waste and Wastewater Fleets – Include Exemption until 2033

Comment Summary: The commenters request an exemption for the public wastewater sector from sections 2013(d) and 2013(i) until 2033 if the fleet complies with the HD Omnibus Regulation.

Commenter: [326-45d]

Agency Response: Changes were made in response to these comments. The Waste and Wastewater Fleet Option was added as part of the 15-day changes which provides more time for some existing CNG trucks operated by eligible waste haulers and wastewater fleets. ZEV requirements would be phased in starting 2030. These provisions allow waste and wastewater fleets additional time to transition the use of biomethane in sectors that are difficult to decarbonize. Changes were also made as part of the 15-day changes to require California certified engines to be purchased when ZEV exemptions are granted to allow the purchase ICE vehicles to ensure higher emitting federal engines are not purchased. All engines sold in California starting with the 2024 model year must already comply with the HD Omnibus Regulation.

b) Waste and Wastewater Fleets – Collaboration for Policy Goals in Wastewater Sector

Comment Summary: The commenter requests that the Board direct CARB staff to collaborate with the wastewater sector in developing a solution that aligns the Regulations with State legislation and policy, specifically focusing on SB 1383. This partnership aims to ensure coherence and mutual support between Regulations and policy goals.

Commenter: [019-OT1, 033-OT1, 079-OT1, 121-OT1, 158-OT1]

Agency Response: No changes were made in response to these comments. Throughout the development of the ACF Regulation, CARB staff has actively engaged with waste and wastewater fleets and groups, holding multiple meetings, workshops, and workgroups to gather valuable input and address concerns. Staff have taken comments and concerns from these stakeholders into consideration while updating the Regulation text, ensuring that the Regulation aligns with policy and emissions targets, while still providing support for the waste and wastewater sectors.

CARB recognizes the importance of ongoing collaboration with the waste and wastewater sector and other stakeholders in implementing and refining the ACF Regulations. CARB staff remains committed to maintaining an open dialogue and working closely with all affected sectors, including the waste and wastewater sector, to ensure that the regulatory efforts effectively support State legislation, policy objectives, and the broader emissions reduction goals.

c) Waste and Wastewater Fleets – Collaborate with CalRecycle on Uses for Digester Gas

Comment Summary: The commenter wants to work with CARB and CalRecycle on what to do with digester gases other than for transportation as they move towards electrification of their fleet. Finally, they state that CARB's assistance is crucial for the success of food waste diversion projects.

Commenter: [033-OT1]

Agency Response: No changes were made in response to these comments. All comments and suggestions from stakeholders and sister agencies such as CalRecycle are welcomed. Collaboration is key to achieving our mutual goal of reducing greenhouse gas emissions and promoting sustainable solutions. In the development of Regulations and policies, CARB staff regularly coordinates with other agencies, including CalRecycle, CEC, CPUC, GO-Biz, Cal OSHA and other stakeholders. Through these interactions, CARB can consider a range of options for promoting clean energy based on thorough scientific assessments of technology and cost-effectiveness.

Finally, the Board approved resolution language recognizing that the successful implementation of the food waste diversion requirements and methane emissions reductions mandated by SB 1383 are critical to the State’s climate goals. As such, the Board has directed staff to continue policy discussions with the above agencies relating to successful implementation of SB 1383, SB 1440 and other biomethane efforts.

d) Waste and Wastewater Fleets – Hydrogen Technology Demonstration

Comment Summary: The commenters ask for an extension for wastewater fleets subject to technology demonstration of biomethane to hydrogen options to validate the reliability of using wastewater biogas for ZE technology.

Commenter: [081-OT1, 084-OT1, 086-OT1, 087-OT1, 088-OT1, 109-OT1, 326-45d]

Agency Response: No changes were made in response to these comments. LCFS has certified several biomethane to hydrogen pathways, including some from renewable organic sources such as dairy manure, wastewater sludge, and landfill gas which proves this technology is beyond the demonstration phase.[188]

e) Waste and Wastewater Fleets – Waste and Wastewater Fleet Implementation

Comment Summary: The commenters raise concerns about waste and wastewater fleet implementation of SB 1383 and the impact of a newly added provision of ACF. They request a 10-year extension for wastewater fleets to use biomethane generated from diverted organic waste and suggest allowing early adopter fleets, especially SB 1383 fleets, to postpone ZEV/NZEV purchases until 2040 to give them more time to recoup their investments. The commenters also urge CARB to provide natural gas adopters until 2040 to make additional new purchases. They highlight the lack of availability of ZEV vehicles to replace some waste trucks, indicating that this creates challenges for fleet implementation.

Commenter: [003-WT1, 019-OT1, 034-OT1, 040-OT1, 077-OT1, 079-OT1, 081-OT1, 084-OT1, 085-OT1, 086-OT1, 087-OT1, 088-OT1, 090-OT1, 130-OT1, 153-OT1, 167-45d, 175-45d, 210-45d, 253-45d, 267-45d, 292-45d, 321-45d, 337-45d]

Agency Response: Changes were made in response to these comments. The Waste and Wastewater Fleet Option was added as part of the 15-day changes which provides more time for some existing CNG trucks operated by eligible waste haulers and wastewater fleets. ZEV requirements would be phased in starting 2030. These provisions allow waste and wastewater fleets additional time to transition the use of biomethane in sectors that are difficult to decarbonize.

The Waste and Wastewater Fleet Option, as outlined in section 2015.3(e), allows fleet owners to delay compliance with the ZEV Milestones Option for vehicles in the California fleet that meet specific criteria, including being fueled exclusively with biomethane. Provisions were made to adjust the ZEV Milestone Calculation, as described in section 2015.3(e)(6). This adjustment allows eligible waste and wastewater fleet vehicles to be moved from Milestone Groups 1 and 2 to Milestone Group 3, providing more time for fleet owners to transition to ZEVs.

[188]CARB. Current Fuel Pathways Table last updated 2/28/2023. (web link: https://ww2.arb.ca.gov/resources/documents/lcfs-pathway-certified-carbon-intensities, last accessed March 2023).

Changes were not made to grant a longer extension or to postpone ZEV/NZEV purchases until 2040, to ensure both criteria and GHG emission benefits would be achieved and the goals of implementing the Regulation would be met. This approach ensures a smooth transition for waste and wastewater fleets while still maintaining the ultimate objective of achieving health protective emissions benefits and GHG reductions from fully transitioning the fleet to ZEVs by 2042.

20. Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption

a) Zero-Emissions Vehicle Purchase Exemption – Allow Fleet Manager Attestation

Comment Summary: The commenters recommend allowing the ZEV Purchase Exemption based solely on fleet managers attesting to the need for the exemption.

Commenter: [170-45d]

Agency Response: No changes were made in response to these comments. Granting exemptions solely based on fleet managers attesting to the need for the exemption would introduce a loophole with large potential for abuse by fleets seeking a delay in compliance regardless of ZEV availability. Establishing a specific process as opposed to relying on fleet manager attestation also ensures that sufficient communication with manufacturers when seeking the needed ZEV configuration is occurring.

b) Zero-Emissions Vehicle Purchase Exemption – Create Availability List Instead of Unavailability List

Comment Summary: The commenters suggest that CARB create a ZEV availability list instead of an unavailability list, recommending that the list be based on the ACF ISOR's Appendix J, or the HVIP list.

Commenter: [003-OT1, 037-WT1, 089-45d, 150-OT1, 233-45d, 235-45d, 237-45d, 266-45d, 277-45d, 291-45d, 305-45d, 322-45d, 333-45d]

Agency Response: No changes were made in response to these comments. Similar to ICE vehicles, ZEVs are being manufactured as chassis or incomplete vehicles and the final vehicle configuration is then built to customer specifications. ZEV drivetrains are also available to convert existing ICE vehicles to ZEVs. It would be difficult and unnecessary to continuously update a changing and growing list of available ZEV chassis with hundreds of body configurations and potentially thousands of vehicle configurations if a wide range of final body customizations are considered. As the ZEV market develops, the list of various vehicle configurations would be exceedingly burdensome to maintain with no apparent advantage or purpose for doing so. There would be no end date for maintaining such a list. Whereas a list of vehicle configuration categories that are not available to purchase in a ZEV configuration is expected to be a smaller list and will become shorter as more ZEV configurations are offered.

c) Zero-Emissions Vehicle Purchase Exemption – Add "Commercial Availability" Definition

Comment Summary: The commenters request a formal definition for "commercial availability" or "available to purchase," emphasizing the need for clear criteria that define a commercially available vehicle, including technical and performance requirements tailored to each utility. They highlight the importance of having well-defined metrics for commercial availability and readiness, noting that the current availability of ZEV medium- and heavy-duty vehicles that meet their specific service requirements is limited.

Commenter: [003-OT1, 003-WT1, 006-OT1, 006-WT1, 007-OT1, 009-OT1, 010-OT1, 014-45d, 015-45d, 015-WT1, 034-OT1, 035-OT1, 053-OT1, 072-OT1, 089-45d, 095-OT1, 103-45d, 121-OT1, 124-OT1, 148-45d, 179-45d, 207-45d, 210-45d, 229-45d, 233-45d, 235-45d, 241-45d, 243-45d, 252-45d, 253-45d, 261-45d, 277-45d, 278-45d, 279-45d, 283-45d, 291-45d, 294-45d, 297-45d, 300-45d, 304-45d, 305-45d, 309-45d, 318-45d, 330-45d, 333-45d, 334-45d, 342-45d]

Agency Response: No changes were made in response to these comments. The Regulation is phased in over several decades and includes flexibility for fleet owners to decide which vehicles to upgrade to ZEVs. The ZEV Purchase Exemption establishes clear criteria used to assess the availability of offered ZEVs for sale, eliminating the need for a definition of "commercial availability" and "available to purchase." The ZEV Purchase Exemption also addresses fleet specific circumstances where available ZEVs may not be available in a configuration that meet the primary intended function for a fleet. It is infeasible to address specific technical and performance requirements, especially tailored to each utility, in the availability criteria as there is a wide range of vehicle bodies and specifications offered for sale as well as a wide range of customization. These specifications would need to be maintained within the configurations list, which would be exceedingly burdensome.

d) Zero-Emissions Vehicle Purchase Exemption – Add Cost Criteria

Comment Summary: The commenters ask that cost be incorporated into the ZEV Purchase Exemption criteria, considering whether the cost of the vehicle can be realized within its life. They request a cost exemption for public agencies under ZEV Purchase, that ZEVs not cost more than 33 percent compared to ICE vehicle counterparts, and exemptions for cost differentials when a ZEV is 10 percent or more expensive than the ICE vehicle equivalent. Additionally, they seek a cap on the TCO payback period for ZEVs based on individual fleet use cases, and that the definition of "commercially available" encompasses consumer costs, a cost differential percentage, and a commercial availability list reflecting economic viability and market conditions.

Commenter: [006-OT1, 006-WT1, 015-45d, 034-OT1, 089-45d, 092-45d, 096-45d, 156-45d, 227-45d, 233-45d, 235-45d, 237-45d, 241-45d, 243-45d, 260-45d, 277-45d, 290-45d, 291-45d, 297-45d, 305-45d, 310-45d, 318-45d, 333-45d]

Agency Response: No changes were made in response to these comments. Costs cannot be assessed in a feasible way, as they rapidly change, and every fleet has different cost concerns. ZEVs have high upfront costs but reduced operational costs and it would not be reasonable to include cost as criteria in determining availability as a result. The TCO payback period for ZEVs based on individual fleet use cases will also vary by fleet. Therefore, creating criteria around the TCO is not a reliable method in assessing availability either. ZEVs vary in price depending on the requested specifications and if a certain cost threshold is incorporated into the availability criteria, those with greater vehicle costs due to specifications needed for fleet operations would unfairly be granted the exemption. Additionally, CARB's incentive programs assist in early adopter purchases by reducing incremental costs and supporting vehicle cost reductions over time. Cost concerns are also expected to decrease as the ZEV market develops and expands.

e) Zero-Emissions Vehicle Purchase Exemption – Group Zero-Emissions Vehicle Purchase List by Payload Capability

Comment Summary: The commenters state that vehicles on the ZEV Purchase List should be grouped by payload capability for determining availability, as it is more relevant to fleet owners' needs than weight class and configuration alone.

Commenter: [342-45d]

Agency Response: No changes were made in response to these comments. ICE vehicles are most commonly classified by weight class and configuration, and that is the approach used in the Regulation. The ZEV Purchase Exemption list identifies which vehicles can be purchased as ICE vehicles for commonly available configurations listed in the Regulation for clarity. Additional details about the payload characteristics are not needed to identify which vehicle categories can be purchased under the exemption. Detail on the ICE truck specifications purchased under the exemption can be worked out with the dealer and varies by fleet.

f) Zero-Emissions Vehicle Purchase Exemption – Add Delivery Time Criteria

Comment Summary: The commenters request that for a ZEV to be considered commercially available, it should be available in sufficient supply, and deliverable within an acceptable timeframe to the fleet or comparable to an ICE vehicle for purchase and receipt.

Commenter: [003-WT1, 006-WT1, 170-45d, 235-45d, 260-45d, 290-45d, 305-45d]

Agency Response: Changes were made in response to these comments. As part of the criteria used in assessing availability, ZEVs or NZEVs offered must have a model year within 18 months of the date the fleet owner submitted the complete ZEV Purchase Exemption request. This change addresses supply concerns if manufacturers sell out of a given model.

The rationale for why this timeframe was appropriate can be found in Chapter A.(B).26., section 2013.1(d)(2), and Chapter C.(D).34., section 2015.3(e)(2), of the ACF 15-Day Notice.

No changes were made to require a specific timeframe in which a ZEV is to be delivered to the fleet following a purchase agreement because ICE vehicle delivery times vary widely and it is unreasonable to apply such a limit only to ZEV purchases for an exemption that would allow for the purchase of an ICE vehicles that takes just as long to be delivered.

g) Zero-Emissions Vehicle Purchase Exemption – Remove Vehicle Exclusions

Comment Summary: The commenters ask that CARB remove the exclusion of vehicles with a GVWR greater than 14,000 pounds, pickup trucks, two-axle buses, box trucks, vans, or any tractors from the ZEV Purchase Exemption, and request that pickup trucks be treated similarly to trucks over 14,000 pounds GVWR in the ZEV Purchase Exemption.

Commenter: [004-WT1, 015-WT1, 207-45d, 233-45d, 342-45d]

Comment Summary: The commenters suggest expanding the ZEV Purchase Exemption to include pickups, as the construction industry relies on these vehicles for material transport and towing equipment.

Commenter: [261-45d]

Agency Response: Changes were made in response to these comments. The exclusion of vehicles with a GVWR greater than 14,000 pounds was removed. No changes were made to exclude pickups, any buses, box trucks, vans, or any tractors from the ZEV Purchase Exemption configurations list as these body types are currently widely available as ZEVs. However, the Regulation includes language for all vehicle types to allow for an exemption if the ZEV cannot be configured to meet the primary intended function for the fleet or if there is a conflict in meeting an established safety requirement.

h) Zero-Emissions Vehicle Purchase Exemption – Add Fleet Specification Criteria

Comment Summary: The commenters request that ZEV Purchase Exemption criteria include matching exact fleet specifications for one-to-one replacement or exact duty cycle replacement. Commenters also request commercial availability be evaluated based on minimum duty cycle requirements identified by the fleet, and that available ZEVs are evaluated and tested by at least one California-based fleet.

Commenter: [006-OT1, 006-WT1, 010-OT1, 014-45d, 015-45d, 092-45d, 096-45d, 170-45d, 235-45d, 241-45d, 243-45d, 253-45d, 260-45d, 285-45d, 291-45d, 297-45d, 300-45d, 305-45d, 310-45d, 333-45d]

Agency Response: Changes were made in response to these comments. The ZEV Purchase Exemption includes a case-by-case process that permits fleet owners to purchase an ICE vehicle if it is demonstrated that no manufacturers or body builders can supply a ZEV in the needed configuration. The rationale for why this process is appropriate can be found in Chapter A.(B).22., section 2013.1(d), and Chapter C.(D).30., section 2015.3(e), of the ACF 15-Day Notice.

No changes were made to include purchase availability criteria that specifically require matching exact fleet specifications because it would be infeasible to maintain the ZEV Purchase Exemption list for every possible combination of vehicle configuration and specification.

Fleet owners are expected to place ZEVs in their fleet where they are best suited. That could mean some changes in planning or assigning vehicles. The Daily Usage Exemption permits fleet owners to purchase a new ICE vehicle if no new ZEV is available that can meet the demonstrated daily usage needs of any existing vehicle of the same type in the fleet. It is therefore unnecessary to incorporate criteria that require a ZEV to match an exact duty cycle of the vehicle being replaced. Concerns regarding duty cycle replacement are also expected to decrease as the ZEV market expands and progresses technologically with greater range capabilities and shorter charging times for BEVs.

No changes were made in requiring that available ZEVs be evaluated and tested by at least one California-based fleet because it isn't a standard applicable to ICE vehicles, is unnecessary and would only add a barrier to delay ZEV deployment when vehicles are under warranty.

i) Zero-Emissions Vehicle Purchase Exemption – Add Process for Infrastructure Availability Issues

Comment Summary: The commenters request an exemption process for situations where charging infrastructure is not available within a reasonable number of miles from the vehicle's operating location.

Commenter: [300-45d, 310-45d, 318-45d]

Agency Response: No changes were made in response to these comments. The scope of the Regulation includes fleets that are well suited for electrification, and most are expected to begin the transition to ZEVs by installing their own infrastructure in their depots. Granting exemptions based on infrastructure proximity to a vehicle's operating location could introduce a loophole with large potential for abuse by fleets seeking to delay compliance without infrastructure proximity issues. Concerns regarding infrastructure availability and proximity are expected to decrease as ZEV infrastructure develops and expands. Finally, the Regulation includes extensions due to delays in installing ZEV infrastructure for reasons outside the control of the fleet owner; this provision would address delays related to fleet owner construction and site electrification.

j) Zero-Emissions Vehicle Purchase Exemption – Clarify Process and Criteria

Comment Summary: The commenters request transparency and clarification in the ZEV Purchase Exemption process, stating that the unavailability list is based on limited, non-transparent, and unrealistic criteria that do not consider fleet needs. They urge CARB to establish a transparent process addressing ZEV availability and implement exemptions if ZEVs are not available in practice or cannot meet fleets' requirements.

Commenter: [002-OT1, 020-OT1, 021-WT1, 031-45d, 051-45d, 060-45d, 083-45d, 090-OT1, 095-OT1, 105-OT1, 128-45d, 129-45d, 148-OT1, 161-45d, 179-45d, 233-45d, 253-45d]

Agency Response: Changes were made in response to these comments. The ZEV Purchase Exemption was updated as part of the 15-day changes to include two basic approaches. The ZEV Purchase Exemption list is a streamlined approach to identify common vehicle configurations that are not available to purchase as ZEVs. This approach simplifies the exemption process and reduces the need for exemption applications. CARB will continue to assess vehicle availability through the Regulation implementation to ensure the list contains configurations that meet the established criteria. The ZEV Purchase Exemption also considers individual fleet needs and includes a fleet-specific case-by-case process that permits fleet owners to purchase an ICE vehicle in a needed vehicle configuration if the criteria are met to show no manufacturers or body builders can equip a ZEV to serve the primary intended function of the vehicle to be replaced. The rationale for why this process is appropriate can be found in Chapter A.(B).22., section 2013.1(d), and Chapter C.(D).30., section 2015.3(e), of the ACF 15-Day Notice.

k) Zero-Emissions Vehicle Purchase Exemption – Add Manufacturer Criteria

Comment Summary: The commenters state that the ZEV Purchase Exemption and commercial availability definitions should take into account various manufacturer related criteria, including manufacturer market penetration for the specific truck application, a specific threshold number of delivered vehicles, and accessibility of customer support systems or manufacturer service centers within a specified distance from the fleet owner. They also emphasize the importance of "brand loyalty" and ask it to be included as criteria, as some fleets rely on a primary manufacturer for vehicle supply and service, suggesting that introducing a secondary manufacturer may result in modifications to purchase and maintenance agreements. The commenters request that a certain number of manufacturers be producing a ZEV type for it to be considered commercially available and that ZEVs be sold on a competitive basis to multiple buyers.

Commenter: [004-WT1, 006-OT1, 006-WT1, 014-45d, 015-45d, 089-45d, 128-45d, 129-45d, 153-45d, 155-45d, 175-45d, 179-45d, 210-45d, 229-45d, 233-45d, 235-45d, 241-45d, 243-45d, 260-45d, 278-45d, 279-45d, 282-45d, 291-45d, 294-45d, 297-45d, 300-45d, 305-45d, 310-45d, 322-45d, 330-45d, 333-45d, 342-45d]

Agency Response: Changes were made to address these comments. As part of the 15-day changes the ZEV Purchase Exemption was modified to ensure that only ZEV's that were certified to the ZEP Certification requirements, where applicable, would be considered in assessing ZEV availability. The Regulation has an extended phase-in period and provides considerable flexibility for fleet owners to plan their purchases and adding additional conditions that fleet owners can decide for themselves are counter to the objectives of the Regulation. The rationale for why this requirement is appropriate can be found in Chapter A.(B).26., section 2013.1(d)(2), and Chapter C.(D).34., section 2015.3(e)(2), of the ACF 15-Day Notice.

No changes were made to require that a certain number of manufacturers produce a ZEV type. It would also be unreasonable to eliminate consideration of an available ZEV configuration based on an arbitrary manufacturer sales threshold, especially if said manufacturer can supply the needed vehicle.

No changes were made to accommodate "brand loyalty" as it is a subjective and individual fleet preference and not a reasonable basis to forgo emission benefits to allow for purchasing ICE vehicles when ZEVs are available in the needed configuration from any manufacturer.

No changes were made to require the accessibility of customer support systems or manufacturer service centers within a specified distance from the fleet owner because it would be somewhat arbitrary and exceptionally burdensome to maintain the ZEV Purchase List in consideration of the location of service centers with respect to every fleet owner subject to the Regulation.

l) Zero-Emissions Vehicle Purchase Exemption – Required Documentation Is Too Onerous

Comment Summary: The commenters argue that the ZEV Purchase Exemption requirement for a signed manufacturer statement is too onerous because they do not have direct business relationships with the chassis manufacturer and suggest the exemption should account for delayed or no responses from manufacturers or allow statements from vendors to qualify.

Commenter: [322-45d]

Agency Response: Changes were made in response to these comments. The ZEV Purchase Exemption was modified in the 15-day changes to include a streamlined exemption process for common vehicle types that could be purchased as ICE vehicles because it is not available for the configuration category. The provision was also modified to allow for fleet specific exemptions for when the vehicle is available in a given category but cannot be configured to meet the primary intended function of the vehicle being replaced. The Regulation specifies that the Executive Officer has 45 days after receiving a complete application to notify the fleet owner if the exemption is granted.

No changes were made in response to a signed manufacturer statement being too onerous due to a lack of a direct business relationship with the chassis manufacturer as it is the fleet owner's responsibility to initially seek the ZEV-equivalent of the needed configuration, which requires direct communication with the manufacturer or through its authorized dealers. A fleet owner may newly establish direct communication with a manufacturer to receive a statement confirming that the needed configuration cannot be produced.

No changes were made in response to allowing statements from vendors to qualify in lieu of statements from the manufacturers as a vendor would not know the manufacturer's capability of producing a specific configuration.

m) Zero-Emissions Vehicle Purchase Exemption – Exclude Vehicles Offered Through Preorders from Availability Criteria

Comment Summary: The commenters state that ZEVs offered through pre-orders should not be considered commercially available.

Commenter: [207-45d, 300-45d]

Agency Response: No changes were made in response to these comments. The commenters refer to pre-orders as the partial or full purchase of a ZEV in advance of its release. Similar to ICE vehicles, it is normal for ZEV manufacturers to conduct pre-orders to determine supply needs to fulfill a higher number of orders and not a guarantee of excessive wait and delivery times. The exemption distinguishes that ZEVs or NZEVs must not be offered as a temporary placeholder for a vehicle that may or may not be offered for sale in the future to be considered available to purchase. Pre-orders, in contrast, require a contractual purchase agreement with manufacturer fulfillment obligations. The exemption also requires that the

ZEVs or NZEVs offered for sale have a model year 18 months or less from the date the fleet owner submitted the complete exemption request to be considered available to purchase; this is to ensure reasonable wait and delivery times comparable to ICE vehicles.

n) Zero-Emissions Vehicle Purchase Exemption – Add Public Fleet Exemption Process

Comment Summary: The commenters request a separate exemption process for public agencies when ZEVs are not practically accessible or unsuitable for operational needs, and that the ZEV Purchase Exemption should not require a POU to purchase a specific ZEV if a supplier cannot meet public procurement standards.

Commenter: [015-45d, 153-45d, 167-45d, 179-45d, 278-45d, 279-45d, 285-45d, 294-45d, 330-45d]

Agency Response: Changes were made in response to these comments. The ZEV Purchase Exemption was expanded to address fleet specific situations with a case-by-case process that permits fleet owners to purchase an ICE vehicle in the needed configuration and weight class if it is demonstrated that no manufacturers or body builders can supply a ZEV to meet the primary intended function of the vehicle. Additionally, the Regulation provides flexibility for fleets to plan their purchases within their own procurement standards and does not require SLG fleets to replace any vehicles. SLG fleets have varying public procurement standards, and it would be impractical to incorporate every existing set of standards into the exemption process and availability criteria.

o) Zero-Emissions Vehicle Purchase Exemption – Add Range Criteria

Comment Summary: The commenters suggest that the criteria for commercial availability consider vehicle range.

Commenter: [310-45d, 318-45d]

Agency Response: No changes were made in response to these comments. Vehicle range and capability requirements vary amongst fleets based on operational use and required duty cycle. It would therefore be unreasonable to deem ZEVs below a certain threshold of range capability as unavailable if they suit the needs of regulated fleets. There are several EV medium-duty and heavy-duty non-tractors capable of a 100- to 200-mile range on a single charge. FCEVs can also provide similar capacity, range, and fueling capabilities as ICE vehicles. For additional information about concerns regarding the range capacity of ZEVs, please see responses to issues raised in section "Zero-Emissions Technology – Range and Work Capacity" in "Zero-Emissions Vehicle Technology Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses." These concerns are expected to decrease as ZE technology improves.

p) Zero-Emissions Vehicle Purchase Exemption – Remove Milestones Limitation

Comment Summary: The commenters state that the requirement for fleet owners to transition all other vehicle types to ZEV first before applying for ZEV Purchase Exemption under the ZEV Milestones Option is overly burdensome.

Commenter: [322-45d]

Agency Response: Changes were made in response to these comments. The ZEV Purchase Exemption under the ZEV Milestones Option was modified to require fleet owners to demonstrate that their next applicable upcoming ZEV Milestone cannot be reached without exemptions by requesting and obtaining exemptions for all other ICE vehicles in their California fleet. The ZEV Milestones Option provides complete flexibility for the fleet owner to plan their vehicle purchases and which ones will be ZEVs or ICE vehicles. The purpose of the exemptions is to address situations where the fleet owner is making a good faith effort to comply but is unable to due to circumstances beyond their control. It is not intended to be used as a method to claim exemptions for some trucks when the ZEV milestones can be met by upgrading other trucks in the fleet. The requirement allows fleets to apply and qualify for applicable exemptions for their remaining ICE vehicles to demonstrate they are out of options to comply. The rationale for why this modification is appropriate can be found in Chapter C.(C).17., section 2015.2(f)(5), of the ACF 15-Day Notice.

q) Zero-Emissions Vehicle Purchase Exemption – Proving Technological Infeasibility After ACF Regulation Adoption Is Reverse Rulemaking

Comment Summary: The commenters assert that CARB requiring stakeholders to prove technological infeasibility after ACF Regulation adoption in the context of the ZEV Purchase Exemption is reverse rulemaking.

Commenter: [253-45d]

Agency Response: No changes were made in response to these comments. The ZE technology suited for most fleet operations is currently available. The ZEV Purchase Exemption is intended to provide flexibility for more specialized configurations that have not yet been electrified, or circumstances where available ZEVs do not meet fleet needs. Therefore, demonstrating technological infeasibility under the ZEV Purchase Exemption for certain configurations is not reverse rulemaking, but rather an accommodation to address case-by-case circumstances.

r) Zero-Emissions Vehicle Purchase Exemption – Add Public Review Process and Comment Period

Comment Summary: The commenters request that the ZEV Purchase Exemption process allow for a public review and comment period.

Commenter: [014-45d]

Agency Response: No changes were made in response to these comments. Requiring a public review and comment period for each exemption application would significantly delay

ACF Regulation implementation and the time it takes to grant an exemption. This requirement would also be administratively burdensome and counterproductive to the goal of providing fleets owners timely responses. The Regulation specifies that the Executive Officer must respond within 45 days of getting a complete application and that timeline cannot reasonably be met with a public review and comment period.

s) Zero-Emissions Vehicle Purchase Exemption – Add Safety Criteria

Comment Summary: The commenters express concerns about ZE tractors' safety when picking up loads at fuel racks, suggesting a ZEV Purchase Exemption for all vehicle categories with valid public safety considerations. They urge CARB to establish alternatives when available ZEVs would result in undue risk to public health and safety.

Commenter: [170-45d, 282-45d]

Agency Response: Changes were made in response to these comments. The ZEV Purchase Exemption was modified as part of the 15-day changes and addresses fleet specific situations as part of the availability assessment criteria. An exemption can be issued if all available ZEVs or NZEVs of the needed configuration present a conflict with existing health and safety standards applicable to the fleet operation. For additional information about concerns regarding the safety of ZEVs, please see responses to issues in section "Zero-Emissions Technology – Safety Concerns" in "Zero-Emissions Vehicle Technology Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

t) Zero-Emissions Vehicle Purchase Exemption – Collaborate with Stakeholders for Availability Criteria

Comment Summary: The commenters recommend that CARB collaborate with stakeholders to develop workable ZEV availability criteria.

Commenter: [004-OT1]

Agency Response: No changes were made in response to these comments. Staff met with numerous stakeholders throughout the rulemaking process to discuss and develop workable ZEV availability criteria that have been incorporated into the ZEV Purchase Exemption. Staff also held a public workgroup and workshops for further discussions with and to receive feedback from stakeholders regarding the ZEV Purchase Exemption process and the ZEV availability criteria.

u) Zero-Emissions Vehicle Purchase Exemption – Add Third Party Assessment of Availability

Comment Summary: The commenters request the involvement of third-party assessments, industrial councils, or committees to evaluate ZEV availability and associated criteria, such as costs, duty cycle, and infrastructure availability. They propose basing the assessment on ZEP Certification criteria to determine availability and technology readiness, and suggest that a specific vehicle type, like construction industry-related vehicles, be assessed.

Commenter: [093-45d, 094-45d, 104-45d, 157-OT1, 170-45d, 233-45d, 235-45d, 253-45d, 263-45d, 266-45d]

Agency Response: Changes were made in response to these comments. As part of the 15-day changes the requirement that a vehicle be ZEP Certified was added as a criteria for determining if a ZEV or NZEV is available.

The Regulation was developed in an open and robust public process. Establishing third-party assessments, industry councils, or committees would be another administrative process that would require their own criteria in determining which third parties would be appropriate to determine ZEV availability and associated criteria. There is no need to assemble such a third-party assessment or committee to determine whether the criteria specified in the Regulation are met. The suggested proposal would delay ACF Regulation implementation which would delay the emissions reductions and objective the Board considered as part of its decision to approve the Regulation. The criteria for assessing ZEV availability have also already been established through the ACF 15-day changes, and do not consider costs and a general review of infrastructure availability because fleet owners are expected to install infrastructure and they have the flexibility to determine how to comply with the Regulation.

v) Zero-Emissions Vehicle Purchase Exemption – Align Exemption with Transport Refrigeration Unit Regulation Provisions

Comment Summary: The commenters request that the ZEV Purchase Exemption align with the provisions in the TRU Regulation, providing a 1-year extension if no compliance technology is available within six months of the compliance date, with additional extensions available as needed.

Commenter: [282-45d]

Agency Response: No changes were made in response to these comments. Box trucks and box trucks with reefer units are already commonly available as ZEVs and is expected to expand. Therefore, it is unlikely that ZEV Purchase Exemptions would be needed. Fleet owners are permitted to purchase ICE vehicles of configurations listed on the ZEV Purchase Exemption List. If an available ZEV does not meet fleet needs, the fleet owner may submit an exemption application to purchase the ICE vehicle equivalent. Fleet owners are also expected to plan sufficiently to meet compliance deadlines when submitting applications. These processes, requirements, and expectations eliminate the need to provide an extension similarly provided under the provisions of the TRU Regulation as well as consider technological readiness within a certain timeframe of a compliance date.

w) Zero-Emissions Vehicle Purchase Exemption – Add Process for Vehicles with Weight Limits

Comment Summary: The commenters request a separate exemption process for situations where vehicles have strict weight limits due to the roads and bridges they traverse.

Commenter: [305-45d]

Comment Summary: The commenters state that the ZEV Purchase Exemption should consider situations where cargo capacity is negatively impacted due to the added weight of ZE tractors, which can reduce payload and necessitate additional truck trips.

Commenter: [282-45d]

Comment Summary: The commenters state that the ZEV Purchase Exemption should consider situations where payload capacity is adversely affected due to the added weight of ZE tractors, which can reduce cargo capacity and create additional truck trips.

Commenter: [318-45d]

Agency Response: No changes were made in response to these comments. Fleets are permitted to select the ZE technology that best fits the range and weight requirements of a fleet's operations. Fleets are also expected to make adjustments in their purchase plans and how they specify their vehicles to best fit their application. For example, if weight is a concern the ZEV Milestones Option provide flexibility to upgrade any truck in the fleet to meet the ZEV Milestones, in addition fleet owners may consider FCEVS, NZEVs, or BEVs with smaller battery packs and strategically planned charging.

changes in fleet operations to accommodate ZEV acquisition in compliance with the Regulation. Therefore, it would be unreasonable and unnecessary to offer a separate exemption process in consideration of weight limits and payload or cargo capacity. For additional information about concerns regarding weight impacts, please see responses to issues raised in section "Zero-Emissions Technology – Vehicle Weight" in "Zero-Emissions Vehicle Technology Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

x) Zero-Emissions Vehicle Purchase Exemption – Add Zero-Emissions Powertrain Certification Criteria

Comment Summary: The commenters suggest that CARB require ZEP Certification in the criteria for the ZEV Purchase Exemption or using ZEP Certification as the threshold requirement for determining commercial readiness and ZEV availability.

Commenter: [127-OT1, 130-OT1, 241-45d, 243-45d, 253-45d]

Agency Response: Changes were made in response to these comments. As part of the ZEV availability assessment criteria, an offered ZEV or NZEV is considered available to purchase, among other criteria, if the manufacturer has certified the ZEV's powertrain with CARB's ZEP Certification requirements.

y) Zero-Emissions Vehicle Purchase Exemption – Allow Fuel of Choice

Comment Summary: The commenters propose separate evaluations for FCEV and BEV availability and enable exemption language once a fleet has committed to the infrastructure investment to support a preferred technology.

Commenter: [248-45d]

Agency Response: No changes were made in response to these comments. The ACF Regulation is technology-neutral and does not specifically require either BEVs or FCEVs as compliance options. As a result, it would be unnecessary, as well as burdensome, to maintain separate availability criteria and configuration lists for all existing ZEV technologies. Additionally, allowing fleet owners to commit to a preferred technology will cause uneven fleet transition amongst stakeholders if a fleet chooses technology that is not as readily available as others. This proposal would create a loophole by which fleets could indefinitely delay transitioning their fleets to ZEVs should they intentionally pick a technology with low market availability, and, as a result, would cause the goals of the Regulation to not be met. Fleets are also expected to install the necessary infrastructure to maintain compliance with the Regulation or rely on public or retail infrastructure. It would therefore be unreasonable to consider technology preference in the ZEV Purchase Exemption based on infrastructure investments.

z) Zero-Emissions Vehicle Purchase Exemption – Allow for Internal Combustion Engine Vehicle Purchase Instead of Delaying Delivery of Zero-Emissions Vehicle

Comment Summary: The commenters request that the ZEV Purchase Exemption allow for the purchase of an ICE vehicle instead of postponing the ZEV delivery when an ICE vehicle necessary for fleet operations can be delivered in an expeditious timeframe, as manufacturers will not have offerings in the needed vocational work trucks for at least five years.

Commenter: [156-45d]

Agency Response: No changes were made in response to these comments. As part of the criteria used in assessing ZEV availability, ZEVs or NZEVs offered must have a model year 18 months or less from the date the fleet owner submitted the complete ZEV Purchase Exemption request to avoid prolonged delivery timeframes. ZEV configurations that are not available to purchase that appear on the ZEV Purchase List may also be purchased as an ICE vehicle. It is therefore unnecessary to consider a specific timeframe in which an ICE vehicle can be delivered compared to a ZEV.

aa) Zero-Emissions Vehicle Purchase Exemption – Too Narrow for Practical Use by U.S. Postal Service

Comment Summary: The commenters argue that the ZEV Purchase Exemption is too narrow for practical use by the U.S. Postal Service, as "unavailable" is defined not by market availability or affordability, but by whether a vehicle class or configuration can be feasibly equipped with a ZEV or NZEV chassis.

Commenter: [228-45d]

Agency Response: No changes were made in response to these comments. The exemption provides flexibility in circumstances where a configuration is not available as a ZEV, or an available ZEV does not meet fleet needs related to the primary intended function of the vehicle. This eliminates the need to specifically include market availability as part of the availability criteria because if a configuration is not available as a ZEV on the market, the fleet owner may purchase the ICE vehicle equivalent. The rationale for why the established exemption criteria are appropriate can be found in Chapter A.(B).26., section 2013.1(d)(2), and Chapter C.(D).34., section 2015.3(e)(2), of the ACF 15-Day Notice. Additionally, affordability is subjective to every fleet and is, therefore, not a realistic factor to incorporate into the availability criteria. In consideration of these factors, the ZEV Purchase Exemption can be practically used by fleets, including the U.S. Postal Service.

bb) Zero-Emissions Vehicle Purchase Exemption – Unique Redlines Comment Letter 326

Comment Summary: The commenter requests edits to the 2013(m) ZEV Unavailability section by deleting "no" in front of ZEV and NZEV and replacing the "is" with "are not" between the words "configuration" and "commercially available."

Commenter: [326-45d]

Agency Response: No changes were made in response to these comments. The language in renumbered section 2013(m)(4) was modified to provide clarity for circumstances in which a fleet owner may purchase a new ICE vehicle or submit a request to obtain an exemption. The original language was not retained entirely and the suggested redlines no longer apply.

cc) Zero-Emissions Vehicle Purchase Exemption – Unique Redlines Comment Letter 277

Comment Summary: Redlines to section 2013(b). Add "'Commercially available' vehicle configuration means the following: (A) The vehicle configuration is available from at least three vehicle manufacturers as a ZEP Certified model in accordance with 13 CCR 1956.8, at least two units of each model has been placed into service, and each manufacturer has at least two years' experience selling vehicles in California. If the vehicle configuration requires upfitting, these requirements shall apply to both the manufacturer of the incomplete chassis and the upfitter."

Commenter: [277-45d]

Agency Response: No changes were made in response to these comments. The ZEV Purchase Exemption establishes clear criteria used to assess the availability of offered ZEVs for sale, eliminating the need for a definition of "commercially available vehicle configuration." The suggested redlines are, therefore, unnecessary. For additional information about the rationale for not including a definition for "commercially available vehicle configuration," please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Add 'Commercial Availability' Definition" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses." Additionally, the ZEP Certification requirement was added to ensure manufacturer reliability, eliminating the need for a threshold number of units per model to have been placed into service as well as requiring a specific amount of selling experience. For additional information about the rationale for not including the specified manufacturer criteria, please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Add Manufacturer Criteria" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

dd) Zero-Emissions Vehicle Purchase Exemption – Unique Redlines Comment Letter 342

Comment Summary: Redlines for ZEV Purchase Exemption. Section 2015.2(e)(5): add "local/ affected," remove "that are not already using an exemption or extension," remove "because they are not available to purchase," and remove "Additionally, if the only remaining ICE vehicles in the fleet cannot be replaced with a ZEV or NZEV of the needed configuration because they are not available to purchase, and the conditions of section 2015.3(e) are met, those ICE vehicles are excluded from the ZEV milestone calculation." Section 2015.3(e): change "14,000" to "8,500," and remove "and will not include pickup trucks, two-axle buses, box trucks, vans, or any tractors." Section 2015.3(e)(1): add "payload capacity." Paragraph without section number in section 2015.3(e): remove "and their good engineering judgement." Section 2015.3(e)(4)(A): remove "and for what reasons." Section 2015.3(e)(4)(B): remove "for each available ZEV or NZEV chassis," add "in general," and removed "of these."

Commenter: [342-45d]

Agency Response: Changes were made in response to these comments. The suggestion to remove "because they are not available to purchase" in section 2015.2(e)(5) was accepted and an ICE vehicle can be purchased if an available ZEV cannot meet fleet needs related to the primary intended function of the vehicle. The suggestion to remove "that are not already using an exemption or extension" in section 2015.2(e)(5) was accepted. The suggestion to remove "Additionally, if the only remaining ICE vehicles in the fleet cannot be replaced with a ZEV or NZEV of the needed configuration because they are not available to purchase, and the conditions of section 2015.3(e) are met, those ICE vehicles are excluded from the ZEV milestone calculation" in section 2015.2(e)(5) resulted in modifying language to clarify that the exemption will be granted if relevant criteria are met and the fleet owner demonstrates their next applicable upcoming ZEV Fleet Milestone cannot be reached without exemptions by requesting and obtaining exemptions for all other ICE vehicles in their California fleet. The suggestion to change "14,000" to "8,500" in section 2015.3(e) resulted in removing "14,000." The suggestion to remove "and for what reasons" in section 2015.3(e)(4)(A) was accepted. The suggestion to remove "for each available ZEV or NZEV chassis" in section 2015.3(e)(4)(B) resulted in modifying language for the submitted documentation to State that the manufacturer does not offer for sale ZEV or NZEV chassis, or complete ZEVs or NZEVs, of the needed configuration.

No changes were made to add "local/ affected" in front of "fleet" in Section 2015.2(e)(5) as "fleet" was removed, but the ZEV Purchase Exemption establishes applicability to the California fleet.

No changes were made to remove "and will not include pickup trucks, two-axle buses, box trucks, vans, or any tractors" in section 2015.3(e) as these vehicle configurations are currently widely available to purchase as ZEVs. Additionally, fleet owners may request an exemption for an available ZEV that cannot meet fleet needs. For additional information about removing certain vehicle configurations from the ZEV Purchase List, please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Remove Vehicle Exclusions" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

No changes were made to add "payload capacity" in section 2015.3(e)(1). For information about not including payload capacity, please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Add Process for Vehicles with Weight Limits" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

No changes were made to remove "and their good engineering judgement" in section 2015.3(e) as it is necessary to include the Executive Officer and their good engineering and business judgement because CARB needs to analyze given information to determine the availability status of a vehicle configuration when adding to the ZEV Purchase List. Additional justification is provided in section 2015.3(e) in Appendix H-2 of the ACF ISOR package on the need for the Executive Officer to make a good engineering judgement.

No changes were made to remove "in general" and "of these" in section 2015.3(e)(4)(B) because it is necessary to identify which specific safety laws or standards a ZEV or NZEV is in violation with, if applicable, and for what reasons to determine if this criterion is unmet by an available ZEV or NZEV.

21. Public Regulatory Process and Outreach Concerns

a) Outreach – Transparency

Comment Summary: The commenters state that CARB's outreach efforts for ACF have been insufficient and suggest that CARB post a list of affected stakeholders on their website to improve outreach.

Commenter: [253-45d]

Agency Response: No changes were made in response to these comments. The Regulation is the result of an extensive four-year public process and nearly all public meetings were held online and recorded. CARB is committed to a rigorous outreach effort which will ensure regulated fleets are educated on their requirements. Posting a list of affected stakeholders in not necessary because the Regulation already provides a platform for fleets through the ZEV Fleet Recognition provision.

b) Periodic Review of Regulatory Implementation Needed

Comment Summary: The commenters suggest that the Board should revisit the progress of Regulation implementation periodically, such as biennially, and include market assessment, infrastructure cost and development, ZEV cost, TCO, vehicle availability, supply chain, and other business impacts in collaboration with stakeholders. They also request that CARB assess the number and type of exemptions used annually and consider future amendments. Moreover, the commenters request that CARB and CEC track the development of California's capacity to power and support the ZEVs resulting from ACF and ACT implementation, develop publicly available real-time data on whether charging infrastructure construction is on pace to meet ZEV needs, and modify the rules if the tracking data shows that infrastructure cannot support ZEVs deployed by ACT and ACF. They also call for CARB, CEC, and CPUC to work closely with utilities and fleet customers to ensure providers can provide the energy and infrastructure needed.

Commenter: [008-45d, 031-WT1, 200-45d, 207-45d, 209-45d, 239-45d, 255-45d, 296-45d, 342-45d]

Agency Response: No changes were made in response to these comments. CARB staff plan to assess various aspects of the Regulation in collaboration with stakeholders during implementation. On September 22, 2022, CARB approved the 2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy), which identifies the State’s control strategy for meeting the federal 70 parts per billion, 8-hour ozone standard over the next 15 years. The Zero-Emissions Truck Measure, as part of the 2022 State SIP Strategy, seeks to accelerate the number of ZE trucks beyond existing measures (including the ACF Regulation as noted in Chapter 5). The 2022 State SIP Strategy is a statewide planning document that identifies the strategies and controls under State authority that are needed to reduce emissions to reduce ground-level ozone. This level of action is needed to ensure federal air quality standards are attained and to deliver on CARB commitments to protect public health, particularly considering the growing body of evidence on the adverse impacts of air pollution. This measure would potentially be heard by the Board in 2028 and would be a significant step in the comprehensive strategy to achieve ZE medium- and heavy-duty vehicles everywhere feasible by 2045. For this measure, staff would implement regulatory strategies to achieve the goal of transitioning the remainder of the heavy-duty combustion fleet to ZE trucks.

c) Additional Public Process Needed Prior to Board Approval

Comment Summary: The commenters express process concerns and request additional workshops, Board hearings, and public comment periods before adopting the ACF Regulation at the October 27 hearing. They emphasize the importance of CARB collaborating with other agencies in developing the Regulation and responding in writing to public comments received outside the formal rulemaking period. The commenters also suggest that CARB should work with fleet managers, who are experts in fleet management, to develop improvements to regulatory provisions. They highlight the need for significant outreach to inform stakeholders about the Regulation and their compliance requirements, as well as engaging and addressing environmental justice communities. Lastly, the commenters request an additional public process before making a draft and 45- day notice.

Commenter: [011-OT1, 022-OT1, 035-OT1, 087-OT1, 127-OT1, 130-OT1, 139-OT1, 143-45d, 207-45d, 321-45d, 322-45d]

Agency Response: No changes were made in response to these comments. Outreach was extensive and CARB is committed to a continuous outreach effort which will ensure regulated fleets are educated on their requirements. Staff worked with fleet managers and representatives for four years over the course of regulatory development, including engaging environmental justice communities. In addition to the ACF ISOR, released for a 45-day public comment period prior to the October 27, 2022, Board hearing, written and oral testimony at that hearing were also accepted as being received during the public comment period. During the rulemaking process, CARB staff met with communities in evenings and nearly all public meetings were recorded and held online. CARB staff have also been closely coordinating with CEC, CPUC, GO-Biz, and other agencies during the development of this Regulation. These meetings and stakeholder coordination have enabled CARB staff to look at options for "clean energy" based on a thorough scientifically based assessment of technology and cost-effectiveness.

In addition to the numerous workshops, workgroups, and other meetings held prior to the October 2022 Board hearing, an additional workshop and two workgroup meetings were held after the October 2022 Board hearing. In preparation for a second Board hearing on April 27, 2023, CARB staff provided a rulemaking package with significant updates based on stakeholder input, for a 15-day public comment period from March 23, 2023, to April 7, 2023. Staff are reorienting our current outreach team to inform stakeholders of new requirements such as the ACF Regulation and the HD I/M Regulation. CARB is obligated to respond in writing to all comments received, including commenter's oral and written testimony at Board hearings, during the open formal comment periods, and is doing so in this FSOR.

d) Additional Discussion Requested on Sections 2015(f), 2015(g), and 2015.4(d)

Comment Summary: Commenter states additional discussion on section 2015(f) Controlling Party Compliance Requirements, Section 2015(g) Corporate Joint Compliance Option, and Section 2015.4(d) Corporate Joint Compliance Reporting is warranted given their complexity.

Commenter: [207-45d]

Agency Response: No changes were made in response to these comments. Commenter has not raised specific concerns about sections in workshops, workgroups, or individual meetings, and commenter's letter does not specify specific issues with the provisions other than mentioning their complexity. The Regulation provides sufficient flexibility while retaining necessary compliance requirements to achieve the goals of the Regulation.

e) Request for Implementation Issues Database

Comment Summary: The commenters request that CARB create an "issues database" for companies to report charger issues, manufacturer delivery delays, problems with certain ZEVs or hardware, and other issues that could affect other fleets.

Commenter: [342-45d]

Agency Response: No changes were made in response to these comments. There is no need for the Regulation team to include language about a tracking database; staff will continue to collect and track information about ZEVs, infrastructure developments, and issues reported by fleets internally to track implementation of CARB's portfolio of ZE incentives and share with the Regulation team as part of research and development for future rulemakings.

22. Funding and Incentive Program Issues

a) Clarify Funding Programs that Generate Early Action Credits

Comment Summary: The commenters suggest adding clarification in the Regulation for which funded vehicles would be eligible for early action credits by providing a list of grants or incentive programs allowed to generate early action credits.

Commenter: [207-45d]

Agency Response: No changes were made in response to these comments. The Regulation already has a provision specifying that the individual funding program guidelines would determine whether funded vehicles would be eligible in determining compliance with the Regulation. If the vehicles are allowed to be used for determining compliance, the early action credits would also apply to such vehicles. Funding program information is available on CARB's website and through local air districts.

b) Accelerate the Clean Transportation Program

Comment Summary: The commenters request that the pace of grant funding under the Clean Transportation Program be accelerated, as the current pace is too slow to support clean vehicle deployment.

Commenter: [021-OT1]

Agency Response: No changes were made in response to these comments. Funding policy decisions are addressed by the funding programs and are not part of the regulatory process for this Regulation.

c) Funding for Individual Truckers

Comment Summary: The commenters stress the need for funding for each individual trucker to enforce the Regulation.

Commenter: [138-45d]

Agency Response: No changes were made in response to these comments. Funding is available for small fleets and independent owner/operators through HVIP and the Volkswagen Environmental Mitigation Trust for California, with HVIP offering enhancements to fleets with 10 or fewer trucks. Additionally, it would be unreasonable to require funding for each individual trucker to enforce the ACF Regulation.

d) Funding for Fleets Burdened by Coronavirus Disease 2019

Comment Summary: The commenters request funding for fleets financially burdened by COVID-19 to support incremental vehicle acquisition costs and infrastructure installation costs.

Commenter: [223-45d]

Agency Response: No changes were made in response to these comments. CARB regularly reevaluates incentive levels in the context of current conditions to ensure that programs are effectively addressing barriers to adoption. Recent adjustments to HVIP incentive amounts reflect many of the factors that have affected truck prices over the past three years. Additionally, funding policy decisions are addressed by the funding programs and are not part of the regulatory process for this Regulation.

e) Funding for Cities

Comment Summary: The commenters state that cities will need funding assistance because most granting organizations require EV charging infrastructure to be publicly accessible, which is problematic for secure facilities like police buildings.

Commenter: [330-45d]

Comment Summary: The commenters state that CARB should provide funding to cities for the necessary backbone infrastructure upgrades resulting from the Regulation.

Commenter: [294-45d, 330-45d]

Agency Response: No changes were made in response to these comments. CARB, CEC, and CPUC are coordinating to ensure infrastructure needs across the state are adequately supported. Investor-owned utilities are authorized under CPUC Regulation to cover rate base the cost of grid upgrades to support transportation electrification.

f) Funding for Charging Infrastructure at Port Entries

Comment Summary: The commenters suggest that CARB ensure funding programs are available to build public charging infrastructure at essential port entries.

Commenter: [150-45d]

Agency Response: No changes were made in response to these comments. CARB, CEC, CPUC, and utilities are coordinating to ensure infrastructure needs across the state are adequately supported. In addition, as required under SB 671, CTC is working with these entities and other stakeholders to identify priority freight corridors, or segments of corridors, and the infrastructure needed to support the deployment of medium- and heavy-duty ZEVs. This Clean Freight Corridor Efficiency Assessment is due December 1, 2023. CEC is currently seeking comment regarding a future Grant Funding Opportunity for public heavy-duty ZEV infrastructure that will target station funding along the corridors identified in this assessment.

g) Equity-Based Funding Policies

Comment Summary: The commenters ask for funding policies to be equity-based, considering region, vulnerable populations, and company size to address small and medium Hispanic operators.

Commenter: [001-45d]

Agency Response: No changes were made in response to these comments. Funding policy decisions are addressed by the funding programs and are not part of the regulatory process for this Regulation.

h) Stakeholder and Air District Funding Collaboration

Comment Summary: The commenters request that CARB continue collaborating with stakeholders to review the State incentives portfolio and adjust eligibility requirements to make programs complementary. They also encourage CARB to work with local air districts to implement adequate funding, incentives, and Carl Moyer program updates to support the ACF Regulation.

Commenter: [154-45d]

Agency Response: No changes were made in response to these comments. CARB maintains close collaboration with its air district partners to coordinate incentives managed by State and local entities and improve outcomes.

i) Maximize Opportunities to Leverage Federal Funds

Comment Summary: The commenters request increased collaboration between CARB, CEC, CTC, GO-Biz, University of California, and Army Corps of Engineers to maximize opportunities to leverage federal funds, ensuring success in launching the hydrogen goods movement and vocational fleets with the support they need to be comfortable in transition, and that incentive programs are designed and updated for the success of its rapidly changing programs.

Commenter: [012-WT1, 207-45d]

Agency Response: No changes were made in response to these comments. Funding policy decisions are addressed by the funding programs and are not part of the regulatory process for this Regulation. CARB aims to maximize the accessibility and effectiveness of its incentive programs, including allowing stacking of different sources in many cases.

j) Funding for Fuel Cell Electric Vehicles and Infrastructure

Comment Summary: The commenters state that funding should support hydrogen fueling infrastructure equitably, with funding carve-outs for FCEVs in agency-administered purchase programs, and increased investments in hydrogen fueling infrastructure. They suggest creating a FCEV-specific set-aside for the HVIP and Carl Moyer programs.

Commenter: [012-WT1, 102-OT1, 317-45d]

Agency Response: No changes were made in response to these comments. There are currently several FCEVs eligible for funding through HVIP on a first-come, first-served basis, with incentive enhancements and flexibilities specific to fuel cell technology. In addition, CEC's EnergIIZE has a funding lane specifically for hydrogen infrastructure for transit buses and commercial vehicles. Funding allocated to CEC for this program, which also includes funding for commercial vehicle charging infrastructure, is determined annually.

k) Funding for Infrastructure

Comment Summary: The commenters state that ZEV infrastructure costs are an unfunded requirement, urging CARB to incentivize and streamline the creation of necessary infrastructure. They recommend increased funding for public charging infrastructure, rebates for private fleet chargers, and funding for cross-border public ZEV fueling stations.

Commenter: [001-45d, 041-OT1, 147-45d, 158-45d, 296-45d]

Agency Response: No changes were made in response to these comments. While funding for ZEV infrastructure in California flows primarily through CEC, CARB and CEC collaborate closely through HVIP and EnergIIZE to link vehicle purchases to infrastructure funding. CARB and CEC also participate in joint efforts through SB 671 (requires the preparation of a Clean Freight Corridor Efficiency Assessment that assess infrastructure needs along freight corridors to support the deployment of commercial ZEVs), and SB 643 (requires preparation of a statewide assessment of hydrogen fueling infrastructure and fuel production needed to support the adoption of fuel cell trucks). The findings of these assessments will help guide future charging and hydrogen infrastructure investments.

As stated in the Chapter I.G.1.c of the ISOR, cross-border commerce is an important part of the economies of both Mexico and California. In addition, the two border crossings, one in Otay Mesa and one in Calexico, lie on or near the major East/West and North/South goods movement corridors of Interstate 8 and Interstate 5, respectively. Given the needs for infrastructure at these locations, CARB staff has worked with the Otay Mesa Chamber of Commerce, as well as other State agencies, including, GO-Biz, CPUC, CEC, CalTrans, with the San Diego Area Governments local planning agency, on possible assistance and solutions, including discussions of available funding for infrastructure in the area.

l) List Funding Sources

Comment Summary: The commenters request that CARB develop a list of public funding sources to help public agency fleets navigate and confirm funding eligibility for new ZEV/NZEV purchases.

Commenter: [014-45d]

Agency Response: No changes were made in response to these comments. CARB worked with partners to create a comprehensive tool, fundingfindertool.org, to help fleets of all kinds find assistance.

m) Funding for Local Government Fleets

Comment Summary: The commenters express concerns about funding assistance for cities, as most granting organizations require EV charging infrastructure to be publicly accessible, which is incompatible with secure facilities. They ask the Board to consider additional funding for local governments affected by the Regulation, as traditional budgeting processes do not cover high upfront infrastructure costs.

Commenter: [032-WT1, 294-45d]

Agency Response: No changes were made in response to these comments. HVIP offers the full voucher amount to public fleets and reduced voucher amounts for private fleets above a certain size. Funding for infrastructure is offered through CEC. Additionally, funding policy decisions are addressed by the funding programs and are not part of the regulatory process for this Regulation.

n) Provide Funding for Advanced Clean Fleets

Comment Summary: The commenters emphasize the need for CARB to provide funding to make the Regulation feasible, stating that programs like HVIP and LCFS should be increased without restricting them to small fleets only. They highlight the importance of substantial financial assistance to lower vehicle purchasing costs and achieve price parity for businesses, particularly during the initial phases of ACF implementation. Additionally, the commenters mention the need for complementary measures to ensure adequate infrastructure and incentives, such as the HVIP, are made available. They argue that since the Regulation creates a framework for an entire energy transition in the truck market, grants are necessary to advance the marketplace.

Commenter: [030-WT1, 104-45d, 120-OT1, 147-45d, 172-45d, 207-45d, 230-45d, 296-45d, 329-45d, 335-45d]

Agency Response: No changes were made in response to these comments. Funding policy decisions are addressed by the funding programs and are not part of the regulatory process for this Regulation. To align with the requirements of ACF and avoid paying for compliance, HVIP incentives remain available for fleets of all sizes until January 1, 2024, after which private fleets with 50 medium- and heavy-duty vehicles or fewer will be eligible for HVIP. Public entities and California Native American tribal governments will not be subject to the fleet size limit. New-to-market technologies such as FCEVs will not be subject to the fleet size limits until they receive a higher degree of market penetration. For small businesses requiring the greatest support, higher incentives are available through HVIP and ISEF. CEC, CPUC, and California utilities continue collaboration to provide financial and non-financial assistance to help fleets deploy the infrastructure they need.

o) Incentives for Scrapped Vehicles

Comment Summary: The commenters request incentives for fleets to scrap retired ICE vehicles, to help achieve permanent emissions reduction. They acknowledge small businesses' reliance on the second-hand market and ask the Board to work with staff to evaluate the pros and cons of this approach.

Commenter: [342-45d]

Agency Response: No changes were made in response to these comments. Some incentive programs, including the Volkswagen Environmental Mitigation Trust and the Carl Moyer Program, require vehicle scrappage. Funding policy decisions, such as evaluating the outcomes of incentivizing the scrappage of ICE vehicles, are addressed by the funding programs and are not part of the regulatory process for this Regulation.

p) Incentives for ZEVs Used for Business and Personal Use

Comment Summary: The commenters suggest that government incentives for shared ZEVs for business and personal use could expose more businesses and individuals to the technology during rental experiences.

Commenter: [002-WT1]

Agency Response: No changes were made in response to these comments. Through programs like ISEF and Advanced Technology Demonstrations and Pilots, CARB is working with technology and truck-as-a-service providers to expand options for fleets to access ZE technology at low cost and low risk.

q) Funding for Small Fleets

Comment Summary: The commenters argue that incentives like the IRA do not offset higher upfront costs for small, independent owner-operators, as they benefit larger truckers and companies with greater access to capital. They claim that competitive grants and complex applications disadvantage smaller fleets.

Commenter: [223-45d, 313-45d]

Agency Response: No changes were made in response to these comments. CARB is aware of the increased challenges faced by small fleets and owner-operators in the transition to ZEVs. Using a community-driven approach, CARB crafted and launched a new program within HVIP, ISEF, that specifically addresses the needs of small fleets and owner-operators with higher incentives, additional flexibilities, and wrap-around support. Simultaneously, HVIP standard is evolving to focus more on small business with higher incentives and reduced incentive access for large fleets. Both HVIP and ISEF are founded on principles of simplicity and easy access for purchasers.

23. Miscellaneous Issues

a) General Support

Comment Summary: Commenters support the Regulation as is.

Commenter: [009-WT1, 012-45d, 027-WT1, 041-WT1, 057-OT1, 066-45d, 096-OT1, 097-OT1, 113-45d, 142-OT1, 154-45d, 208-45d, 306-45d, 307-45d, 317-45d, 343-45d, 348-45d]

Agency Response: No changes were made in response to these comments. Thank you for your comments.

b) General Opposition

Comment Summary: The commenters generally oppose the Regulation.

Commenter: [201-45d, 315-45d]

Agency Response: No changes were made in response to these comments. Thank you for your comment.

c) Environmental Justice Efforts

Comment Summary: The commenters contend that the Regulation inadequately considers impacts on disproportionately affected communities, environmental justice, and land-use policies. They argue that increased costs in the goods movement sector or electricity will harm vulnerable or low-income communities, while the Regulation may lead to continued diesel use over cleaner technologies. They claim the Regulation could be called the "Default to Diesel" rule, as ZEV truck deployment has been slow, potentially resulting in health issues for children in affected areas.

Commenter: [019-WT1, 020-WT1, 021-45d, 022-45d, 027-45d, 033-45d, 038-45d, 039-45d, 041-45d, 045-OT1, 046-OT1, 050-OT1, 051-OT1, 052-OT1, 054-OT1, 055-OT1, 056-OT1, 057-45d, 059-OT1, 117-45d, 122-OT1, 136-OT1, 143-OT1, 165-45d, 184-45d, 188-45d, 189-45d, 190-45d, 194-45d, 204-45d, 228-45d, 249-45d, 259-45d, 265-45d, 268-45d, 295-45d, 304-45d, 328-45d, 331-45d]

Agency Response: Changes were made in response to these comments. As part of the 15-day changes, the Regulation was modified to require that California certified engines be purchased when ZEV exemptions are granted. California engine standards are the most stringent in the nation and apply to all fuel types. For this reason, the commenter is incorrect in asserting the Regulation may lead to continued use of diesel over cleaner technologies. ZEVs are the cleanest technology as they have no tail pipe emissions, they result in additional GHG emissions reductions and are considerably more efficient than ICE vehicles. The Regulation targets reductions at ports and railyards which are typically located near, in, or around disadvantaged and low-income communities. These communities bear a disproportionate health burden due to their close proximity to ICE vehicle emissions. The Regulation ensures that the lowest emitting medium- and heavy-duty vehicles are phased in while older ICE vehicles are phased out. It builds on the efforts already made by the Board requiring inspection and maintenance for existing medium- and heavy-duty ICE vehicles. In addition to drayage applications, ZEV deployment would occur in other freight sectors and services where medium- and heavy-duty vehicles are deployed. Distribution centers, warehouses, and major roadways are commonly located around more densely populated urban areas, including in low-income and DACs. Additional information on the benefits of this Regulation to DACs is described in Chapter IV.F. of the ACF ISOR.

In recognition that air pollution heavily impacts DACs in California, AB 617 places additional emphasis on protecting such communities by requiring new community-focused and community-driven action to reduce air pollution and improve public health in areas that experience disproportionate burdens from exposure to air pollutants. Additional information on the environmental justice efforts of the Regulation is described in Chapter VII. of the ACF ISOR.

d) Delay the Approval of the Advanced Clean Fleets Regulation

Comment Summary: The commenters state that CARB should postpone the Regulation due to various reasons, such as conducting further analysis, gathering more information, allowing advancements in technology and infrastructure, waiting for economic recovery, and facilitating necessary grid upgrades.

Commenter: [004-45d, 008-45d, 019-45d, 030-OT1, 054-45d, 060-45d, 063-45d, 063-OT1, 067-45d, 069-45d, 072-45d, 074-45d, 075-45d, 080-45d, 083-45d, 084-45d, 085-45d, 088-45d, 092-45d, 093-45d, 094-45d, 096-45d, 101-45d, 102-45d, 104-45d, 105-45d, 106-45d, 107-45d, 121-45d, 132-45d, 134-45d, 141-45d, 142-45d, 144-45d, 148-45d, 149-45d, 158-45d, 162-45d, 219-45d, 286-45d, 292-45d, 313-45d, 321-45d, 345-45d]

Agency Response: No changes were made in response to these comments. To meet various statutory goals, the Governor's goals, and other emissions reduction requirements, it is necessary to achieve these reductions as soon as possible. Sufficient economic, technological feasibility, infrastructure, and emissions analysis were conducted to support the Regulation timeframe and structure, and appropriate exemptions or extensions are included to address edge cases and provide flexibility. The Regulation timeframe was carefully balanced with achieving needed emissions reductions with a feasible phased-in timeframe for fleets. Delaying approval and implementation of the Regulation would result in reduced health and economic benefits and increase the burden of compliance on fleets to meet the same end goals in a more compressed timeframe.

e) Delay Start Date of the Regulation for High Priority and Federal, State, and Local Government Fleets

Comment Summary: The commenters request that the proposed start date of both HPF and SLG Regulations should be delayed by three years from final approval, allowing for adequate planning, budgeting, and procurement of vehicles and infrastructure.

Commenter: [297-45d]

Agency Response: No changes were made in response to these comments. To reach the various health and climate goals set by the Legislature and the Governor, all medium- and heavy-duty vehicles in California must be ZE by 2045 for all operations where feasible and by 2035 for drayage trucks. Delaying the initial deadlines of the Regulation for any fleets, High Priority or Government, would result in reduced health and economic benefits and increase the burden of compliance on fleets to meet the same end goals in a more compressed timeframe.

f) Expand Low-Carbon Fuel Standards Program

Comment Summary: The commenters suggest that CARB should use and expand the LCFS program to achieve the Regulation's goals rather than require ZEVs, arguing that the timeline is too aggressive and ACF would be less effective at reducing carbon emissions.

Commenter: [055-45d]

Agency Response: No changes were made in response to these comments. The LCFS Regulation is complementary to this Regulation, but outside the scope of this rulemaking. Please see response to comments in Chapter IV.3 on Alternative Fuels and Combustion Vehicles for a detailed response.

g) Fleet Challenges for Transitions While Operation Both Internal Combustion Engine Vehicles and Zero-Emissions Vehicles

Comment Summary: The commenters highlight that the Regulation doesn't address the challenges faced by private and public fleets while transitioning to 100 percent ZEVs, particularly the need to operate dual fleets of both ICE vehicles and ZEVs during the transition period.

Commenter: [252-45d]

Agency Response: No changes were made in response to these comments. The Regulation intends to alleviate difficulties fleets may face during the transition process by allowing public and private fleets certain flexibilities when determining their compliance path. The Regulation includes provisions that allow regulated fleets to apply for various extensions and exemptions to better enable compliance with the Regulation.

h) Strengthen the Regulation

Comment Summary: The commenters request stronger Regulations to reduce air pollution and address emission concerns, particularly for disadvantaged communities. They support an accelerated timeline for ZEVs, recommend reducing the compliance threshold, and urge CARB to fully understand lost emissions benefits with exemptions and delays in the ACF Regulation.

Commenter: [037-OT1, 043-OT1, 044-OT1, 047-OT1, 050-OT1, 051-OT1, 054-OT1, 059-OT1, 062-OT1, 065-OT1, 068-OT1, 350-45d]

Agency Response: Changes were made in response to these comments. Staff have modified the original proposal to move the 100 percent sales requirement to 2036 as part of the ACF 15-day changes. This acceleration is expected to contribute to faster adoption of ZEVs and reduce emissions, particularly in disadvantaged communities.

No changes were made to fleet size for tractors to 10 because the initial upfront cost to purchase ZEV is higher than for ICE vehicles. Changes were not made due to the initial upfront costs associated with ZEVs being higher than those of ICE vehicles. The approximately 4,000 smaller fleets impacted typically have limited access to capital and are more likely to purchase used vehicles. Additionally, retail infrastructure for ZEVs is currently limited in availability. We believe that the timing is crucial; once a robust secondary market for ZEVs is established by the end of this decade, smaller fleets will be better positioned to transition to ZEVs. Staff plans to present a Zero-Emissions Truck Measure to the Board in 2028. This measure will evaluate various strategies that could facilitate a smoother and more equitable transition to ZEVs for the owners of the remaining 61,500 tractors regulated. For more information, please refer to the February 10, 2023, Memorandum to the Board.[189]

No changes were made to accelerate HPF Milestone Schedule for Group 3 to start in 2027. As previously mentioned, this increase in ZEVs will create a misalignment between manufacturer sales and fleet purchase requirements shifting ZEV deployments towards a

[189] CARB, Executive Officer Memo to Board - Advanced Clean Fleets Regulation High Priority Fleet Size Analysis, 2023 (web link: https://ww2.arb.ca.gov/sites/default/files/2023-02/HPF%20Fleet%20Size%20Board%20Memo_ADA.pdf, last accessed March 2023).

demand-based market which may increase cost. The ZEV market for Group 3 vehicles is expected to take the longest to develop and tractors in this category are more likely to be involved in regional or long-haul operations that will depend on a widespread regional ZEV fueling and charging network.

To address the concern about lost emissions benefits with exemptions and delays, CARB has made efforts to minimize exemptions and ensure that any delays are justified by market and infrastructure readiness. CARB will continue monitoring the progress of ZEV market development and infrastructure expansion and will consider adjustments to the regulatory framework as needed to maximize emissions benefits.

i) Limit Regulatory Scope to Delivery Trucks with Set Routes

Comment Summary: The commenter recommends focusing the Regulation on the high percentage of delivery vehicles operating in California, particularly light to heavy-duty logistics trucks, such as box trucks, vans and pick-ups, which have set routes.

Commenter: [058-45d]

Agency Response: No changes were made in response to these comments. The Regulation needs to achieve reductions from all transportation sectors to meet the ZEV goals outlined in the Governor’s Executive Order N-79-20. To reach the various health and climate goals set by the Legislature and the Governor, all medium- and heavy-duty vehicles in California must be ZE by 2045 for all operations where feasible and by 2035 for drayage trucks. The statement this commenter made is substantially similar to an alternative discussed in the ACF ISOR. See rationale for why this approach was rejected in Chapter IX, section B. 6. of the ACF ISOR.

j) Regulation Not Feasible

Comment Summary: The commenters argue that the ACF Regulation could be unworkable in real-world situations, potentially leading to various negative impacts on industries, the economy, disadvantaged communities, and other areas. They imply that the Regulation may need adjustments or reconsideration to prevent unintended consequences. In addition, one commenter representing a refuse/waste fleet states that the Regulation is not feasible as they cannot comply with the fleet conversion timelines.

Commenter: [011-OT1, 025-WT1, 045-45d, 047-45d, 050-45d, 051-45d, 055-45d, 064-45d, 072-45d, 075-45d, 080-45d, 092-OT1, 093-OT1, 121-45d, 132-45d, 139-OT1, 143-45d, 148-45d, 149-45d, 165-45d, 177-45d, 178-45d, 207-45d, 251-45d, 252-45d, 259-45d, 278-45d, 279-45d, 339-45d, 344-45d]

Agency Response: No changes were made in response to these comments, except for the one relative to refuse/waste trucks. The Regulation is workable because it is phased-in over a 20-year timeframe and contains appropriate exemptions and extension provisions to address edge-case scenarios. Staff have worked closely with stakeholders over numerous public and private meetings to develop a workable solution. Finally, the Regulation is necessary to reduce health and climate impacts of associated combustion pollution.

Changes were made in response to the comment regarding refuse/waste trucks. Many waste trucks have a GVWR greater than 33,000 pounds and a heavy front axle, which qualifies them as a Specialty Vehicle in the Regulation. Specialty Vehicles are listed in Group 3 of the ZEV

Milestone compliance option and the initial deadline for that Group is not until 2030. Exemptions and extensions are also available as part of that compliance path. Lastly, since the ACF ISOR was released, the Board provided direction for staff to recognize the statutory compliance obligations for some waste and wastewater fleets to mitigate methane by diverting organics from landfills, and to provide more time for these fleet's transition to ZEV. A new provision that allows waste and wastewater fleets to delay their ZEV transition until 2030 was added to allow these fleets to continue to utilize their CNG combustion fleets and run them on biomethane.

k) Regulation Not Feasible – U.S. Postal Service

Comment Summary: The commenters argue that it is not possible for interstate Postal Service transportation to comply with the current Regulation.

Commenter: [105-OT1, 228-45d]

Agency Response: No changes were made in response to these comments. The postal service has one of the most suitable fleets for electrification. The Regulation includes the ZEV Milestones Option which is phased in based on vehicle suitability, and fleet owners can meet those targets with any vehicles they want. They could transition short distance vehicles in the near-term and delay the long-haul vehicles until a later time, when infrastructure is expected to be available for long-distance travel. If the distances they travel exceed what available ZEVs can achieve during a given day, there is a Daily Usage Exemption that can provide compliance relief. Commenter can install infrastructure in their owned facilities to facilitate nationwide. No explanation is provided for how the ZEV Milestones Option would degrade nationwide Postal Service standard and is a speculative comment that is not likely to occur.

l) Regulation Not Feasible – Rental Fleets

Comment Summary: The commenter suggests that CARB should avoid fleet mandates for "shared mobility fleets," as a full range of fuel types and powertrains are necessary to serve customers' mobility needs. Fundamentally, the continued ability to rent an ICE medium- or heavy-duty truck offers the logistical security for businesses and consumers that seek to purchase a ZE truck for their everyday use. Those businesses know that if they need to go into areas where charging infrastructure is deficient; need a larger capacity truck; or have other unique needs that cannot be met by a ZEV, traditional medium- and heavy-duty shared vehicles will still be available for their short-term use. They emphasize that existing shared service vehicles will typically be the cleanest and having different powertrain options allows fleets to use conventional vehicles in roles ZE trucks cannot service and a multi-fuel approach will better meet California's emissions goals.

Commenter: [002-WT1]

Agency Response: No changes were made in response to these comments. Rental fleets may continue to offer a full range of fuel types and power trains as the regulatory deadlines and exemptions and extensions allow. To reach the various health and climate goals set by the Legislature and the Governor, all medium- and heavy-duty vehicles in California must be ZE by 2045 for all operations where feasible and by 2035 for drayage trucks.

m) Regulation Not Feasible – Useful Life Option

Comment Summary: The commenter claims that 2010 trucks were supposed to be fully compliant under the Truck and Bus Regulation and with an 800,000-mile limit under the minimum useful life definition, they will not be usable.

Commenter: [053-45d]

Agency Response: No changes were made in response to these comments. In 2017, the Legislature passed SB 1. Part of this bill established the "useful life provision," (California Health and Safety Code §43021), which provides that any laws or Regulations adopted or amended after January 1, 2017, cannot require the retirement, replacement, retrofit, or repower of commercial motor vehicle until the later of the following:

a) Thirteen years from the model year that the engine and emission control system are first certified for use in the vehicle; or

b) The vehicle reaching either 800,000 vehicle miles traveled or 18 years from the model year of the engine and emission control system are first certified for use in the vehicle, whichever is earlier.

CARB must implement the Regulation consistent with SB 1 and the Legislature's definition of "useful life," and has structured the ACF Regulation's provisions to be fully consistent with the useful life provisions of SB 1.

The different compliance paths provided in the Regulation offer potential benefits for a given fleet situation. The "Model Year Schedule" ensures fleets can use their vehicles for their full "useful lives," is simple to understand, but it treats all existing vehicles the same based on age and mileage. This compliance path may present challenges for fleets, with high turnover rates (such as long-haul fleets), fleets with most vehicles already beyond their useful life, and would limit the ability of controlling parties to manage their fleet. The Model Year Schedule allows for a gradual transition to the ZEV requirements based on a percentage of the total California fleet regardless of vehicle age and mileage. The schedule more closely aligns projected ZEV feasibility and infrastructure buildout with the compliance requirements. However, the "ZEV Fleet Milestone option" provides more flexibility for controlling parties to add and remove vehicles from the California fleet provided the fleet average continues to be met. Regardless of the compliance path chosen, the emissions reductions achieved from the implementation of the ACF Regulation are required to reach the health and climate goals set by the Legislature and the Governor, that all medium- and heavy-duty vehicles in California must be ZE by 2045 for all operations where feasible and by 2035 for drayage trucks.

n) Align Advanced Clean Fleets and the U.S. Environmental Protection Agency's Regulations Regarding Tailpipe Emissions

Comment Summary: The commenters state that they appreciate ACF's stable requirements and encourage CARB to align with U.S. EPA tailpipe Regulations to lower the burden on businesses. They also suggest coordinating and harmonizing final regulatory provisions with national programs developed by the U.S. EPA to benefit supplier investments in various propulsion technologies.

Commenter: [234-45d, 247-45d, 281-45d]

Agency Response: No changes were made in response to these comments. CARB has been, and continues to, coordinate with U.S. EPA to align federal standards as much as possible with CARB standards. However, California needs to achieve the greatest degree of emissions reductions from criteria pollutants and GHGs to reduce the serious risks to the health and welfare of Californians posed by such pollutants, to attain State and federal ambient air quality standards, and to address climate change-induced harms and carbon neutrality goals. ZEVs have no tailpipe emissions and have lower PM emissions from reduced brake wear than even the cleanest ICE vehicles and the transition to ZEVs is a critical component of reducing emissions to the greatest extent possible. California continues to experience some of the worst air quality in the nation. The South Coast and San Joaquin Valley Air Basins are designated as extreme non-attainment with the ozone NAAQS areas while seven other areas are in serious or severe non-attainment with the ozone NAAQS. For California to achieve federally mandated NAAQS and provide clean air for all Californians, more must be done, especially in overburdened communities.

o) Align Advanced Clean Fleets with Advanced Clean Trucks

Comment Summary: The commenters recommend that CARB align ACF ZEV fleet percentages with the manufacturer production and sales percentages required by ACT. They suggest that ACF should be revised to align with ACT, including timing, quantity, treatment of NZEVs, and types of ZEVs. The commenters request that CARB harmonize the ACF vehicle categories with the weight classes adopted in ACT, apply the same weight class modifiers in ACT to ZEV additions for ACF credits, and not allow fungibility between vehicle categories in ACF, in alignment with ACT. They suggest modifying ACF so that the ZEVs purchased are eligible for ACT credit because a fleet owner may choose to avoid ZEP Certification required by ACT by purchasing or registering the vehicle out of state.

Commenter: [147-45d, 161-OT1, 234-45d, 253-45d, 255-45d]

Agency Response: No changes were made in response to these comments. The ACF Regulation will result in more ZEVs being sold than the ACT Regulation requires, and therefore it would be counterproductive to meeting the goals of both Regulations by reducing requirements of either Regulation. The commenter's proposal would add significant complexity to the Regulation for little gain. To reach the various health and climate goals set by the Legislature and the Governor, all medium- and heavy-duty vehicles in California must be ZE by 2045 for all operations where feasible and by 2035 for drayage trucks. Additionally, the commenters' proposal would add more difficulty in fleet management, as removing fungibility between vehicle weight classes would significantly reduce fleet choice and flexibility. This flexibility was included in the Regulation intentionally and this proposal would lead to disparate consequences for fleets that innately have the flexibility to manage such complexity against those that do not.

p) Scoping Plan Alignment

Comment Summary: The commenters claim that there may be some misalignment between the requirements of ACT and ACF Regulations and the current modeling of expected heavy-duty ZEV sales being conducted to support the updated Scoping Plan. Additionally, the commenters urge CARB to revisit ACT and ACF targets if FCEVs are later found to be gaining in sales and performance metrics faster than expected today.

Commenter: [303-45d]

Agency Response: No changes were made in response to these comments. The commenter is incorrect; the projections of ACF and ACT are in fact consistent with the Scoping Plan scenarios; however, the Scoping plan shows more needs to be done beyond these Regulations. The commenters present a time series chart from 2024 to 2045 showing the percentage of heavy-duty vehicle sales from CARB's 2022 Scoping Plan Alternative 3 scenario for BEVs overlayed with two other scenarios from the ACF ZEV Milestones Option schedule and ACT to support this claim. The commenters only included the BEV purchase projections in the figure and omitted the FCEV purchase projections which were at 60 percent share of the heavy-duty sector by 2050, according to the Scoping Plan modeling scenario 3. The Scoping Plan is designed to guide high-level policy decisions and is not a regulatory proposal. The ACF ISOR analysis shows that across all ACF sectors, 85 percent would be BEVs, and 15 percent would be FCEVs; however, these are fungible in the Regulation because either FCEVs or BEVs count as ZEV for compliance purposes. Regardless, the Board directed the Executive Officer to align ACT with the State SIP Strategy in the Resolution that requires more ZEVs than projected with existing regulations including ACF.

q) Enforcement

Comment Summary: The commenters request the inclusion of potential penalties and enforcement actions in the Regulation, questioning the feasibility of regulating fleets registered outside California but operated within the state. They ask for clarification on the practicality of enforcing the "operated in California" requirement and encourage CARB to remain consistent with other programs focusing on vehicles sold or registered in California.

Commenter: [005-45d, 228-45d, 234-45d]

Agency Response: No changes were made in response to these comments. To maintain a level playing field between trucks registered in California and trucks registered in other states, CARB’s Enforcement Division has a long history of conducting field inspections at border crossings and throughout the state. These inspections have been supplemented in recent years using Portable Emissions Acquisition Systems equipped with Automated License Plate Reader cameras that are deployed at border crossings and major thoroughfares. In addition, Automated License Plate Reader data collected from these sites identify which heavy-duty diesel vehicles are entering and operating in California. When an out-of-state fleet that is potentially noncompliant is identified, the case is pursued directly or referred to another agency for enforcement. CARB has an ongoing partnership with the U.S. EPA Region 9 to pursue investigations of fleets registered outside of California and identified as operating in California. These tools were used to effectively enforce the Truck and Bus Regulation, which applies to over one million vehicles that operate in California regardless of where they are registered. CARB has similarly developed a Memorandum of Understanding with environmental prosecutors’ offices in Southern California to pursue enforcement action against noncompliant out-of-state fleets that operate in their counties. In addition, the inclusion in the ACF Regulation of specific information regarding penalties and enforcement actions is not necessary as CARB’s enforcement authority and penalty determination is outlined in the Health and Safety Code and those sections are referenced in the ACF Regulation.

r) Supports Other Commenters – 214-45d

Comment Summary: Commenter supports comments made by MEMA.

Commenter: [214-45d]

Agency Response: The comments supported by the commenter are already summarized and responded to in other parts of this FSOR and do not require a different response here. See agency responses to commenter 234-45d.

s) Supports Other Commenters – 239-45d

Comment Summary: Commenter supports comments made by Western States Trucking Association, the San Diego Chapter of the Associated General Contractors, the California Caterpillar Dealers and the AGC of California.

Commenter: [239-45d]

Agency Response: The comments supported by the commenter are already summarized and responded to in other parts of this FSOR and do not require a different response here. See agency responses to commenters 334-45d, 104-45d, 048-45d, and 058-45d.

24. Out of Scope and Irrelevant Comments

a) Irrelevant

Comment Summary: Comment is off topic or irrelevant and not directed at ACF or to the procedures followed by the agency in proposing or adopting ACF.

Commenter: [001-45d, 012-WT1, 014-45d, 015-OT1, 021-OT1, 026-OT1, 033-WT1, 034-WT1, 039-WT1, 042-45d, 058-45d, 062-45d, 072-OT1, 095-45d, 097-45d, 134-OT1, 138-45d, 144-OT1, 160-45d, 162-45d, 166-45d, 211-45d, 215-45d, 221-45d, 239-45d, 241-45d, 247-45d, 264-45d, 281-45d, 316-45d, 322-45d, 323-45d, 342-45d]

Agency Response: No changes were made in response to these comments. Thank you for your comment. These comments are not directed at the ACF Regulation or the process by which it was adopted and therefore CARB is not required to respond.

b) Out of Scope - Advanced Clean Truck Regulation Exemptions

Comment Summary: The commenter recommends that CARB expand the exemptions in the ACT Regulation to align with ACF exemptions.

Commenter: [147-45d, 255-45d]

Agency Response: No changes were made in response to these comments. Thank you for your comment. These comments are not directed at the ACF Regulation or the process by which it was adopted and therefore CARB is not required to respond.

c) Out of Scope – Zero-Emissions Vehicle Credits in Advanced Clean Trucks Regulation

Comment Summary: The commenters request that CARB clarify the timing and transaction type for generating ZEV credits under the ACT Regulation, considering the sale of incomplete vehicles to upfitters and potential delays in credit generation.

Commenter: [147-45d, 255-45d]

Agency Response: No changes were made in response to these comments. Thank you for your comment. These comments are not directed at the ACF Regulation or the process by which it was adopted and therefore CARB is not required to respond.

d) Out of Scope – Zero-Emissions Vehicle Credits in Heavy-Duty Omnibus Regulation

Comment Summary: The commenters suggest that CARB reconsider ZEV credits in the HD Omnibus program for calendar year 2027+.

Commenter: [147-45d]

Agency Response: No changes were made in response to these comments. Thank you for your comment. These comments are not directed at the ACF Regulation or the process by which it was adopted and therefore CARB is not required to respond.

e) Out of Scope – Zero-Emissions Technology Battery Supply Chain

Comment Summary: The commenters suggest that ACF does little to encourage coordination with the private sector related to the five main battery supply chains, using the example of battery recycling rates and processing capacity in the United States.

Commenter: [334-45d]

Agency Response: No changes were made in response to these comments. These comments are not directed at the ACF Regulation or the process by which it was adopted and therefore CARB is not required to respond, nevertheless it is responded to here. The commenter shows that the Federal government is already establishing policy to protect the battery supply chain; this is not within the scope of the ACF Regulation and there is no reason this kind of policy would be established by the ACF Regulation.

f) Out of Scope - Amend Truck and Bus Regulation

Comment Summary: The commenters recommend modifying the existing Truck and Bus language to allow interstate fleets one-time access without registering and exempting vehicles operating less than 10 days per year in California from being counted as part of the California fleet.

Commenter: [109-45d, 230-45d]

Agency Response: No changes were made in response to these comments. Thank you for your comment. The final upgrade deadline in the Truck and Bus Regulation was January 1, 2023, and it is not part of the ACF Regulation. These comments are not directed at the ACF Regulation or the process by which it was adopted and therefore CARB is not required to respond. Notwithstanding that response, CARB did add a 5 day pass to the ACF Regulation to allow interstate fleets to operate any vehicle in California for up to 5 days once per year.

g) Out of Scope – Work Truck Project Team

Comment Summary: The commenters recommend that CARB establish a "work truck project team" to collaborate with stakeholders in addressing issues specific to the diverse category of "work trucks," such as availability, duty cycle, and other concerns.

Commenter: [266-45d]

Agency Response: No changes were made in response to these comments. Thank you for your comment. CARB is committed to working with stakeholders throughout the implementation stage of the Regulation on these key issues. This comments is not directed at the ACF Regulation or the process by which it was adopted and therefore CARB is not required to respond.

h) Out of Scope - Zero-Emissions Powertrain Certification Program

Comment Summary: The commenters request that CARB revisit the ZEP Certification program and Regulation to set performance standards for batteries and components used in electric trucks.

Commenter: [329-45d]

Agency Response: Thank you for your comment. This comment is not directed at the ACF Regulation or the process by which it was adopted and therefore CARB is not required to respond.

15-Day Comment Period Public Comments with Agency Responses

1. Cost Comments

a) Cost – Impacts of the Inflation Reduction Act

Comment Summary: Commenter states cost savings due to the IRA are speculative and uncertain as these assumptions assume the fleet owner is profitable, and that the Buy America requirements will prove challenging to infrastructure buildout and development per a cited article.

Commenter: [103-15d, 160-15d]

Agency Response: No changes were made in response to these comments. Given that the ACF Regulation’s implementation is phased in over the next two decades and upfront costs for vehicles and infrastructure can be amortized, CARB does not agree with the commenter’s assertion that the ACF Regulation will cause all trucking fleets to immediately become unprofitable. As described in response “Costs – Cost of the Regulation” in “Cost Comments” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses,” CARB’s analysis showed the ACF Regulation is expected to result in a cumulative net savings to the State of $48.0 billion by 2050 in part due to reduced fuel costs, maintenance savings, and revenue from the LCFS program. This finding is supported by numerous other third-party studies evaluating ZEV costs and savings. Achieving and maintaining profitability is a core goal of businesses, and each business has options to modify their business model to maintain profitability and to stay in business.

The IRA does not place Buy America provisions on fueling equipment under the Alternative Fuel Vehicle Refueling Property Tax Credit. The cited article discusses provisions related to implementation of IIJA which is focused on the deployment of public light-duty fast chargers. This is outside the scope of the ACF 15-Day Changes to the ACF Regulation. Similarly, the IRA's Commercial Clean Vehicle Tax Credit does not impose Buy America provisions on the sale of medium- and heavy-duty vehicles.

b) Cost – Updated Fuel Cost Numbers

Comment Summary: Commenter disagrees with the updated fuel cost assumptions. Commenters dispute the assumption that electricity costs are 10.8 percent lower than modeled in the ACF ISOR and states given the abysmal failure of the State and its electrical utilities to provide a clear path towards new electrical generation to support the ACF Regulation, this assumption is unreasonable. Commenters also state the updated fuel cost projections have no basis and lack transparency given the large shift in cost of -$21.5 billion.

Commenter: [103-15d, 160-15d]

Agency Response: No changes were made in response to these comments. CARB solely uses CEC fuel cost estimates for economic modeling per DOF guidance. The CEC updates these projections based on a multitude of factors on an annual basis, which reduces subjectivity and provides certainty given the variety of different fuel price forecasts available.

CARB recognized in the ACF ISOR that the costs of the Regulation are dependent on a number of assumptions and in particular is highly sensitive to the expected fuel costs for ZEVs and ICE vehicles. To illustrate this, Chapter VIII of the ACF ISOR contained a number of sensitivity analyses which included adjusting the fuel costs for ZEVs and ICE vehicles. The sensitivity analysis for 10 percent higher combustion fuel costs changed the cost of the Regulation by -$16.7 billion representing an increase in savings. The sensitivity analysis for 10 percent lower ZEV fuel costs changed the cost of the Regulation by -$11.0 billion also representing an increase in savings. Given these results in the ISOR, the increased savings due to the updated CEC fuel cost values are not a surprise and the results are in line with the analysis performed in the ACF ISOR.

c) Cost – Inadequate Analysis and Failure to Assess Impact of the 2036 100 Percent ZEV Sales Requirement

Comment Summary: Commenter states the Costs and Benefits Analysis is inadequate, devoting only seven pages to the updated cost analysis, and leaves stakeholders unable to discern whether the analysis incorporates accelerating the impact of accelerating the 100 Percent ZEV Sales requirement to 2036.

Commenter: [103-15d]

Agency Response: No changes were made in response to these comments. As described in Section "Cost Analysis" in Appendix B to the ACF 15-Day Changes, this updated analysis only described changes to the assumptions or methodology due to the ACF 15-day changes. The full analysis performed in Appendix B to the 15-Day Changes, Chapter VIII of the ACF ISOR, the ACF SRIA, and Appendix F and G to the ACF ISOR, and associated cost spreadsheets in the record represent hundreds of pages of analysis on vehicle costs.

The 100 percent ZEV sales requirement is analyzed as part of Appendix B to the 15-day changes. As described in Chapter VIII of the ACF ISOR, ZEV prices are expected to decline over time while continuing to have lower operating costs. As a result, by 2036 ZEVs will be at near price parity with ICE vehicles and have substantially lower TCO. This results in larger cost savings as well as higher emission benefits.

d) Cost – Nominal Emissions Reductions Under New Baseline

Comment Summary: Commenter states that the Adjusted Legal Baseline "Tank-to-Wheel" emissions released as part of the Updated Costs and Benefit Analysis to the ACF 15-Day Changes show that the HD I/M and Federal CTP Regulations will achieve significant emissions reductions and the nominal emissions reductions from the ACF Regulation cannot justify the profound impacts the trucking industry will experience because of this rule in its current form.

Commenter: [160-15d]

Agency Response: No changes were made in response to these comments. Even more reductions are needed beyond ACF to achieve California's federal attainment requirements and achieve emissions goals. As described in Chapter II of the ACF ISOR, the ACF Regulation is needed to achieve multiple California state goals including achieving criteria emissions reductions as outlined in the 2020 Mobile Source Strategy, achieving federal attainment standards as part of the 2022 State Implementation Plan, achieving greenhouse gas emissions reductions as outlined in the 2022 Scoping Plan, achieving health benefits to protect the wellness of all Californians, among other goals. The ACF Regulation is one of the largest NOx measures in the State SIP Strategy and the largest source of medium- and heavy-duty GHG reductions. Given these tremendous emissions reductions, we disagree with the commenter's claim that the Regulation's emissions reductions are "nominal."

As described in Appendix B of the ACF 15-Day Changes, the ACF Regulation is expected to result in greater benefits than costs and in fact has a higher cost-benefit ratio than each of the modeled alternatives. Given this information, CARB does not agree with the commenter's characterization that the ACF Regulation cannot be justified as the Regulation is critical to meeting the state's goals and is justified from a cost benefit analysis.

e) Cost – California Engine Requirement

Comment Summary: Commenter states that the costs to fleets for the new ICE Vehicle Additions requirement are not adequately accounted for in the draft Regulation's "Notice of Public Availability." Commenter states that this requirement will add unnecessarily higher costs for interstate fleets that operate outside of California 99 percent of the time.

Commenter: [132-15d]

Agency Response: No changes were made in response to these comments. Staff accounted for the impact of the California engine requirement by assuming all 2024 and newer vehicles purchased by regulated fleets who enter California would be required to purchase engines certified to the California standard which added cost to the Regulation. As a result, staff's analysis appropriately included expected costs associated with the California engine requirement.

Fleets have options on how to comply with this aspect of the Regulation and minimize the cost impact. Interstate fleets can focus a portion of their fleet on California operations which will minimize the number of vehicles which need to be equipped with California engines.

f) Cost – Infrastructure Costs

Comment Summary: Commenter states the $50 billion in estimated costs for EVSE and Infrastructure Installation fail to analyze the amount of public funding committed, the impact of increased interest rates, or the ability for fleets to pay the infrastructure expenses in combination with $9.2 billion in costs for "Vehicle Price." Commenter states their members cannot see how the heavy upfront capital expense is survivable given that avoided fuel costs and LCFS revenue (which commenter considers a subsidy) payback the fleet owner in a few years. Commenter states that the onus is on CARB to perform an adequate cost analysis on the cost to business which it has failed to do.

Commenter: [160-15d]

Agency Response: No changes were made in response to these comments. Please see responses to identical infrastructure issues raised in section "Costs – Infrastructure Costs" in "Cost Comments" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

In addition, CARB disagrees with the assertion that CAB has failed to perform an adequate cost analysis. Please see responses to issues raised in section "Costs – Cost of the Regulation" in "Cost Comments" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses" which highlight the robust cost analysis which staff performed.

CARB notes the LCFS Regulation is not a "subsidy" as characterized by the commenter but is a Regulation which utilizes a market-based structure to lower the CI of transportation fuels. The program sets a CI standard that all fuels must meet, and any low carbon fuels below this standard are eligible to earn LCFS credits. The LCFS Regulation does not "subsidize" fuels used by ZEVs over other fuels used by ICE vehicles such as RD or biomethane; instead, each fuel earns LCFS credits based on its own CI versus the standard and earns revenue based on the number of credits generated and the credit price.

g) Costs – Electricity Costs

Comment Summary: The commenters state that the Regulation will increase electricity costs, which will have a significant impact on low-income households.

Commenter: [120-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Costs – Electricity Costs” in “Cost Comments” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

h) Costs – Response to Comments from NAFA Fleet Management Association

Comment Summary: Commenter states the SRIA is deficient because it does not discuss fleet costs for disproportionately impacted fleets, and the SRIA should separate upfront cost from TCO. They also state CARB should explain and support with analysis the statement "We expect the change in costs for SLG fleets would be proportional to the number of vehicles in each fleet. However, larger fleets may have additional cost savings opportunities per vehicle due to their size."

Commenter: [113-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Costs – Response to Comments from NAFA Fleet Management Association Regarding Vehicle Cost”, “Costs – Response to Comments from National Association of Fleet Administrators Fleet Management Association Regarding Response to Department of Finance Comments on Upfront and Ongoing Costs”, and “Costs – Response to Comments from National Association of Fleet Administrators Fleet Management Association Regarding Response to Department of Finance Comments on Exemptions” in “Cost Comments” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

2. Definition Issues

a) Definition of Fleet Owner – Unique Regulation Redlines from Comment Letter 122

Comment Summary: Commenters suggest redlines for the "fleet owner" definition to provide more clarity on the assumption of who is considered a fleet owner with compliance responsibility as between a leasing company and lessee, and to address instances where there may be something less than a formal or comprehensive lease agreement that contemplated compliance with ACF, but such responsibility could be allocated by a separate agreement, including a contract entered into by e-mail. Redlines: add back in the "other equally reliable evidence" language, replace an "and" with "or,” or alternatively remove "and the terms of rental or lease agreement identifies the renting operator or lessee of the vehicle as the party responsible for compliance with state laws.”

Commenter: [122-15d]

Agency Response: No changes were made in response to these comments. The definition was modified as part of the first ACF 15-day changes in that the term "reliable evidence" was deleted due to the subjectivity of the term. The definition is not being modified further because the remainder of the definition is clear regarding the party that is responsible for compliance based on the duration and terms of the agreement between the rental or leasing entity and the renting operator or lessee of the vehicle.

b) Definition of Heavy Crane – Include Concrete Pump Trucks

Comment Summary: Commenter states concrete pump trucks meet the definition of a heavy crane because a concrete pump hoists, lowers, and horizontally moves a suspended load of concrete, a concrete pump has a gross vehicle weight rating in excess of 54,000 pounds, and a concrete pump is not designed, nor is capable of transporting cargo.

Commenter: [160-15d]

Agency Response: No changes were made in response to these comments. The definition of Heavy Crane also includes that the on-road single engine crane is required to be operated by a licensed crane operator. This is not a requirement for concrete pump trucks; therefore, concrete pump trucks do not meet the definition of heavy crane as set forth in the Regulation.

c) Definition of Vehicle - California Vehicle Code Section 670

Comment Summary: Commenter states that within CARB's own Modified Proposed Rule, the definition of 'vehicle' has been revised to reference section 670 of the CVC. The revised definition could be interpreted to include off-road equipment that is also subject to CARB's LSI Regulation. For this particular example, commenters request that equipment subject to the LSI Regulation be exempt similar to the exemption for mobile cargo handling equipment at ports and intermodal rail yards.

Commenter: [121-15d]

Agency Response: No changes were made in response to these comments. This definition was modified as part of the first ACF 15-day changes and is not being modified further because section 670 of the CVC defines a "vehicle" as a device by which any person or property may be propelled, moved, or drawn upon a highway. This definition does not, however, govern which vehicles are subject to the ACF Regulation – as specified in sections 2013(a)(2), 2014(a), and 2015(a)(2). The ACF Regulation does not include vehicles originally designed to be operated off-road such as those subject to CARB's LSI Regulation which includes forklifts, floor scrubbers and sweepers, and industrial tow tractors (e.g., baggage carriers) with LSI engines of 25 horsepower (19 kW) or greater, and greater than 1.0-liter displacement. Vehicles with LSI engines that were originally designed to operate on highways, such as some airport ground support equipment, and off-road yard tractors are subject to the ACF Regulation. Cargo handling vehicles were left out of ACF because the cargo handling Regulation is expected to be more stringent than the ACF Regulation, where the LSI Regulation is not.

d) Definition of Vehicle Purchase – Unique Regulation Redlines from Comment Letter 122

Comment Summary: Commenters state the following redlines would improve clarity and consistency and address confusion around specific lease situations and lease buyouts.

Redlines: Change "vehicle purchase" or "purchase" definition as follows: replace "placed an order for" with "contractually committed"; add "new" in front of "lease agreement with a contract term…"; add "or exercising an option to buy a leased vehicle" after "A vehicle purchase does not include renewing a lease vehicle"; and add "and registered to the fleet owner" after "already in the California fleet."

Commenter: [122-15d]

Agency Response: No changes were made in response to these comments. The current definitions have sufficient clarity and consistency to explain purchase and lease requirements and therefore the suggested changes are unnecessary. It is the intent of the lease language included in the vehicle purchase definition to ensure actions with leased vehicles that are considered part of the fleet owner's California fleet do not help or hinder their compliance obligations. This is why language specifying that lease renewals would not be counted as a new vehicle addition, to prevent ICE vehicle leases from violating the Model Year Schedule requirements if they were renewed within the vehicle's useful life. The same logic would apply to lease buyouts where the fleet takes possession of a vehicle at the end of the lease period, and the intent would be to not include those situations as adding a new vehicle.

e) Definition of Configuration – Unique Redlines from Comment Letter 135

Comment Summary: Redlines to the "configuration" definition. Section 2015: replace "the primary intended function for which a complete vehicle is designed, or as determined by the body permanently attached to the chassis of an incomplete vehicle" with "a unique combination of basic vehicle inertia weight, axle ratio and spacing, cargo body type, payload capacity as applicable, and is designed to achieve a specified performance output," add "concrete mixer trucks, bulk pneumatic trucks," add "Vehicles of the same configuration can generally perform equivalent work," and remove "The configuration does not include any auxiliary equipment or secondary uses of equipment that is added to or carried on the vehicle body. Such equipment may include such commonly understood terms as welding equipment, lift gates, portable tanks, generators, storage cabinets, and winches."

Commenter: [135-15d]

Agency Response: No changes were made in response to these comments. The definition of configuration as modified by the ACF 15-day changes is sufficient to implement the ZEV Purchase Exemption while balancing the need to keep the criteria and process streamlined, per the Board's direction at the first hearing. The primary intended function language is necessary to retain, as considering every possible truck specification as part of the configuration would make the provision too difficult to implement and introduce unneeded complexity to the process.

f) Definition of Configuration

Comment Summary: The commenters express concern about the definition of "configuration."

Commenter: [106-15d, 111-15d, 135-15d, 160-15d, 169-15d, 175-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Definition of Configuration” in “Definition Issues” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

g) Definition of Emergency Event

Comment Summary: The commenters express concern about the definition of an ”emergency event.”

Commenter: [060-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Definition of Emergency Event” in “Definition Issues” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

h) Definition of Emergency Operations

Comment Summary: The commenters express concern about the definition of "emergency operations."

Commenter: [115-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Definition of Emergency Operations / Emergency Support Vehicle” in “Definition Issues” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

i) Definition of Emergency Support Vehicle

Comment Summary: The commenters express concern about the definition of an "emergency support vehicle."

Commenter: [115-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Definition of Emergency Operations / Emergency Support Vehicle” in “Definition Issues” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

j) Definition of Specialty Vehicle

Comment Summary: The commenters express concern about the definition of a "specialty vehicle."

Commenter: [120-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Definition of Specialty Vehicle” in “Definition Issues” of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

3. 100 Percent ZEV Sales Issues

a) 100 Percent ZEV Sales Requirement – Align with Waste Provision

Comment Summary: Commenters state that biomethane trucks sold to fleets complying with the waste and wastewater provision of the ACF Regulation should be excluded from the 100 Percent ZEV Sales requirement of ACF and the ACT Regulation requirements, because the timeline of the provision would result in fleet demand for such vehicles after the timeframe of 100 Percent ZEV Sales kicks in in 2036, and even if every non-biomethane truck sold was a ZEV, which is not possible, commenter would necessarily fall behind in their compliance requirements.

Commenter: [119-15d]

Agency Response: No changes were made in response to these comments. The purpose of the Regulation is not to perpetuate the sale and use of combustion vehicles. To meet the ZEV Milestones Option, the fleet owner would need to transition their eligible vehicles from 2030 through 2042 and would phase out their combustion trucks by 2042. It is unlikely a fleet owner would choose to purchase a combustion vehicle after 2036 because they would only be able to operate the vehicle for five years or less as the ZEV Milestone requirements are phased in and ultimately meet the 100 percent ZEVs in 2042. The extension only provides extra time to move the start date for some eligible vehicles to 2030 but would still require the full transition by 2042. It is likely all purchases will be ZEVs starting in 2030 to meet this requirement. The ACT and ACF Regulations are independent and complementary and there is no need to extend exemptions granted in one Regulation to entities subject to the other. There is no reason the ACT Regulation on the manufacturers could not be implemented without a complementary fleet Regulation. This is the same concept as how engine standards are applied to manufacturers and do not directly affect fleet owners. In addition, the comment is speculative in that it assumes the buyer would not go to a different manufacturer.

b) Feasibility of 100 Percent ZEV Sales Requirement by 2036 - Motorhomes

Comment Summary: Commenter states that given the costs associated with electrifying motorhome chassis and the fact that the ACF Regulation is not applicable to most motorhome buyers, motorhomes will be one of the last segments to be fully electrified. Given motorhomes will not likely be fully electrified until later next decade (as allowed by the ACT rule), we ask that the ACF Regulation specify the 2040 model year as the earliest year in which the 100 Percent ZEV requirement in Section 2016 of Title 13 would be applicable to motorhomes.

Commenter: [069-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Exempt Motor Homes from the 100 Percent ZEV Sales

Requirement and Fleet Requirements" in "Exempt Vehicles or Fleets" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses." The commenter previously stated that the 2040 deadline was not feasible and is asking in this comment for a 2040 timeline, which contradicts their prior statement that 2040 would not be feasible.

c) Feasibility of 100 Percent ZEV Sales Requirement by 2036

Comment Summary: The commenter states that the advancement of the 100 Percent ZEV Sales requirement to 2036 will make the already challenging ACF implementation timeline even more challenging. Additionally, given where it is today, the ZE truck market and charging infrastructure in California would benefit from further data gathering and analysis before revising a 100 Percent ZEV Sales requirement before it even begins to be implemented. Commenter states that it is fundamentally inconsistent and illogical to provide extensive exemptions from the ZEV purchase requirements, while not exempting those same vehicles from the sales mandates. Manufacturers simply cannot sell a vehicle without a buyer. The commenter states that there is no technical feasibility analysis provided to show accelerating the 100 Percent ZEV Sales requirement from 2040 to 2036 is technologically or economically feasible.

Commenter: [021-15d, 066-15d, 109-15d, 117-15d, 123-15d, 171-15d]

Agency Response: No changes were made in response to these comments. The 100 Percent ZEV Sales requirement was modified as part of the first ACF 15-day changes and is not being modified further because the 100 percent ZEV target in 2036 brings California even closer to meeting the ZEV targets outlined in the Governor's Executive Order (N-79-20) and carbon neutrality targets set forth in California's Climate Crisis Act (AB 1279). This change was in fact analyzed in the ACF ISOR Alternative 2, which broadly shows ZEVs become more cost effective over time, and the TCO is generally better than most ICE vehicles in the 2030 timeframe and would only improve from there.

This change meets Board direction and is necessary to achieve state air quality and climate goals. Accelerating the 100 percent manufacturer ZEV sales requirement sends a stronger market signal indicating the end of combustion-powered sales in California in 2036 rather than in 2040. Given the long lead time before this requirement takes place, manufacturers have sufficient time to plan their transition to installing all electric drivetrains. Moving up the 100 percent sales date is likely to improve availability of battery-electric and hydrogen fuel cell vehicles in all configurations, increases the likelihood manufacturers will coordinate with infrastructure providers, and design vehicles to meet the needs for all duty cycles. An earlier date also places more of the onus on manufacturers to develop these technologies and to make them available for fleets at a competitive price rather than placing the primary responsibility on fleet owners. The 100 percent requirement also sends key market signals to the trucking market including manufacturers, fleets, infrastructure providers, service technicians, and local governments. Furthermore, the Board directs the Executive Officer to continue coordination between the ACF Regulation and the ACT Regulation and return to the Board if needed to ensure alignment between the two Regulations. Establishing an earlier end date to 2036 sets a clear target to align these two complementary Regulations.

Furthermore, the commenter claims providing a ZEV Purchase Exemption is illogical and that those vehicles should simply be exempt from the Regulation. CARB disagrees. Manufacturers must sell ZEVs as a percentage of their sales, and they have complete control over which markets and truck types to serve. It is probable that manufacturers will focus on particular market segments and will not have solutions for all truck types initially. If a fleet owner is unable to purchase a ZEV in the needed configuration because the manufacturers fail to make it available, this would be outside the control of the fleet owner, thus necessitating the inclusion of the ZEV Purchase Exemption. The manufacturer, on the other hand, can sell their vehicles to the segment they are focused on. As discussed above, CARB anticipates that the market availability of ZEVs will rapidly increase and will accordingly reduce a fleet's need for exemptions. For these reasons, there is no legitimate claim to an exemption when the manufacturer chooses not to produce a vehicle, therefore exemptions should not be granted to manufacturers.

4. High Priority Fleet Issues

a) High Priority Fleets – Exempt San Nicolas and San Clemente Islands

Comment Summary: Commenters request adding an exemption for vehicles operated solely on San Nicolas or San Clemente islands due to potential impacts to military training operations due to adding EV charging and grid storage to a grid operating at and above capacity.

Commenter: [116-15d]

Agency Response: No changes were made in response to these comments. The islands mentioned by the commenter provide a constrained network of roadways so the distance vehicles would need to travel is relatively short and within the range of today's ZEVs. The infrastructure upgrades needed to support a gradual phase-in of ZEVs could be optimized and right sized to minimize impact to the existing grid. The vehicles could be charged with mobile, off-grid, or temporary charging and generation solutions. The vehicles are likely to do relatively low annual miles, for which a Backup Vehicle exemption may be appropriate. NZEVs could be a solution as well as they come to market. There would be no need to import fuel to the islands if they are fueled from on-island generation.

b) High Priority Fleets – Internal Combustion Engine Vehicle Addition Requirement Notice Insufficient

Comment Summary: Commenter states that the industry has not been given adequate notice of the new ICE Vehicle Additions requirement and such changes should be handled in Truck and Bus level Regulations with appropriate lead times and change notice.

Commenter: [132-15d]

Agency Response: No changes were made in response to these comments. This commenter is a HPF fleet and has had sufficient notice because the Regulation and the ICE Vehicle Additions requirement clearly apply to HPF fleets. The new requirements were discussed during workshops prior to the release of the ACF 15-Day Notice, and sufficiently related edits were made to the provision during the 15-Day Notice period. In fact, commenter submitted comments during the 45-Day Notice period when the original proposal was released, and during the 15-Day Notice period, indicating their proper notice. The new ICE Vehicle Additions requirement was appropriately noticed within this rulemaking action, and not the Truck and Bus Regulation, because the additions modify the ACF Regulation, not the Truck and Bus Regulation.

c) High Priority Fleets – Internal Combustion Engine Vehicle Addition Requirement Implementation Delay

Comment Summary: Commenter requests, at minimum, a transitional period allowance to 2027 for the ICE Vehicle Additions requirement to better align with EPA's low-NOx changes that take effect that year.

Commenter: [132-15d]

Agency Response: No changes were made in response to these comments. The delay presented by the commenter would not achieve the goals of the Regulation. The EPA low-NOx Regulation does not take effect until 2027, so adopting the commenter's suggestion would mean California could not ensure that fleets would purchase the cleanest available trucks for three years, which is inconsistent with our directives and goals of ensuring only the cleanest trucks are purchased if ZEVs are not available.

d) High Priority Fleets – Internal Combustion Engine Vehicle Addition Requirement Decreases Flexibility

Comment Summary: The commenter claims the availability of new ICE vehicles that meet California's emissions standards will likely be limited, if not non-existent. Then, by extension, ACF will affect all fleets in California and drive them all towards ZEVs instead of preserving a fleet owner's right to choose the technology that best fits the fleet's needs.

Commenter: [103-15d]

Agency Response: No changes were made in response to these comments. CARB rejects the notion that there will not be California certified engines available to comply with the HD Omnibus Regulation. The comment is speculative and is not a realistic outcome warranting analysis and would apply whether the ACF Regulation was in place.

e) High Priority Fleets – Model Year Schedule – Allow Future Purchase Contracts to Count Today

Comment Summary: Commenters suggest allowing fleets that contractually commit to acquire ZEVs in the future that execute such an agreement today be granted credit as having made a ZEV addition under the Model Year Schedule for long-term planning and manufacturing considerations.

Commenter: [122-15d]

Agency Response: No changes were made in response to these comments. The Model Year Schedule compliance mechanism is based on vehicle additions to the fleet, a subset of which are vehicle purchases. The vehicle purchase definition already states that entering into a purchase agreement for immediate delivery counts as a vehicle purchase. Opening this provision to future purchases would introduce a loophole in the Regulation by which fleet owners could cancel purchase agreements made for future delivery after those agreements were used to demonstrate compliance in prior years, and result in no ZEVs being added to the fleet.

f) High Priority Fleets – Milestones – Delay Zero-Emissions Vehicle Purchase Instead Of Requiring Combustion Purchase

Comment Summary: Commenter states that for a facility that successfully secures a 1-year exemption under the ZEV Milestones Option for Daily Usage or ZEV Purchase Exemption, the benefit of the exemption should be that the ZEV purchase is delayed until the ZEV unit becomes available one year later. There should be no diesel vehicle purchase required to qualify for the exemption for a fleet under the ZEV Milestones Option.

Commenter: [013-15d]

Agency Response: No changes were made in response to these comments. Fleet owners have expressed concern in public meetings that vehicles are needed when a vehicle needs to be replaced; these exemptions allow them to purchase an ICE vehicle if required. Nothing in the Regulation language forces a fleet owner to apply for these exemptions, and nothing prohibits the fleet from meeting compliance using other strategies and waiting for that particular ZEV to be available to purchase. Therefore, this change would not be necessary, because fleet owners can already voluntarily wait to purchase a ZEV if their fleet is in compliance.

g) High Priority Fleets – Milestones – Unique Redlines from Comment Letter 155

Comment Summary: Redlines to HPF Section 2015.2(f): add: "(10) Non-repairable Vehicles. Fleet owners that need to temporarily replace a vehicle due to an accident or other onetime event due to circumstances beyond the fleet owner's control, such as fire, catastrophic failure, or theft, that damages the chassis or primary equipment such that the vehicle is not repairable, or results in loss of the vehicle, may request and obtain an exemption as follows: (A) A fleet owner that receives this exemption for a qualifying ICE vehicle may purchase a vehicle of the same configuration and engine of the same or newer model year and exclude it from the ZEV Milestone Calculation specified in section 2015.2 (b) until the end of its useful life. (B) A fleet owner that receives this exemption for a qualifying ZEV may continue to count the ZEV toward its Milestone requirements until a replacement ZEV has been purchased and delivered, even if the qualifying ZEV is removed from the California fleet before the replacement ZEV delivery."

Commenter: [155-15d]

Agency Response: No changes were made in response to these comments. The non-repairable vehicle exemption was not added to the ZEV Milestones Option because fleets under that option have full flexibility to manage their fleet of vehicles, whereas fleets using the Model Year Schedule or are SLGs subject to purchase requirements have no choice but to only add ZEVs, starting in 2024 or 2027 respectively. Fleets using the ZEV Milestones

Option can already add ICE vehicles as long as they are meeting their Milestones, so extending this exemption for these fleets is not necessary.

h) High Priority Fleets – Milestones – Double Counting

Comment Summary: Commenter states that under Section 2015.2, CARB modified the definition of a fleet to include, "if a vehicle is operated in California at any time during the calendar year, it will be considered part of the California fleet for the entire calendar year for the purposes of calculating the ZEV Fleet Milestones of section 2015.2(a)." This definition is flawed in two significant ways. First, this definition does not account for one-for-one swap outs, therefore the total number of vehicles included in the ZEV Fleet Milestone Calculation will always skew higher than the intended milestone. Many entities plan for fleet upgrades years in advance and take delivery of vehicles throughout the year. By counting both the original vehicle and the new vehicle as part of the fleet that was operated within a given calendar year, CARB is inappropriately inflating the total number of vehicles to be used in the ZEV Fleet Milestone Calculation. Under this methodology, no regulated entity is likely to be able to meet the milestone in a given calendar year because the calculation includes vehicles that are no longer part of the fleet. Second, CARB has not provided a definition for "a vehicle operated in California." In aviation, ground support equipment may be moved between airports for training purposes, but not used for their intended operational purpose. It is unclear if this or other atypical uses meets the definition of a vehicle operated within the state.

Commenter: [121-15d, 138-15d]

Agency Response: No changes were made in response to these comments. The intent of the provision is not to require double counting of vehicles that have been removed from the California fleet in the same calendar year that are no longer owned; the intent is to prevent gaming from out-of-state fleets operating different sets of vehicles in California throughout the year that are still owned and artificially reducing the fleet size that operated in California. The intent was to make sure that vehicles sold, scrapped, or otherwise no longer owned or that no longer exist, would reduce the number for purposes of the ZEV Milestones calculation; these vehicles would be removed from the California fleet size immediately for purposes of compliance. However, it was not intended to reduce the fleet size for vehicles that are still owned that are transferred out of state that could be brought back to operate in California in the same or subsequent calendar year. Transferring a vehicle out of state and permanently allocating it to local operation somewhere else, then bringing it back to operate in California after it was transferred out of state, is not considered removing a vehicle from the California fleet by definition in the Regulation because the fleet owner is still eligible to continue operating that vehicle in the state. Indicating a vehicle is transferred out of state is effectively telling CARB the vehicle will not be operated in California the following year. Therefore, these vehicles would not be removed from the California fleet count until the end of the calendar year for purposes of the ZEV Milestones Calculation.

It is not necessary to provide a definition for "a vehicle operated in California" because this phrase is commonly understood by industry to mean that a vehicle is driven, run while stationary, or otherwise operated within California's borders.

i) High Priority Fleets – Joint Compliance – Clarify Consequences

Comment Summary: Commenter asks how the corporate joint compliance works in the event of non-compliance at the joint level; would subsidiary fleets be required to comply individually at that point and questioned if this would this result in a compliance trap.

Commenter: [169-15d]

Agency Response: No changes were made in response to these comments. The ACF 15-day changes provided clarification to address situations when subsidiaries, parent companies, or joint ventures wish to comply jointly with the ZEV Milestones Option instead of complying independently if the combined California fleet meets the requirements. If such subsidiaries, parent companies or joint ventures elect to utilize this compliance option and then subsequently do not fully comply with any requirement, each of the participating entities must then demonstrate compliance with the requirements on an individual basis. If an entity chooses to comply jointly, each individual subsidiary or joint venture must report separately, and include the CARB-issued ID number of the primary controlling corporate parent, joint venture business, or designated primary. It would not result in a compliance trap because it is an optional choice entity can make to benefit their business operation.

j) High Priority Fleets – Mergers – Require Compliance Plan

Comment Summary: Commenter recommends requiring the submittal of a compliance plan and timing for any acquisitions to assure CARB that the acquired fleet is earnestly moving as quickly as possible towards compliance.

Commenter: [132-15d]

Agency Response: No changes were made in response to these comments. A merger compliance plan would not be necessary because fleets are expected to be in compliance after the allotted year; this would present an unnecessary burden on the merging entities to provide such documentation. Information already required to be reported is sufficient to determine compliance at the end of the one-year period.

k) High Priority Fleets – Mergers – Provide Additional Time

Comment Summary: The commenters propose allowing additional time for fleets to comply with Regulations after mergers.

Commenter: [132-15d]

Agency Response: No changes were made in response to these comments. The ACF 15-day changes already increased the allowed amount of time to comply for mergers from 30 days to one year. Because mergers are fully within the control of a fleet owner's actions, it is not necessary to provide additional time; mergers often are planned for a significant period of time before they occur and are expected to plan for compliance with applicable laws and Regulations as part of that process.

l) High Priority Fleets – Mergers – Align with Newly Affected Fleet

Comment Summary: Commenter states the timeframe for a fleet newly affected by the Regulation through a merger should equal the timeframe for a newly affected fleet.

Commenter: [138-15d]

Agency Response: No changes were made in response to these comments. Changes were already made in the ACF 15-day changes specifying that if any entity merges with another entity or acquires vehicles as part of the merger, they will now have one year from the date the merger or acquisition completes to comply with relevant requirements. Extending this to two years is not necessary, as mergers are foreseeable and able to be planned for in advance. One year is sufficient for reasons discussed in Chapter C.(A).52., section 2015(k)(1), of the ACF 15-Day Notice.

m) Rental Vehicle Provision – Match Rental Demand to Supply

Comment Summary: Commenter states that once a rental company makes a required ZEV truck purchase as required by ACF, that purchase becomes the supply within the rental market. Just as in the manufacturer context (ACT), this is supply that has been required by Regulation. But unlike the manufacturer example (ACT), there is no corresponding regulatory effort to match up rental demand to the supply that has been required by Regulation. If the aim of ACF is to match up supply and demand, then that effort should apply throughout the rule. Unfortunately, because the draft ACF falls short, additional work remains to address the unique characteristics of rental fleets. Public and private fleets subject to ACF would benefit greatly from a menu of options to assist in their compliance with required ZEV purchases under the rule.

Commenter: [129-15d]

Agency Response: No changes were made in response to these comments. The purpose of the Regulation is to achieve emissions reductions through a gradual transition to ZEVs, not to match up supply and demand. Fleet owners are expected to have to make adjustments to the way they operate to comply with the Regulation. The Regulation has significant flexibility built in to allow fleets to choose the easiest path to electrify vehicles first, with appropriate exemptions and extensions. Additionally, NZEVs that can operate like an ICE vehicle could alleviate some of these concerns and are allowed to count as ZEVs until the 2035 model year and FCEVs are coming to market soon. The Board has directed staff to bring a future rulemaking to transition all other medium- and heavy-duty vehicles in California to ZEVs in 2028 as part of the 2022 State SIP Strategy. At that point, all fleets would have to electrify, creating the demand commenter is asking for. Finally, the Board has authority to modify the Regulation at any time; if unforeseen issues with Regulatory implementation arise, the Board can ask for changes.

n) Rental Vehicle Provision – Count All Zero-Emissions Vehicle Rentals Toward Compliance

Comment Summary: Commenter states that allowing public and private entities the option to rent ZEV trucks and count those rentals toward required ZEV usage compliance under ACF would provide much needed flexibility to those fleets, particularly those budget-constrained public sector entities for whom the purchase of ZEV trucks or installation of charging infrastructure might not be practical within the required timeline. Authorizing this method of shared mobility compliance could stimulate more efficient use of a shared resource, and accordingly stimulate demand for rented trucks. This could reduce the possibility that ZEV trucks will sit idle at rental locations throughout the state. Allowing public and private fleets to count rented ZEV trucks toward their own compliance with the rule would be a significant step in the right direction toward addressing demand deficiencies that exist in ACF for rental truck fleets. It also creates an incentive for fleet owners to rent a ZEV truck as a replacement vehicle when an ICE truck is being repaired or unavailable, creating the opportunity for a test drive. Furthermore, some ZEV trucks may require complicated repairs including ADAS that could result in long repair times; and encouraging fleet owners to rent ZEV increases the likelihood that a ZEV truck in the shop for repair is replaced with a rented ZEV truck. Commenter states that rental fleet companies are not themselves the end-users. Rental customers are the end users; and we request that distinction be reflected in ACF.

Commenter: [129-15d]

Agency Response: No changes were made in response to these comments. Most rental fleets would already be covered under this Regulation therefore this change is unnecessary. Also, the Regulation does not create demand deficiencies for rental fleets, in fact it is the opposite. The Regulation creates demand for ZEV by rental fleets and all other fleets subject to the Regulation. Whether or not a customer selects a ZEV to rent is outside the scope of this Regulation. Furthermore, nothing in this Regulation prevents a fleet from renting a ZEV when a ZEV is unavailable or for any other reason, such as when an ICE vehicle or ZEV is being serviced. The commenter’s suggestion does not directly advance the statutory mandates and policy directives to electrify the truck sector as quickly as possible, and could in fact delay that goal because allowing fleets to simply rent trucks does not expose them to the cost savings of ZEVs from reduced operating costs, and would not incentivize the expanded infrastructure needed to support the 100 percent ZEV requirement in 2036.

o) Rental Vehicle Provision – Subtract Exempt Vehicles from Rental Fleet Obligations

Comment Summary: Commenter states that some fleets have been expressly exempted from ACF due to the unique nature of their usage. Many of these exempted entities rely on the rental truck industry to supplement their fleets in times of need. For example, Cal FIRE depends on the rental truck industry every year to provide hundreds of trucks to move equipment and personnel to the front lines. If a rental company is satisfying an exempt entity's transportation needs by providing an ICE vehicle because only an ICE vehicle can serve the needed function, the provision of that service to an exempt entity should not encumber the rental company's ZEV requirement under ACF. Therefore, we respectfully request that you direct staff to provide guidance as to how rental companies can appropriately subtract rentals provided to exempt entities from rental company's ACF ZEV requirements for their fleet.

Commenter: [129-15d]

Agency Response: No changes were made in response to these comments. The structure of the Regulation provides flexibility for fleets to choose which vehicles to electrify first and provides a lengthy transition period to ZEV technology. In addition, any ZEV in the fleet will count towards compliance providing fleets with flexibility to electrify some vehicles while purchasing ICE vehicles when needed.

5. Drayage Truck Requirements Issues

a) Drayage – Reporting

Comment Summary: The commenter states concern with reporting requirements. The commenters state that the non-container terminals at their respective seaports will still have to manually collect truck entry data, which may lead to long queues at the affected terminals.

Commenter: [063-15d]

Agency Response: No changes were made in response to these comments. The reporting provision was added as part of the first ACF 15-day changes. This change was made to align with the reporting requirements of the CARB HD I/M Regulation to provide reporting flexibility to seaports, terminals, and intermodal railyards that do not have automatic reporting systems. This reporting is necessary to enable enforcement of the relevant drayage truck requirements.

b) Drayage – Daily Usage Exemption

Comment Summary: The commenter requests a daily use exemption for drayage trucks with longer routes. For example, a Daily Usage Exemption is needed because some drayage trucks currently travel four-hundred miles or more round-trip route and back on a daily basis.

Commenter: [149-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Drayage – Daily Usage Exemption" in "Drayage Truck Requirements Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

c) Drayage – Infrastructure Availability – Retail

Comment Summary: The commenter remains concerned about the availability of public or retail infrastructure for small fleets operating at the seaports.

Commenter: [63-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Drayage – Infrastructure Availability – Retail" in the "Drayage Truck Requirements Issues" section of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

d) Drayage – Exemption – Combustion Vehicles Ordered Pre-2024

Comment Summary: The commenter states the January 1, 2024, deadline for drayage should allow for the registration of combustion vehicles purchased prior to the deadline that are not delivered until after deadline.

Commenter: [169-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Drayage – Exemption – Combustion Vehicles Ordered Pre-2024" in "Drayage Truck Requirements Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

6. State and Local Government Issues

a) State and Local Government – 13th Year Limit – Remove Limit

Comment Summary: Commenters state the 13th model year restriction should be removed from the SLG Regulation requirements because utility specialty vehicles have a seven to 10 year life on average, and are turned over at a faster rate to ensure they can perform necessary functions reliably, and would prevent the fleet from using the ZEV Purchase or Daily Usage Exemptions if they have to replace a utility vehicle less than 13 years old. Other commenters state the limit should be removed to align with CCR title 13 section 2112(I), which indicates a useful life for most medium- and heavy-duty vehicles for 10 to 11 years through model year 2031. Commenters also state the rationale for the requirement is unfounded, as the rationale relies on SB 1 which is to provide accommodation for vehicles less than 13 model years old, not to force the retention of vehicles until they are at least that old.

Commenter: [044-15d, 055-15d, 068-15d, 072-15d, 079-15d, 079-15d, 112-15d, 124-15d, 125-15d, 133-15d, 144-15d, 148-15d, 155-15d]

Agency Response: No changes were made in response to these comments. See more discussion for why adding the restriction was appropriate in Chapter A.(A).44., section 2013(n)(2), Chapter A.(A).45., section 2013(n)(3), and Chapter A.(A).46., section 2013(n)(4), of the ACF 15-Day Notice. The Regulation is designed to include sufficient flexibility for fleet owners to manage their replacements and retain existing ICE vehicles to perform utility operations. For example, taking early or excess actions to replace ICE vehicles with ZEVs would allow a fleet owner to use the Regulation's early action credit to replace an existing ICE vehicle at any time with another ICE vehicle. Additionally, the Regulation was modified in the first ACF 15-day changes to allow SLG fleet owners to opt into the ZEV Milestones Option, which would allow fleet owners to have full flexibility to manage their fleet as long as they are meeting the Milestones, as that option has no limitations on vehicle age when applying for ZEV Purchase or Daily Usage Exemptions. The CCR Title 13, Section 2112 alternative useful life period is not necessary to use because that Regulation is related to when vehicle recalls can be required from manufacturers, which is not related to how long a fleet would keep a vehicle. The commenter misstates that the rationale states SB 1 is the reason for this; for the rationale, see Chapter A.(A).44., section 2013(n)(2), Chapter A.(A).45., section 2013(n)(3), and Chapter A.(A).46., section 2013(n)(4), of the ACF 15-Day Notice.

b) State and Local Government – 13th Year Limit – Clarify Limit

Comment Summary: Commenters request clarification of the 13th model year requirement or include an example of how this would be applied.

Commenter: [113-15d]

Agency Response: No changes were made in response to these comments. As explained in Chapter A.(A).44., section 2013(n)(2), Chapter A.(A).45., section 2013(n)(3), and Chapter A.(A).46., section 2013(n)(4), of the ACF 15-Day Notice, the 13th model year requirement language was added to specify that the application window for an exemption or extension is no earlier than the 13th model year of the ICE vehicle requesting the additional compliance flexibility. This is necessary to ensure that exemptions and extensions are not requested prematurely within the normal useful life of an ICE vehicle and reduces the likelihood that fleet owner might purchase an ICE vehicle because it is unavailable as a ZEV. Furthermore, it reduces administrative burden for staff processing unnecessary applications. For an example, if a 2010 model year ICE vehicle needs to be replaced, the fleet owner would be eligible to apply starting in 2023. This also gives staff the ability to plan and direct resources accordingly.

c) State and Local Government – 13th Year Limit – Conflicts with Truck and Bus

Comment Summary: Commenter states that the 13th year provision creates an additional issue because certain vehicles would then be in violation of California's Truck and Bus Regulation, which requires any vehicle with a GVWR over 14,000 to be taken out of service after 13 years. Effectively, it would create a period of time where the utility would be unable to operate the vehicle in question while waiting for a decision on the exemption request.

Commenter: [148-15d]

Agency Response: No changes were made in response to these comments. The commenter is mistaken because it conflates the Truck and Bus Regulation with the provisions of SB 1. The Truck and Bus Regulation does not require vehicles to be retired after 13 years; it primarily requires on-road diesel-fueled heavy-duty trucks and buses operating on California highways to be equipped with 2010 or newer model year engines by January 1, 2023, and has been fully implemented. It does not have any ongoing requirement to retire vehicles after 13 years old. There are no additional upgrade requirements as part of the Truck and Bus Regulation. All diesel engines should be 2010 or newer unless using one of the minimal exceptions to that Regulation and can operate their full useful life. For these reasons, staff disagree there is any conflict, and the commenter does not provide information to support how these requirements would conflict. Finally, the commenter represents a public agency or is a POU which are not subject to the Truck and Bus Regulation.

d) State and Local Government – Small Fleets – Increase Threshold

Comment Summary: Commenter states the SLG Regulation small fleet provision should be increased from 10 to 49 or less vehicles.

Commenter: [133-15d]

Agency Response: No changes were made in response to these comments. This change was added to address stakeholder concerns that small public fleets would have less flexibility to selectively choose which vehicles to replace with ZEVs in the first few years of the Regulation. The change also addresses an unintended consequence of the rounding provisions that would effectively mean a fleet with 10 vehicles making a single vehicle purchase between 2024 and 2027 would effectively have a 100 percent ZEV purchase requirement due to rounding. These fleets may also have less flexibility in selectively upgrading sites with ZEV infrastructure and may have less access to upfront capital. This change was made in response to direction from the Board at the first hearing for the Regulation, as well as stakeholder concerns.

e) State and Local Government – Small Fleets – Include Smaller Counties

Comment Summary: Commenters state that small counties under 50,000 in population be fully exempt, or be granted a 10-year delay, from the Regulation due to disproportionate impact of the costs to comply.

Commenter: [032-15d]

Agency Response: No changes were made in response to these comments. A delay was already provided in the SLG Regulation for small fleets to delay purchases until starting in 2027, and that same delay applies to identified designated low population counties as those with less than 125,000 residents in 2021 per the 2020 U.S. Census. However, the delay provided is until 2027. Granting a blanket exemption or a 10-year delay would not achieve the emissions goals of the Regulation, the Governor's Executive Order N-79-20, nor the Board's direction in the ACT Resolution to transition government fleets to 100 percent ZEVs by 2035.

f) State and Local Government – Small Fleets – Include Financial Hardship Exemption

Comment Summary: Commenter states the Regulation should include an automatic exemption for small public entities based on fiscal hardship.

Commenter: [027-15d, 028-15d, 029-15d, 030-15d, 034-15d, 040-15d, 041-15d, 045-15d, 049-15d, 051-15d, 059-15d, 061-15d, 062-15d, 067-15d, 115-15d, 128-15d, 142-15d, 150-15d]

Agency Response: No changes were made in response to these comments. Though ZEVs have a higher upfront cost, analysis shows that ZEVs will result in cost savings over the life of the vehicle compared to ICE vehicles. For more discussion regarding staff's analysis related to ZEV costs, please see responses to issues raised in section “Costs – Zero-Emissions Vehicle Costs” in “Cost Comments” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.” Because ZEVs can result in cost savings for most fleets, especially in the long term, adding a fiscal hardship provision for small fleets is not necessary. Additionally, flexibility in the Regulation's structure and sufficient exemptions and extensions for edge case scenarios will ensure fleet owners have a long phase-in period to transition their fleets to ZEVs. This change would also add unnecessary additional complexity to the Regulation due to the need to track individual fleets financial situations to assess whether a delay is warranted, lack of ability to use objective criteria equally applied to fleets in differing financial situations, and the potentially large administrative burden in assessing and verifying these claims to ensure the provision would not become a loophole.

g) State and Local Government – Small Fleets – Include Fleets that Purchase Single Vehicles in a Year

Comment Summary: Commenter states the small fleet delayed implementation schedule in SLG Regulation should be extended to agencies that purchase less than two vehicles in a calendar year, because the rounding treatment would effectively result in a 100 percent requirement for fleets only procuring one vehicle in a year; these agencies would be the smallest in the state that are least capable of complying with reporting mandates and costs.

Commenter: [027-15d, 028-15d, 029-15d, 030-15d, 034-15d, 040-15d, 041-15d, 045-15d, 049-15d, 051-15d, 059-15d, 061-15d, 062-15d, 067-15d, 115-15d, 128-15d, 142-15d, 150-15d]

Agency Response: No changes were made in response to these comments. As the comment mentioned, a delay was already provided in the SLG Regulation for small fleets to delay purchases until starting in 2027. This delay addresses these concerns for small fleets. Larger fleets that only purchase a single vehicle in a year will have additional choices in vehicles or could delay making the purchase for an additional year until more vehicles need to be replaced, because they are not required to turn over their vehicles, and therefore have sufficient flexibility such that an additional extension is not necessary.

h) State and Local Government – Clarify Milestones Option

Comment Summary: Commenter states clarity is needed on which requirements apply for SLGs that opt into the ZEV Milestones Option given that different exemption criteria are specified for fleets complying with the SLG requirements compared to the ZEV Milestones Option.

Commenter: [169-15d]

Agency Response: No changes were made in response to these comments because the commenter is seeking clarification and not requesting a change. The ZEV Milestones Option is part of the HPF Regulation therefore the flexibilities under that provision would apply. SLGs opting into the ZEV Milestone could be eligible for the waste and wastewater extension and the Vehicle Delivery Delay Extension but would no longer eligible for the Non-repairable Vehicle Provision.

i) State and Local Government – Allow Fleet Cancellations

Comment Summary: Commenters state that fleets should be allowed to cancel ZEV orders and be granted a one year extension to re-order ZEVs due to reasons beyond their control such as when a manufacturer substantially changes the specification of an already ordered ZEV that no longer meets the order specifications, options are discontinued, the vehicle will be delivered without a specification with an undefined amount of time that it will take the manufacturer to install the specifications at a later date.

Commenter: [113-15d]

Agency Response: No changes were made in response to these comments. Fleet owner cancellations are inherently within the control of the fleet owner, though the circumstances driving such decisions may not be. Fleet owners would be expected to manage their turnover decisions and adjust their compliance response if a fleet-based cancellation is warranted.

j) State and Local Government – Manufacturer Cancellation Notice Issues

Comment Summary: Commenters ask that the manufacturer cancellation notice requirement be removed, or require manufacturers to provide cancellation notices, because not all manufacturers provide written cancellation notices to customers.

Commenter: [113-15d]

Agency Response: No changes were made in response to these comments. Some form of notice from the manufacturer is reasonable to request from fleet owners; written correspondence is preferred, but not expressly required in the Regulation. The intent of this provision is to require third party documentation to show that the order was cancelled. Cancellation notices do not necessarily need to be in formal written correspondence. To the extent the manufacturer does not provide that, communication with the manufacturer could suffice, like an email, as long as the documentation shows that the order will not be fulfilled by the manufacturer.

k) State and Local Government – Delay Start Date

Comment Summary: The commenters ask for a delay in the start date of the SLG requirements.

Commenter: [018-15d, 022-15d, 023-15d, 026-15d, 027-15d, 028-15d, 029-15d, 030-15d, 032-15d, 034-15d, 036-15d, 040-15d, 041-15d, 043-15d, 045-15d, 049-15d, 051-15d, 054-15d, 059-15d, 061-15d, 062-15d, 064-15d, 067-15d, 072-15d, 079-15d, 110-15d, 113-15d, 115-15d, 118-15d, 128-15d, 134-15d, 140-15d, 142-15d, 150-15d, 157-15d, 166-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "State and Local Government – Delay Start Date" in "State and Local Government Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

l) State and Local Government – Allow Alternative Vehicle Purchases When Manufacturer Cancels Orders

Comment Summary: The commenters suggest that ACF allow alternative vehicle purchases (presumably ICE vehicles) when manufacturer orders are delayed or canceled.

Commenter: [115-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “State and Local Government – Allow Alternative Vehicle Purchases When Manufacturer Cancels Orders” in “State and Local Government Issues” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

7. Provisions, Reporting, and Recordkeeping Issues

a) Recordkeeping – Remove Verbal Audit

Comment Summary: Commenter states that the requirement for a fleet to respond to a verbal audit request is an unnecessary change because without documentation of the request, a fleet that does not respond within 72 hours to a verbal request from CARB would be subject to penalties without any proof such a request was ever made and CARB would also have no proof of a verbal request to require penalties of a non-responsive fleet.

Commenter: [132-15d]

Agency Response: No changes were made in response to these comments. CARB added verbal or written to request records for audits to clarify that the request may be both written or verbal.

b) Recordkeeping – Allow Digital Records

Comment Summary: Commenter states the "Right of Entry" provision should be modified to allow CARB to request digital records for records that are maintained solely in digital format to prevent commenter from being forced to only store paper records.

Commenter: [122-15d]

Agency Response: No changes were made in response to these comments. If vehicles are not at a location or records are not kept at a location, the language already precludes CARB staff from this right of entry. Additionally, the recordkeeping language in section 2015.5 of the Regulation language already specifies that fleets may make such records available in an electronic or paper format upon request.

c) Recordkeeping – Leased Vehicle Removal

Comment Summary: Commenter states that the recordkeeping requirements for vehicles removed from the California fleet cannot be met for fleets that are returning leased vehicles to their lessors.

Commenter: [122-15d]

Agency Response: No changes were made in response to these comments. Section 2015.5(a)(2) requires a fleet owner to retain their lease agreements which would have the end date of the lease, this functions the same as a record of disposal does in terms of removing a vehicle from the California fleet.

d) Recordkeeping – ZEV Requirements

Comment Summary: Commenter states the requirement that fleets keep documentation that a ZEV operates within California within a given model year conflicts with IRP requirements and limits ZEV flexibility in the interstate fleet.

Commenter: [138-15d]

Agency Response: No changes were made in response to these comments because the ZEV Milestones Option is voluntary, so if that documentation requirement doesn't work for fleet, then they can use model year schedule. Also, this is necessary to close a loophole by which fleet owners could artificially inflate their ZEV counts under the Milestones option by reporting ZEVs that the fleet owns, but that never are operated in California during the calendar year they are reported for compliance. The various documents are necessary to include as each document can show CARB staff information proving the vehicle was operated in California during a given calendar year in question. CARB disagrees that the requirement conflicts with IRP requirements. IRP Section 1000 requires registrants to maintain records to support reported distances traveled in California for the registration year and three previous registration years.

e) Reporting – 30 Day Deadlines

Comment Summary: Commenter states the Regulation has too many 30-day deadlines which are unnecessary and create administrative burden.

Commenter: [169-15d]

Agency Response: No changes were made in response to these comments. The 30-day deadline requirement to report any changes to their fleet provides a reasonable timeframe for a fleet owner that might have affected the compliance. Fleets are required to be in-compliance throughout the year. Fleet owner will be only reporting changes to their existing fleet and therefore, it should not create administrative burden.

f) Reporting – SLG-No Reporting Changes Within 30Days

Comment Summary: The commenters propose requiring a single, comprehensive annual report for SLG fleets, rather than reporting changes within 30 days, to minimize the reporting burden and associated costs.

Commenter: [115-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Reporting – State and Local Government – No Reporting Changes Within 30 Days" in "Provisions, Reporting, and Recordkeeping Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

g) Reporting – Allow Other CARB Reports

Comment Summary: Commenters state that reporting from other CARB programs should be accepted in lieu of a separate ACF report if they contain the same information, and that CARB in general should provide one reporting template for all programs to minimize reporting burden. Some commenters request a consolidated compliance reporting system to streamline fleet reporting, stating that fleets often report to CARB through systems such as TRUCRS, DTR, and ARBER, reporting the same information multiple times (e.g., company/contact information) and, in many cases, which cover or will cover (HD I/M, ACF) the same vehicle.

Commenter: [138-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Reporting – Allow Other CARB Reports" in "Provisions, Reporting, and Recordkeeping" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

h) Reporting – Too Onerous

Comment Summary: The commenters express concerns that VIN level reporting on cargo origin and destinations, as well as daily usage reports, will be difficult to track for large entities. They emphasize the need for sufficient lead time to develop tracking systems before the January 1, 2024, start date. Commenters also urge CARB to ensure that ACF reporting is less onerous than the Truck and Bus Regulation, which required extensive validations for simple reporting changes, and allow fleet owners to report vehicle types without CARB staff intervention.

Commenter: [033-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Reporting – Too Onerous" in "Provisions, Reporting, and Recordkeeping Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

8. Exempt Vehicles or Fleets

a) Test Fleet Exemption – Add Fuel and Lubricant Testing Vehicles

Comment Summary: Commenters request adding fuel and lubricant research fleets and laboratory vehicles to the test fleet exemption. Petrochemical and lubricant industries will maintain a specialized fleet of vehicles to support research and development of fuels, fuel additives, and lubricants, and should fall under a definition of "test fleet." These test vehicles are not used to transport goods or provide service and represent a comparatively small number of vehicles. These test vehicles are typically operated on a chassis dynamometer and, when appropriately registered and licensed, will occasionally operate on the roadway to conduct real-world testing. The research is critical to enable the reliable supply of our products globally, including renewable fuels and hydrogen.

Commenter: [117-15d, 169-15d]

Agency Response: No changes were made in response to these comments. Existing lube and fuel test vehicles can be reported as part of the California fleet and would not need to be retired until the end of their useful life. The commenter did not specify the age of the test vehicles, so there is no indication that the useful life would not be sufficient to meet their needs. In the event existing vehicles need to continue operating past the useful life for testing purposes, the 5-Day Pass exemption added during the ACF 15-day changes is sufficient for temporary trips in California and the backup vehicle exemption would allow vehicles to operate up to 1000 miles per year.

b) Exempt Water Agencies

Comment Summary: The commenters state water agencies should be exempt from the Regulation.

Commenter: [031-15d, 141-15d]

Agency Response: No changes were made in response to these comments Please see responses to issues raised in section "Exempt Various Vehicles, Industries, or Sectors from the Regulation" in "Exempt Vehicles or Fleets" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

c) Exempt Various Vehicles, Industries, or Sectors from the Regulation

Comment Summary: The commenters state that the Regulation should exclude rental, service, and transportation vehicles serving the construction, agricultural, military, and critical service industries, and should exempt heavy-duty rental, heavy-duty equipment repair vehicles, and private not-for-hire heavy equipment transportation vehicles from the ACF Regulation.

Commenter: [026-15d, 027-15d, 028-15d, 029-15d, 030-15d, 034-15d, 040-15d, 041-15d, 045-15d, 049-15d, 051-15d, 059-15d, 061-15d, 062-15d, 067-15d, 115-15d, 118-15d, 128-15d, 142-15d, 150-15d, 158-15d, 160-15d, 171-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in sections "Exempt Heavy Equipment Rental Fleets" and "Exempt Various Vehicles, Industries, or Sectors from the Regulation" in "Exempt Vehicles or Fleets" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

9. Exemptions and Extensions – 5-Day Pass

a) 5-Day Pass – Request for Automatic Process

Comment Summary: Commenter requests an automated process to acquire a temporary in-state pass because the time needed for submitting and getting approval for a 5-Day Pass does not align with how trucking companies conduct business. For example, a fleet that bids and wins a contract to haul a one-time load into California in the same week would not be afforded enough time to request and get approval for a temporary 5-Day Pass.

Commenter: [169-15d, 171-15d]

Agency Response: No changes were made in response to these comments. The 5-Day Pass process is already automated in the reporting system. Fleet owners would simply need to log into their TRUCRS account, report and select the vehicle desired, and select a 5-Day Pass. The system already is automated to approve a pass as long as a pass has not been claimed in the calendar year.

b) 5-Day Pass – Allow More Time

Comment Summary: Commenters state the 5-Day Pass is too short and should be expanded to varying lengths of time, including extending to 10 days, 15 days, weeks, or months. Commenters cite long project timelines and circumstances beyond the control of the driver or fleet owner as reasons for needing additional time, such as equipment breakdowns, driver illness, scheduling issues, or inclement weather. Commenter suggests extending it to 15 days.

Commenter: [167-15d, 169-15d, 171-15d]

Agency Response: No changes were made in response to these comments. The 5-Day Pass was selected to be five days consistent with existing Regulations, and was expanded greatly, as prior Regulations limited use to one time per fleet per year, whereas the ACF Regulation would allow one pass per vehicle. This provides much more flexibility. In conjunction with other exemptions and extensions, and the flexibility built into the long phase-in period of the Regulation requirements, this provision is sufficient to meet most fleet needs for temporary operations in the state.

c) 5-Day Pass – Allow Non-Consecutive Days

Comment Summary: Commenter requests fleets using the 5-Day Pass be allowed to split the five days between multiple days.

Commenter: [138-15d, 169-15d]

Agency Response: No changes were made in response to these comments. Allowing non-consecutive days of entry would complicate implementation and enforcement of the provision. At its extreme, it would be equivalent to giving five separate passes to every truck a company owns, which would introduce a loophole into the Regulation. The time period was selected for reasons described in Chapter C.(D).44., section 2015.3(g), of the ACF 15-Day Notice. For example, vehicles travelling through California from Nevada to Oregon or mechanic vehicles that need to come in temporarily to make a repair would primarily benefit from the 5-day time period. This was a minimal amount of time affecting a small number of trucks intended to deal with certain practical limitations and will not significantly impact competitive disadvantages of out-of-state vehicles competing with in-state vehicles. Expanding this would have an adverse impact on the level playing field the Regulation strives to strike between in and out-of-state vehicles. It would also not achieve the goals of the Regulation to provide more exemptions.

10. Exemptions and Extensions – Daily Usage

a) Daily Usage Exemption – Allow Calculated BEV Comparison Data Instead of Measured Data

Comment Summary: Commenter suggests adding "In the event that no telemetric data is available, fleet owners may instead submit quantitative data from reputable sources, and route maps and drive-cycle specifications to inform their request" to the language specifying that measured BEV energy use data can be submitted in lieu of performing the specified range calculations. The purpose would be to address situations where a ZEV has not yet been deployed and telemetric data would not be available. Such data would include calculated ZEV energy use data using fundamental physics calculations, drive-cycle speed, distance and ZEV specifications like GVWR and frontal area, and data from reputable studies dedicated to quantifying the relationship between ZEV range and ambient temperature.

Commenter: [044-15d, 124-15d]

Agency Response: No changes were made in response to these comments. A simplified calculation based on reasonable, averaged energy efficiency factors collected from a range of vehicles in real world operation and dynamometer testing is already available in the Regulation. Adding an additional calculation method would introduce unnecessary complexity to address edge-case scenarios. It is necessary to include measured BEV data as an alternative, rather than additional complex calculations, because measured data is based on real world operation; anything less would be insufficient to validate the need for an ICE vehicle purchase which would then continue to operate for 13 years or longer.

b) Daily Usage Exemption – Allow a Representative Sample Instead of Data for Each Vehicle

Comment Summary: Commenters state the documentation requirement for every similar vehicle in the fleet for Daily Usage Exemption is too onerous and should instead require a representative sample of vehicles operated in similar environments.

Commenter: [175-15d]

Agency Response: No changes were made in response to these comments. The purpose of the exemption is to allow purchase of an ICE vehicle with demonstrated need when the fleet owner has no other choices to comply; showing a sample of representative vehicles does not provide the Executive Officer an accurate picture of the whole fleet and could leave out some vehicles that could be transitioned to ZEVs. This would create a loophole to incentivize only selecting the worst-case daily usage scenarios to falsely demonstrate need. Additionally, the Regulation only requires information from other ICE vehicles of the same configuration and weight class; this is already a representative sample of the vehicle type and does not require information from every vehicle in the fleet.

c) Daily Usage Exemption – Clarify Energy Usage

Comment Summary: Commenter requests clarification on the "energy usage" portion of the Daily Usage Exemption requirement to track ICE vehicle stationary equipment energy used and hours of operation, and whether fuel consumption plus hours of operation would be sufficient.

Commenter: [122-15d]

Agency Response: No changes were made in response to these comments. The intent of the provision is to address situations where there is no new FCEV, NZEV, or BEV available that can meet the demonstrated daily usage needs of any existing ICE vehicle of the same configuration in the fleet. The measure of work for a fleet of vocational trucks of the same fuel type can be compared in total energy use instead of miles. Energy use of ICE vehicles in the fleet could be measured in diesel gallons, gasoline gallons, or in BTU's depending on the ICE vehicle fuel type. Information about the hours of operation, miles travelled, and type of vehicle being operated is still necessary to confirm the duty-cycle is comparable for any test data collected.

In lieu of using miles, fleet owners may use data from a BEV and a comparable ICE vehicle doing the same work to compare how much fuel the ICE vehicle uses to complete the work the BEV performs until the battery is depleted. If the daily assignment does not deplete the battery of the BEV, then the state of charge would be used to prorate how much work the BEV could perform. For example, if a BEV can perform the same work as a truck that uses 20 gallons of diesel to perform the work, then the fleet owner would not qualify for an exemption but would qualify if all trucks in the fleet use more than 20 gallons of diesel as determined by the ranking method specified in the Regulation.

As an example of an ideal data collection scenario, a fleet could run a BEV and a comparable diesel ICE vehicle of the same type, in the same application, for the same amount of time until the state of charge of the BEV is depleted to zero. The diesel gallons used by the ICE vehicle in the test data would represent the maximum amount of work the BEV can displace in that application for other diesel vehicles in the fleet. This value would be compared to the diesel fuel use of other vehicles in the fleet of the same type to determine whether the criteria to receive an exemption have been met. Staff will work with fleet owners to prorate test data based on the BEV state of charge when the data collected on a given day does not deplete the battery of the BEV.

d) Daily Usage Exemption – Clarify Explanation Requirement

Comment Summary: Commenters state that the Daily Usage Exemption criteria for explanations why BEVs could not be charged or fueled during the workday at the depot, within a mile of routes, or where ZEV fueling infrastructure is available, and why charging could not be managed during driver rest breaks during the workday are unreasonable for fleets with unpredictable routes, and that charging times would be hours longer than the rest breaks would provide.

Commenter: [122-15d]

Agency Response: No changes were made in response to these comments. The commenter would simply need to submit an explanation for their situation explaining why these conditions could not be met; in fact, commenter's letter explains in detail why these conditions could not be met, and the explanation would be accepted as long as it is accurate for the fleet applying for the exemption. The intent of the language is to ensure fleet owners are making a good faith attempt to use infrastructure that could support their operations and provide enough information so if other solutions can be identified they could facilitate infrastructure development in the long-term. The intent of the driver rest breaks language is to recognize the long-term expectation that fueling time will improve; long fueling times are not reasonable to expect over the next 20 years, and the language indicates to fleet owners that exemptions would be granted based on actual situation.

e) Daily Usage Exemption – Clarify Milestone Requirement

Comment Summary: Commenter states the phrase "The Executive Officer will grant this exemption only if the fleet owner demonstrates their next applicable upcoming ZEV Fleet Milestone cannot be reached without exemptions by requesting and obtaining exemptions for all other ICE vehicles in their California fleet" sets an unclear bar to be eligible for the Daily Usage Exemption under the ZEV Milestones Option and asks how this would be assessed.

Commenter: [169-15d]

Agency Response: No changes were made in response to these comments. The bar is clearly set by the Regulation language. If a fleet has remaining ICE vehicles in the fleet under the ZEV Milestones Option, the fleet owner must demonstrate that no other vehicles can be upgraded to ZEVs to meet their next ZEV Milestone. Because the Regulation lays out clear exemption provisions that would demonstrate existing ICE vehicles could not be transitioned to ZEVs, it is necessary to require fleet owners to apply for and obtain exemptions to satisfactorily demonstrate this. Any exemption that the ICE vehicle qualifies for could be applied for and used, pursuant to the clear criteria specified for these provisions.

f) Daily Usage Exemption – Consider Weight or Dimension Limits

Comment Summary: The commenters state The Daily Usage Exemption should also consider additional factors such as weight limits or dimension constraints for vehicles because unique terrain or infrastructure limitations pose greater challenges than range or energy capacity when purchasing a ZEV that is able to meet the necessary duty cycle for the fleet. For example, access roads and bridges may not be rated for the additional weight of the ZEV.

Commenter: [133-15d, 155-15d]

Agency Response: No changes were made in response to these comments. The Daily Usage Exemption is intended to address daily range or energy usage concerns, not every possible aspect of a vehicle's duty cycle. Bridge weight limits may be less of a concern over time as ZEV technology improves, and the fleet will likely have a high percentage of ICE vehicles they can use to traverse those areas in the unlikely event a ZEV would exceed a specific limit. Additionally, the ZEV Purchase Exemption considers various safety related factors, including highway safety requirements, in the fleet-specific purchase exemption, which may provide compliance relief in edge case scenarios where fleets have no other choice.

g) Daily Usage Exemption – Historical Data Not Representative of Future Needs

Comment Summary: Commenter states the Daily Usage Exemption's five-year lookback period does not account for future, unforeseen emergency events such as those due to climate change. Only looking retrospectively limits utilities from preparing for and responding to future events by acquiring vehicles that have more capability than average daily needs.

Commenter: [055-15d, 136-15d]

Agency Response: No changes were made in response to these comments. The commenter's suggestion would result in using a subjective or speculative estimate which would not achieve the goal of having objective data to assess the need for the exemption. Additionally, ZEVs are already capable of operating in most duty-cycles today. As the Regulation timeline progresses, ZEVs are expected to have improved range and capabilities that would lessen a fleet owner's need for this exemption.

h) Daily Usage Exemption – Include Aerodynamic Drag and Ambient Temperature in Calculations

Comment Summary: Commenter suggests the Daily Usage Exemption calculation requirement include language specifying that "calculations may include estimated impacts of aerodynamic drag and ambient temperature on energy usage of ZEVs" to address real-world factors that limit ZEV range, stating that the proposed calculation is too simplistic to take these factors into account.

Commenter: [044-15d, 124-15d]

Agency Response: No changes were made in response to these comments. The simplified calculation uses average efficiency ratings developed through real world and dynamometer tested ZEV efficiencies. Including this language in the simple calculation method would be counter to the intent of providing a simple option. Furthermore, the Regulation already includes a pathway by which fleet owners can submit actual real-world data, in lieu of performing this calculation, which would implicitly include the effects of ambient temperatures and aerodynamic drag on energy needs since the BEV for which the data is collected is to be of the same configuration already operated on similar daily assignments.

i) Daily Usage Exemption – Remove Term "Fleet"

Comment Summary: Commenter states using the term "fleet" in Daily Usage Exemption means vehicles "operated under common ownership or control," which could consist of all the vehicles they operate throughout the state, creating severe issues for companies that operate in varying operating environments to qualify for the exemption.

Commenter: [175-15d]

Agency Response: No changes were made in response to these comments. The term fleet was intended to be included because if a fleet has other options to transition to ZEVs, there is no need for a Daily Usage Exemption.

j) Daily Usage Exemption – Tie Configuration to Vehicle Operating Environment

Comment Summary: Commenter states only configurations in similar operating environments, vehicles operating out of the same yard, or the same limited geographic area should be compared for the Daily Usage Exemption.

Commenter: [175-15d]

Agency Response: No changes were made in response to these comments. The purpose of the exemption is to allow purchase of an ICE vehicle with demonstrated need when the fleet owner has no other choices to comply; only comparing vehicles in similar environments does not provide the Executive Officer an accurate picture of the whole fleet and could leave out some vehicles that could be transitioned to ZEVs. This would create a loophole to incentivize only selecting the worst-case daily usage scenarios to falsely demonstrate need.

k) Daily Usage Exemption – 10 Percent Threshold Cost Burden Unfair

Comment Summary: Commenter states the requirement for at least ten percent of a fleet to be ZEVs, related to the Daily Usage Exemption, places an unfair cost burden on fleets that have greater daily mileage.

Commenter: [135-15d]

Agency Response: No changes were made in response to these comments. The Daily Usage Exemption's 10 percent ZEV threshold is designed to ensure fleets are gaining experience with ZEVs and making minimum basic progress towards electrification before applying for an exemption. Further, fleets who are applying for this exemption which have different mileage needs are less likely to be directly competing against one another which mitigates the competitive disadvantage concerns expressed by the commenter. The ZEV Milestones Option defers requirements for higher mileage fleets with sleeper cab tractors until 2030 as technology and infrastructure access improves. Fleet owners will have flexibility on how to meet the criteria, and can electrify the lower range need trucks first, and can use the exemption for all their high mileage trucks if criteria are met. To the extent that fleets specialize in high mileage operations compete against other high mileage fleets, there would be no competitive disadvantage, and the commenter fails to demonstrate why this provision places an unfair burden on these fleets. Finally, the need for exemptions is less likely due to the availability of FCEVs, NZEVs, and demonstrated 500 mile range of some tractors.

l) Daily Usage Exemption – Unique Redlines from Comment Letter 135

Comment Summary: Redlines to Daily Usage. Section 2015.3(b): add "If no new BEV that can meet the demonstrated daily usage needs of an existing vehicles of the same configuration in the fleet, is available for purchase as determined by the criteria specified in section 2015.3(b)(2) through (5)," replace "an" with "the existing," remove "if no new BEV is available to purchase that can meet the demonstrated daily usage needs of any existing vehicles of the same configuration in the fleet, as determined by the criteria specified in section 2015.3(b)(2) through (5)," remove "their new ICE vehicle," add "to purchase the exempt vehicles," add "of exemption approval," add "orders for," remove "fleet owners may request their exemption only if at least ten percent of their California fleet is comprised of ZEVs or NZEVs," and add "and is commercially available."

Section 2015.3(b)(2): add "as determined on the CARB ACF webpage as commercially available."

Section 2015.3(b)(3)(A): remove "must," add "and," remove "and state of charge at the beginning and end of the daily shift to show typical daily energy usage for the BEV, over five consecutive business days," and add "Fleet owners may also submit documentation from ZEV manufacturer data collected from ZEVs in actual service to substantiate the claim. Vehicles that lack stable routes, service rural routes without charging infrastructure, or require the capacity to do work at remote locations after travel may submit evidence of this when seeking this exemption."

Section 2015.3(b)(4): remove "Identify the lowest mileage or energy use reading for each day and exclude the three highest readings."

Section 2015.3(b)(5): add "without incurring additional labor costs and delays or resulting in material damage and spoilage."

Commenter: [135-15d]

Agency Response: No changes were made in response to these comments.

Suggested changes to the introduction to 2015.3(b) limiting the demonstration that a ZEV could not complete the daily usage needs of a single vehicle in the fleet would introduce a loophole in the Regulation and would be counter to the intent to verify that the ZEV could not meet the daily usage needs of any other vehicle of similar configuration. For example, a fleet owner with one truck that operates high mileage and one truck that operates low mileage could cherry pick the highest mileage vehicle to justify an exemption, when the low mileage vehicle could easily be replaced by an available ZEV. Other changes suggested in the introduction are changes to be grammatically consistent with this and would not be necessary to make because the introduction language would not be changed.

Suggested changes to the introduction to 2015.3(b) that would remove the 10 percent ZEVs requirement to qualify for the provision would not be appropriate for reasons described in section "Daily Usage Exemption – Remove 10 Percent Threshold Requirement" in "Exemptions and Extensions – Daily Usage" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

Suggested additions of "and is commercially available" in the introduction language of section 2015.3(b), and "as determined on the CARB ACF webpage as commercially available" in section 2015.3(b)(2) are not necessary because section 2015.3(b)(2) already specifies that a BEV must be available to purchase, for which extensive criteria are laid out in section 2015.3(e) to make such a determination, and because the rest of the Regulation language does not use the term "commercially available."

Suggested change of "must" to "can" in section 2015.3(b)(3)(A) would change the meaning and make the criteria subjective, which would not achieve the Board's direction to have clear and objective criteria. Additionally, removal of the "state of charge…" language is not necessary, as all of this data is necessary to have an accurate real-world picture of the capability of a BEV to compare against the fleet's real-world ICE vehicles. Removal of the "over five consecutive business days" language is not necessary because more than one day of data is necessary to have an apples-to-apples comparison between existing ICE vehicles and the BEV from which data is being collected.

Suggested addition of "Fleet owners may also submit documentation from ZEV manufacturer data collected from ZEVs in actual service to substantiate the claim. Vehicles that lack stable routes, service rural routes without charging infrastructure, or require the capacity to do work at remote locations after travel may submit evidence of this when seeking this exemption," are not necessary. The allowance to submit ZEV data from manufacturers is not necessary because the ACF 15-day changes already removed a requirement that the fleet operate a BEV in their own fleet's service; this change allows data from BEVs operated on similar assignments, which would already allow a manufacturer, other fleet, or even a study to be used to substantiate the claim, as long as it is from a comparable vehicle operated on similar assignments. The last half of this change is not necessary as the Regulation only needs to state the information that fleet owners must provide to demonstrate they meet the criteria. Nothing in the language would preclude a fleet owner from voluntarily submitting additional information; however, only information that would be used to determine whether the exemption criteria were met could be considered.

Suggested removal of the requirement to exclude the three highest readings from the daily usage report is not necessary for reasons described in the responses to issues raised in section "Daily Usage Exemption – Allow Three Highest Values" in "Exemptions and Extensions – Daily Usage" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

Suggested addition of "…without incurring additional labor costs and delays or resulting in material damage and spoilage" is not necessary as the Regulation only needs to state the information that fleet owners must provide to demonstrate they meet the criteria. Nothing in the language would preclude a fleet owner from voluntarily submitting additional information; however, only information that would be used to determine whether the exemption criteria were met could be considered.

m) Daily Usage Exemption – Remove 10 Percent Threshold Requirement

Comment Summary: The commenters ask for the removal of the 10 percent ZEV/NZEV threshold for accessing the Daily Usage Exemption.

Commenter: [033-15d, 117-15d, 133-15d, 135-15d, 160-15d, 175-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Daily Usage Exemption – Remove 10 Percent Threshold Requirement" in "Exemptions and Extensions – Daily Usage" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

n) Daily Usage Exemption – Remove Battery-Electric Vehicle Capacity Sunsets

Comment Summary: The commenters state the Daily Use Exemption should not sunset when vehicles become available with certain energy capacities, or that the sunset capacities should be edited.

Commenter: [155-15d, 175-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Daily Usage Exemption – Remove Battery-Electric Vehicle Capacity Sunsets" in "Exemptions and Extensions – Daily Usage" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

o) Daily Usage Exemption – Remove Fuel Cell Electric Vehicle Limit

Comment Summary: The commenters state that the Daily Usage Exemption should not require fleets to purchase FCEVs if available.

Commenter: [122-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Daily Usage Exemption – Remove Fuel Cell Electric Vehicle Limit" in "Exemptions and Extensions – Daily Usage" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

p) Daily Usage Exemption – Allow Internal Combustion Engine Vehicle Data to Substantiate Exemption Requests

Comment Summary: The commenters request that the Daily Usage Exemption be expanded to allow fleets to substantiate and calculate daily usage from existing ICE vehicles, without requiring the purchase of a ZEV for energy use calculations.

Commenter: [055-15d, 125-15d, 133-15d, 135-15d, 155-15d, 175-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Daily Usage Exemption – Allow Internal Combustion Engine Vehicle Data to Substantiate Exemption Requests" in "Exemptions and Extensions – Daily Usage" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

q) Daily Usage Exemption – Master Response

Comment Summary: The commenters suggest the need for exemptions when ZEVs are available but not operationally feasible or cannot meet duty cycles.

Commenter: [160-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Daily Usage Exemption – Master" in "Exemptions and

Extensions – Daily Usage" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

r) Daily Usage Exemption – Include Additional Usage Factors

Comment Summary: The commenters suggest modifying the daily use exemption criteria to include additional relevant usage factors.

Commenter: [117-15d, 175-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Daily Usage Exemption – Include Additional Usage Factors" in "Exemptions and Extensions – Daily Usage" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

s) Daily Usage Exemption – Allow Three Highest Values

Comment Summary: The commenters argue against excluding the three highest values from calculations for Daily Usage Exemption.

Commenter: [055-15d, 058-15d, 112-15d, 125-15d, 133-15d, 135-15d, 144-15d, 155-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Daily Usage Exemption – Allow Three Highest Values" in "Exemptions and Extensions – Daily Usage" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

11. Exemptions and Extensions – Non-Repairable Vehicles

a) Non-Repairable Vehicles – Allow One Year to Replace

Comment Summary: Commenters state fleets should be permitted up to one year to replace a non-repairable vehicle because it is an unforeseen event and public fleets must have adequate time to follow their necessary public procurement processes.

Commenter: [133-15d]

Agency Response: No changes were made in response to these comments. The language allows fleet owners to purchase a used vehicle which are available on the open market. The process is different, where a manufacturer would not need to build a truck and would not take as much time. 180 days is sufficient because the provision was meant to address situations where the non-repairable vehicle was critical to operations and needs to be replaced quickly and allow for purchase of an existing vehicle rather than a new one which could take a year or more in manufacturing. The fleet owner has other options as well; they can have backup vehicles and use those instead, renting or leasing vehicles, or contracting the work out in case this timeframe is insufficient.

b) Non-Repairable Vehicles – Allow Fleets to Attest Vehicles are Non-Repairable

Comment Summary: Commenter suggests allowing HPF fleets to submit their own attestation that a vehicle is not repairable for situations where police reports would not be generated or insurance companies would not be involved, citing an example where a vehicle suffers a catastrophic engine failure during routine operations, it may be deemed by the company to be non-repairable because the cost to repair or replace the engine outweighs the value of the vehicle.

Commenter: [122-15d]

Agency Response: No changes were made in response to these comments. The intent of the provision is to provide some predictability to fleet compliance timelines under these catastrophic scenarios, and not to have another exemption from the Regulation requirements. The example of the engine not being worth repairing, and it is time to replace the vehicle, a ZEV would be expected to replace the vehicle. It is a business or economic decision to either buy the ZEV or fix the engine. The purpose of the Regulation is ultimately air quality benefits and to deploy ZEVs. Engine maintenance can be planned for in advance. This would effectively introduce a loophole that could be abused by fleets not acting in good faith. The police or insurance reports would be necessary to ensure this failure was unanticipated and couldn't be addressed with preventative maintenance. The provision was crafted narrowly for the Model Year Schedule to only address damage to the engine and vehicle such that the vehicle is not repairable and exclude economic reasons for replacing vehicles, because these are the most common reasons vehicles are replaced. Alternatively, fleet owners can use the ZEV Milestones Option to have full flexibility to manage their fleet of vehicles, and purchase ICE vehicles in these scenarios if the fleet is meeting its Milestone requirement, so the fleet owner would not need this provision.

c) Non-Repairable Vehicles – Allow New Vehicle Purchase Instead of Used

Comment Summary: Commenters state the Non-Repairable Vehicle Exemption should allow purchase of new vehicles, as the used vehicle market for specialized utility vehicles is not adequate to rely on. If no used vehicle and no comparable ZEVs are available to purchase, a fleet would be out of options.

Commenter: [112-15d, 133-15d, 138-15d, 155-15d, 173-15d]

Agency Response: No changes were made in response to these comments. If the truck is 13 years old or older, if there is no ZEV available to purchase, the Regulation has language to address this in the ZEV Purchase Exemption. If the vehicle is newer than 13 years old, the fleet owner can buy a new ZEV or NZEV, and if they want to buy used, they can purchase an ICE vehicle. Additionally, in case this is a significant issue, they can opt-in to the ZEV Milestones Option provided they meet the targets, until 2030 to have more flexibility to manage their fleet to purchase ICE vehicles as long as the Milestones are met. The provision was crafted narrowly for the Model Year Schedule to only address damage to the engine and vehicle such that the vehicle is not repairable and exclude economic reasons for replacing vehicles, because these are the most common reasons vehicles are replaced. Alternatively, fleet owners can use the ZEV Milestones Option to have full flexibility to manage their fleet of vehicles, and purchase ICE vehicles in these scenarios if the fleet is meeting its Milestone requirement, so the fleet owner would not need this provision.

d) Non-Repairable Vehicles – Allow Exemption to Apply to Non-Repairable Engine or Vehicle

Comment Summary: Commenter states that the Non-Repairable Vehicle Exemption should allow for either the engine or the vehicle to be considered non-repairable and qualify for the exemption, rather than requiring both the engine and vehicle be non- repairable, because other parts of the vehicle besides the engine could be damaged and require the vehicle to be replaced, for example a transmission, drive shaft, or combination of other expensive components that would constitute the vehicle being non-repairable. A vehicle can be damaged beyond repair due to damage to either the body, or the engine, or both. Insurance companies can declare a vehicle a total loss due to body damage that does not impact the motor.

Commenter: [112-15d, 125-15d, 133-15d, 169-15d, 173-15d]

Agency Response: No changes were made in response to these comments. Where applicable, this provision was included to cover uncommon or unexpected events that cannot reasonably be anticipated by the fleet owner, such as an accident or catastrophic fire, that render the vehicle inoperable and is beyond repair; individual part failures are foreseeable, can typically be replaced or repaired, and can be mitigated with regular maintenance, and would not require a whole vehicle and engine to be replaced. The intent of the provision was not to provide an exception for relatively common parts repairs, including engine rebuilds, that could be reduced or planned for with normal maintenance where the vehicle would not need to be replaced. See more discussion on rationale for the provision in Chapter C.(B).19., section 2015.1(c)(9), of the ACF 15-Day Notice. The provision was crafted narrowly for the Model Year Schedule to only address damage to the engine and vehicle such that the vehicle is not repairable and exclude economic reasons for replacing vehicles, because these are the most common reasons vehicles are replaced. Alternatively, fleet owners can use the ZEV Milestones Option to have full flexibility to manage their fleet of vehicles, and purchase ICE vehicles in these scenarios if the fleet is meeting its Milestone requirement, so the fleet owner would not need this provision.

e) Non-Repairable Vehicles – Include All Vehicle Loss Reasons

Comment Summary: Commenters state ‘non-repairable’ should include any situation where a vehicle may be deemed non-repairable, a loss, or salvage, including when a vehicle is stolen and not recovered.

Commenter: [055-15d, 133-15d, 155-15d]

Agency Response: No changes were made in response to these comments. The intent of the provision is to provide some predictability to fleet compliance timelines under these catastrophic scenarios, and not to have another exemption from the Regulation requirements. In the example of the engine or vehicle not being worth replacing, and it is time to replace the vehicle, an owner would be expected to replace the vehicle. It is a business or economic decision to either buy the ZEV or fix the engine. The purpose of the

Regulation is ultimately air quality benefits and to deploy ZEVs. Engine maintenance can be planned for in advance. This would effectively introduce a loophole that could be abused by fleets not acting in good faith. In the event of a theft, the fleet would be required to purchase a ZEV. The provision was crafted narrowly for the Model Year Schedule to only address damage to the engine and vehicle such that the vehicle is not repairable and exclude economic reasons for replacing vehicles, because these are the most common reasons vehicles are replaced. Alternatively, fleet owners can use the ZEV Milestones Option to have full flexibility to manage their fleet of vehicles, and purchase ICE vehicles in these scenarios if the fleet is meeting its Milestone requirement, so the fleet owner would not need this provision.

f) Non-Repairable Vehicles – Include in ZEV Milestones Option

Comment Summary: Commenter requests that CARB extend the Non-repairable Vehicle Provision to fleets complying with the ZEV Milestones Option. Commenter states that this is necessary in circumstances where a lost or damaged ZEV is needed to meet the ZEV Milestone requirement and time is needed to secure a replacement, or the fleet owner purchases a replacement ICE vehicle, but is required to retire it before the end of its useful life to meet their ZEV Milestone requirement.

Commenter: [155-15d]

Agency Response: No changes were made in response to these comments. The rationale for including the Non-repairable Vehicle Provision in the Model Year Schedule and not the ZEV Milestones Option is because the Milestones Option provides fleet owners greater flexibility to manage their fleet regardless of vehicle age and mileage. For example, an ACF compliant fleet utilizing the ZEV Milestones Option has the flexibility to replace the non-repairable vehicle with either an ICE or ZEV that best meets the fleet's operational needs, as long as the Milestones overall are met. A fleet will remain compliant as long as the fleet continues to meet the required ZEV percentages.

g) Non-Repairable Vehicles – Unique Redlines from Comment Letter 155

Comment Summary: Redlines to ZEV Milestone Exemptions. Section 2015.2(f) add “(10) Non-repairable Vehicles. Fleet owners that need to temporarily replace a vehicle due to an accident or other onetime event due to circumstances beyond the fleet owner's control, such as fire, catastrophic failure, or theft, that damages the chassis or primary equipment such that the vehicle is not repairable, or results in loss of the vehicle, may request and obtain an exemption as follows: (A) A fleet owner that receives this exemption for a qualifying ICE vehicle may purchase a vehicle of the same configuration and engine of the same or newer model year and exclude it from the ZEV Milestone Calculation specified in section 2015.2(b) until the end of its useful life. (B) A fleet owner that receives this exemption for a qualifying ZEV may continue to count the ZEV toward its Milestone requirements until a replacement ZEV has been purchased and delivered, even if the qualifying ZEV is removed from the California fleet before the replacement ZEV delivery.”

Commenter: [155-15d]

Agency Response: No changes were made in response to these comments. Suggested addition of the provision in general to the ZEV Milestones Option is not necessary for reasons discussed in section "Non-Repairable Vehicles – Include in ZEV Milestones Option" in "Exemptions and Extensions – Non-Repairable Vehicles" of the "15-Day Comment Period Public Comments with Agency Responses."

Suggested addition of "… theft, which damages the chassis or primary equipment… or results in loss of the vehicle" is not necessary because the intent of the provision is to provide some predictability to fleet compliance timelines under these catastrophic scenarios, and not to have another exemption from the Regulation requirements. The example of the engine or vehicle not being worth replacing, and it is time to replace the vehicle, a ZEV would be expected to replace the vehicle. It is a business or economic decision to either buy the ZEV or fix the engine. The purpose of the Regulation is ultimately air quality benefits and to deploy ZEVs. Engine maintenance can be planned for in advance. This would effectively introduce a loophole that could be abused by fleets not acting in good faith. The police or insurance reports would be necessary to ensure this failure was unanticipated and couldn't be addressed with preventative maintenance. In the event of a theft, the fleet would be required to purchase a ZEV. The provision was crafted narrowly for the Model Year Schedule to only address damage to the engine and vehicle such that the vehicle is not repairable and exclude economic reasons for replacing vehicles, because these are the most common reasons vehicles are replaced. Alternatively, fleet owners can use the ZEV Milestones Option to have full flexibility to manage their fleet of vehicles, and purchase ICE vehicles in these scenarios if the fleet is meeting its Milestone requirement, so the fleet owner would not need this provision.

Suggested addition that would make the provision apply to both damaged ICE vehicles and ZEVs to address non-repairable vehicle interactions with the ZEV Milestones Option are not necessary because no change is being made to include this provision in that compliance pathway, thus the commenter's rationale for including the provision for non-repairable ZEVs would not apply. Including the language allowing the full useful life of an ICE vehicle with the same or newer model year engine would introduce a loophole in the Regulation by which vehicles that are deemed no longer repairable or a loss/salvage by the fleet owner could just be swapped out with newer ICE vehicles to indefinitely extend the useful life period, and therefore never have to replace the vehicle with a ZEV. The intent of the provision is to provide essentially the original useful life of the original vehicle to the fleet owner before they would need to upgrade to ZEVs, thereby preventing a fleet owner from being forced to upgrade to a ZEV earlier than originally planned. The intent is not to provide flexibility to extend compliance timeframes beyond the original useful life.

12. Exemptions and Extensions – General

a) Criteria and Process 15-Day Changes Are Too Complex

Comment Summary: Commenters state the ACF 15-day changes to exemption or extension criteria, or processes are generally too complex, overly burdensome, or use a one-size fits all approach.

Commenter: [053-15d, 117-15d, 135-15d]

Agency Response: No changes were made in response to these comments. In the first ACF 15-day changes, language was added to enhance clarity to multiple exemptions and extensions under the board's direction while addressing process related concerns. The exemption process will not impose an excessive burden on applicants, as the provisions were specifically designed with both staff resources and fleet owner burden in mind. Furthermore, the Board has directed staff to ensure a more streamlined and clear approach to all exemptions and extensions.

b) Backup Vehicle Exemption – Remove Requirement to Remove Backup Vehicles that Exceed Mileage from California Fleet

Comment Summary: Commenter states that A4A recommends that CARB revisit the changes to the definition for Backup Vehicles. Based on the term, it seems that CARB intended to provide a provision for vehicles that may be brought into operational service if other vehicles in the fleet break down or are no longer operational. However, the changes penalize fleet owners for implementing beneficial operational redundancies by housing backup vehicles. The provision only applies if the vehicle is operated less than 1,000 miles per year, and as soon as a vehicle "no longer meet[s] the criteria" it "cannot be operated in California and must be removed from the California fleet." This contradicts CARB's earlier definition that if a vehicle is operated in California, it should be counted as part of the fleet. Instead of requiring fleet owners to remove backup vehicles from the state altogether if they are utilized beyond the 1,000-mile limit, we suggest that CARB simply change the Regulation to count the vehicle as part of the fleet once the Backup Vehicle criteria is no longer met.

Commenter: [121-15d, 165-15d]

Agency Response: No changes were made in response to these comments. The backup vehicle language does not conflict with the California fleet definition; the language explicitly excludes the vehicles from the calculations of the ZEV Milestones Option. Nothing compels a fleet owner to report a vehicle as a backup vehicle. It is the fleet owner's choice to report one as such and should not report it as a backup vehicle if they do not believe they can stay within the mileage threshold. The Regulation language does not say fleet owners should identify any vehicle that might operate less than 1,000 miles then be penalized if they are wrong; they simply have an option to identify vehicles that will meet the criteria and designate those vehicles as such. Additionally, if a fleet owner does not have a compliance obligation until a later timeframe, the fleet owner does not have to report a vehicle as a backup vehicle until the compliance requirements are upcoming and the fleet owner deems it necessary to exclude the vehicle from the ZEV compliance calculations. As written, the fleet owner would have to identify backup vehicles and meet the requirement. If a fleet owner needs to use the vehicle more, they can change the status of the vehicle themselves in the reporting system to no longer opt-in as a backup vehicle. The intent of the language is to require the vehicle to be removed; if a fleet selects backup for a vehicle, they are expected to track the vehicle's mileage and not exceed the mileage. Exceeding the vehicle's allowed mileage is foreseeable and within the control of the fleet owner. Therefore, the vehicle must be removed from the California fleet instead of just returning to normal service. This would create a loophole where fleet owners would be incentivized to report every vehicle as a backup vehicle, and thus unfairly skew the fleet's compliance obligations, if there were no consequences for exceeding the mileage threshold.

c) Allow Fleet Expansion

Comment Summary: Commenter states that the exemptions should not be limited to vehicles being replaced and should be allowed to qualify for fleet expansions.

Commenter: [175-15d]

Agency Response: No changes were made in response to these comments. Exemptions and extensions are designed to be narrow to capture edge-case scenarios outside of a fleet owners' control. Fleet expansions are well within the control of the fleet owner. The commenter's proposal to acquire ICE vehicles to expand their fleet is contrary to the purpose and goals of the ACF Regulation.

d) Consequence if Approval or Denial Not Provided Within 45 Days

Comment Summary: Commenter states the response timeframe language for the Executive Officer responding to complete exemption or extension requests should include language stating the exemption or extension would be deemed approved if no response was received within 45 days.

Commenter: [113-15d, 122-15d]

Agency Response: No changes were made in response to these comments. The intent of the language is to indicate that a request for exemption or extension would be approved or disapproved within 45 days after an owner submits a complete application. If a fleet owner submits an incomplete application, the clock will not start until the application is complete. Staff will make every attempt to work with fleet owners as quickly as possible and anticipate most review and determinations can be made within that period.

e) Clarify Exemption or Extension Application Timeline Overlap with Compliance Requirements

Comment Summary: Commenter states exemption and extension request processes should clarify what happens when a timely submitted request overlaps a deadline while awaiting CARB response and suggests clarifying additional requirements for the timeliness of request submissions.

Commenter: [122-15d]

Agency Response: No changes were made in response to these comments. Each exemption and extension provision already has clear timelines during which the fleet owner must submit requests for consideration and were further clarified with the ACF 15-day changes. For example, fleet owners seeking an Infrastructure Delay Extension must submit their application no later than 45 days prior to an upcoming compliance deadline, and those seeking a Daily Usage Exemption must submit applications no later than one year prior to upcoming compliance deadlines. With the language specifying that CARB would respond to exemption or extension requests within 45 days, the commenter's example scenario of an overlap would not occur with the language as written.

f) Taking Action One Year in Advance

Comment Summary: Commenters state the requirement for various exemptions to take action a year in advance of an upcoming deadline should be extended because exemption requests for 2025 deadlines would need to be filed by December 31, 2023, which is not enough time for fleets to go through the process, and that if the Regulation is delayed due to OAL, these deadlines are also extended.

Commenter: [122-15d]

Agency Response: No changes were made in response to these comments. The first exemption request deadline for HPF fleets subject to the ACF Regulation is not until January 1, 2024, for an upgrade deadline of January 1, 2025. Therefore, submission would not be required until January 1, 2024. If for any reason the Regulation does not become effective until after that date, the HPF section of the ACF Regulation provides language referencing the effective date as the deadline. It is necessary to request submission for this additional flexibility in advance to ensure fleets are making good faith planning efforts in advance to comply with the Regulation and to give staff sufficient time to process exemption requests. In addition, in the early years of the ACF Regulation, the need for exemptions will be much less due to the flexibility already built into the regulatory upgrade requirements.

g) Remove Executive Officer Judgement Language

Comment Summary: Commenters state "good engineering judgement of the Executive Officer" should be removed from the ZEV Purchase Exemption or needs to be removed broadly from the rule.

Commenter: [113-15d, 139-15d, 169-15d]

Agency Response: No changes were made in response to these comments. The Exemption necessarily requires the Executive Officer or their delegates to make engineering or business judgements about information submitted by fleets, manufacturers, utilities, or other parties in determining whether exemption or extension criteria have been met in edge-case scenarios where additional variables not foreseen by the Regulation can be assessed in determining approval. Additionally, this approach is consistent with other CARB Regulations that also introduce the judgement of the Executive Officer in determining whether objective criteria have been met.

h) Remove Requirement to Demonstrate Milestone Cannot be Met Without Exemptions

Comment Summary: Commenter requests the removal of the requirement for fleets to demonstrate that their next applicable upcoming ZEV Fleet Milestone cannot be reached without exemptions by requesting and obtaining exemptions for all other ICE vehicles in their California fleet under the Daily Usage and ZEV Purchase Exemptions. Commenter states that this is an administrative burden and requiring exemptions for all ICE vehicles in the California fleet would also effectively nullify the future milestone targets because the fleet would have received exemptions for all remaining ICE vehicles. Commenter alternatively requests for fleets to identify why no other fleet vehicle can be replaced with a ZEV rather than submitting simultaneous exemption applications for every remaining vehicle in the fleet.

Commenter: [155-15d]

Agency Response: No changes were made in response to these comments. The addition requiring applying and obtaining exemptions for all remaining ICE vehicles in the fleet for fleet owners opting in the ZEV Milestones Option was made during the first ACF 15-day changes and is necessary as the ZEV Milestones Option provides fleet owners full flexibility to manage their fleet composition as they see fit as long as they meet the ZEV Milestones. This additional flexibility means the exemption would otherwise not be needed if other vehicles in the California fleet can be upgraded to ZEVs. This change will reduce administrative burden by minimizing unnecessary exemption requests.

i) Require Installation of Electric Power Take Off for Granted Work Truck Exemptions

Comment Summary: Commenter states that granted work truck exemptions should require the installation of ePTO systems on the purchased ICE vehicle.

Commenter: [172-15d]

Agency Response: No changes were made in response to these comments. ePTO systems can reduce emissions from combustion vehicles and are being incorporated into ZEV designs or being installed on ZEV bodies. CARB already provides considerable incentive funding to encourage the ePTO market and determined that a regulatory requirement is not necessary to incentivize these technologies. The purpose of the Regulation is to expand the ZEV market, and ePTOs are not ZEVs.

j) Adequate Infrastructure Exemption

Comment Summary: The commenters request that CARB create off-ramps if adequate infrastructure is not present, linking targets to related electrical generation, transmission, distribution, and infrastructure availability.

Commenter: [171-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Adequate Infrastructure Exemption" in "Exemptions and Extensions – General" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

k) Exemption Process is Too Burdensome

Comment Summary: The commenters state that the exemption process is too burdensome on CARB staff or regulated parties to be feasible or efficient.

Commenter: [113-15d, 158-15d, 169-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Exemption Process is Too Burdensome" in

"Exemptions and Extensions – General" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

l) Alternative Fuels and Combustion Vehicles – Require 'Optional Low NOx' ICE Vehicles Combusting Biomethane When ZEV Are Not Available

Comment Summary: The commenters recommend that ACF consider alternative compliance options like natural gas/RNG and hydrogen blended fuel vehicles during the transition to ZEVs.

Commenter: [174-15d, 176-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Alternative Fuels and Combustion Vehicles – Require 'Optional Low NOx' ICE Vehicles Combusting Biomethane When ZEV Are Not Available" in "Alternative Fuels and Combustion Vehicles" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

m) Establish Independent Exemption Hearing Board

Comment Summary: The commenters state that CARB should establish a hearing board to review exemption requests.

Commenter: [158-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Establish Independent Exemption Hearing Board" in "Exemptions and Extensions – General" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

n) Include Appeals Process for All Exemptions

Comment Summary: The commenters request an appeal process for all exemptions.

Commenter: [122-15d, 135-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Include Appeals Process for All Exemptions" in "Exemptions and Extensions – General" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

o) Adjust One Year Advance Action Requirement to Start After Regulation Finalized

Comment Summary: The commenters request that extensions with a one-year advance action requirement begin after the ACF Regulation is finalized.

Commenter: [121-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Adjust One Year Advance Action Requirement to Start

After Regulation Finalized" in "Exemptions and Extensions – General" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

13. Exemptions and Extensions – Infrastructure Delays

a) Infrastructure Delay Extension – 15-Day Changes Too Onerous

Comment Summary: Commenter states the changes to Infrastructure Delay Extension are too onerous and detailed to be used and applied.

Commenter: [100-15d, 143-15d]

Agency Response: No changes were made in response to these comments. The extension criteria were streamlined, clarified, and made more objective in the direction of the Board and in response to stakeholder comments in the ACF 15-day changes. Additional process language was added to address complexities of verifying and implementing the newly added criteria for site electrification related delays. The complex nature of assessing individual site infrastructure delays while preventing potential loopholes in the Regulation necessitates detailed information to verify an applicant fleet's need for extensions.

b) Infrastructure Delay Extension – Include Lack of Access to Public Charging

Comment Summary: Commenter states the Infrastructure Delay Provision needs to account for lack of access to public charging.

Commenter: [138-15d, 160-15d]

Agency Response: No changes were made in response to these comments. The ACF Regulations will set clear market signals to infrastructure providers that a ZEV market for supporting fuels will be there. The Regulation was structured with later timelines for vehicles that are more likely to use public infrastructure to provide time for that infrastructure to be built out. Fleets have the choice to electrify vehicles they desire first. The HPF Regulation also generally targets larger entities that have more flexibility and capital to select vehicles and sites to transition first. According to the LER data, most trucks don't travel more than 100 miles a day on average, and most trucks return to base. The Milestones Option starts with predominantly local, short distance duty cycle vehicles. The likelihood of this being an issue will shrink over time. The Regulation also provides flexibility to use NZEVs for compliance which would not have similar limitations on public fueling infrastructure availability. With more time, there is a higher likelihood FCEVs will be available and stations will be developed. There are charging and hydrogen fueling stations that can be used by lighter trucks as well. Charging-as-a-service, mobile, temporary, and off-grid fueling, and generation solutions exist today for ZEVs and can be used as alternative fueling solutions. With the recent passage of the IRA and the IIJA, public infrastructure will be less of an issue as these programs are rolled out. See more information about developments in public or retail ZEV fueling in section "Infrastructure Availability – Publicly Accessible" in "Infrastructure and Grid Concerns" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

c) Infrastructure Delay Extension – Include When Driver Takes Truck Home

Comment Summary: Commenter states the Infrastructure Delay Provision needs to account for vehicles that are taken home at the end of the night.

Commenter: [160-15d]

Agency Response: No changes were made in response to these comments. Based on staff's assessment of the market, most fleets subject to the Regulation are expected to use depot charging initially, and therefore this factor does not need to be considered as part of the extension criteria. It is a business decision to allow drivers to take trucks home and fleet owners can adjust their business practices if needed to best utilize their ZEVs. ZEVs can save fleet owners time because overnight charging would take less time than fueling a conventional vehicle during work hours. Manufacturers already provide services that identify vehicle charging such that companies could pay for an upgrade at the driver's home and track such charging. The costs of installing residential charging for a lower weight class vehicle is typically considerably lower than a centralized depot and could result in cost savings for the company compared to installing infrastructure at a depot. Fleet owners also have additional options besides paying for infrastructure at driver's homes; they could develop a centralized parking and fueling depot, utilize mobile or temporary or off grid charging or self-generation solutions or public charging, etc. See more information about developments in public or retail ZEV fueling in section "Infrastructure Availability – Drivers Park Truck at Home" in "Infrastructure and Grid Concerns" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

d) Infrastructure Delay Extension – Incremental Upgrade Requirement Concerns

Comment Summary: Commenter states that the new documentation required for the extension under the ZEV Infrastructure Site Electrification Delays (Section 2015.3(c)(2)(C)), includes the application, or a copy of utility contract, "consistent with the number of ZEVs the fleet owner must deploy each calendar year," which fails to take into account how a grid is operated and upgraded. Utilities do not make annual individual infrastructure upgrades in the piecemeal manner that is anticipated by this proposed Regulation.

Commenter: [121-15d]

Agency Response: No changes were made in response to these comments. Utility stakeholders have indicated, and existing infrastructure projects validate, that utilities are willing to install infrastructure in a phased-in manner. For example, a hypothetical site needs 100 ZEVs for compliance but can only support 10 with the current amount of power a utility can deliver to the site. 30 more could be supported over a few years with an upgraded transformer while all 100 could be supported with an upgraded substation or line reconductoring. With a granted extension, the fleet owner would first be required to deploy the 10 ZEVs the site can support. The utility could decide to install the transformer first, which may take less time than upgrading or installing a substation. If the utility decides to do so, the fleet owner would be required to then deploy all 30 ZEVs until the substation upgrade is complete, at which time the fleet owner would need all 100 ZEVs and the extension would no longer be necessary. The intent of this is to ensure the fleet owner is reasonably deploying ZEVs in a good faith effort to comply with the requirements.

e) Infrastructure Delay Extension – Capacity Evaluation Concerns

Comment Summary: Commenters state the Infrastructure Delay Extension requirement for utility site infrastructure capacity evaluations is unreasonable, as most utility providers do not provide site infrastructure capacity evaluations until a work request is submitted for work to be conducted at the site and due to competing interests from other ratepayers needing upgrades, any capacity estimate without a work contract in place with a utility provider could change at any time. If this occurs, the utility estimate and resulting required amount of ZEVs to be deployed would no longer be accurate and could jeopardize a fleet owner's compliance if CARB expects a number of ZEVs based on an old capacity estimate that the fleet owner could not reasonably meet if the capacity is taken by another ratepayer.

Commenter: [113-15d]

Agency Response: No changes were made in response to these comments. These scenarios are speculative, and staff are not aware of any instances of this occurring. The Regulation cannot anticipate every possible scenario that might occur; sufficient flexibility is built in to comply with the Regulation while providing reasonable criteria for fleet owners to demonstrate actual need for extensions to remain in compliance. Nothing in the Regulation precludes a fleet from submitting additional information from the utility to CARB to consider as part of the Executive Officer’s good engineering and business judgement. Additionally, nothing in the Regulation presumes that the Regulation is the only source of load upgrades a utility would need to make. The intent of the provision is not to suggest a utility would not make upgrades affecting their capacity estimates for other reasons. These kinds of scenarios are why inclusion of the language related to the Executive Officer’s good engineering or business judgement is necessary, to consider all relevant issues. A utility’s assessment of site requirements would likely include other needed on-site loads that are communicated to the utility.

f) Infrastructure Delay Extension – Multiple Fleets at One Site Concerns

Comment Summary: Commenter states that the revised language states that the extension may be “up to two years, beginning on the applicable compliance date for the number of vehicles that qualify for the extension,” but this is an unknown quantity as on-airport charging facilities may have shared charging stations utilized by all carriers operating at the airport. By requiring fleet owners to “deploy the maximum number of ZEVs needed to meet its compliance obligations and that can be supported by the utility” in Section 2015.3(c)(2), CARB is failing to take into account that airports have multiple fleet owners utilizing the same charging capacity and the “maximum number” for one entity is mutually dependent on the charging demand of all of the other owners and operators. Lead times to procure and install chargers are a minimum of 18-24 months.

Commenter: [121-15d]

Agency Response: No changes were made in response to these comments. Nothing in the Regulation precludes a fleet from submitting additional information to the utility or to CARB to consider as part of the Executive Officer's good engineering and business judgement. The intent of the provision is not to suggest a fleet would not make upgrades requiring utility capacity for other reasons. These kinds of scenarios are why inclusion of the language related to the Executive Officer's good engineering or business judgement is necessary, to consider all relevant issues. A utility's assessment of site requirements would likely include other needed on-site loads that are communicated to the utility.

An extension for a prorated or shared station could be treated the same as a station utilized by a single fleet with the current language. The utility serving the location would likely be aware that multiple fleets are requiring upgrades at the site and would likely include that information in their estimate. Multiple fleets utilizing a common site can also submit a joint application. Nothing in the Regulation precludes the Executive Officer from considering all vehicles that would rely on a common charger and information about what portion of the fleet would be using it. The extension could be granted for the number of vehicles that could not be supported by the fleet's proportion of the shared infrastructure.

g) Infrastructure Delay Extension – Cumulative Demand Concerns

Comment Summary: Commenter states CARB must also consider the electricity demand that will be caused by concurrent state efforts to electrify other sectors, such as the residential and light-duty vehicle sectors as part of the broader energy system for supply, distribution, and system reliability, as part of what staff assumes is the Infrastructure Delay Extension based on immediate context. Utility commenter states the approach would segregate total load analysis of a customer into ZEV Regulation compartmentalization, i.e., a determination is needed for ACF needs only, as opposed to total cumulative electrification needs, i.e., ZEV forklifts or off-road equipment.

Commenter: [103-15d, 117-15d, 133-15d, 169-15d]

Agency Response: No changes were made in response to these comments. Nothing in the Regulation precludes a fleet from submitting additional documents to support their extension request from the utility to CARB to consider as part of the Executive Officer's good engineering and business judgement to demonstrate that the specified criteria have been met. Additionally, nothing in the Regulation presumes that the Regulation is the only requirement to which a fleet may be subject. The intent of the provision is not to suggest a fleet would not make upgrades requiring utility capacity for other reasons. The language does focus on compliance with the Regulation because that is the scope and focus of this language. These kinds of scenarios are why inclusion of the language related to the Executive Officer's good engineering or business judgement is necessary, to consider all relevant issues. A utility's assessment of site requirements would likely include other needed on-site loads that are communicated to the utility such as that expected from electrification of forklifts and cargo handling equipment. Utilities can provide information to fleets about total load needed at a site for all upgrades needed, whether it is for compliance with multiple Regulations, multiple fleets sharing infrastructure the same site, or other needed non-regulatory upgrades.

The site electrification delay added as part of the first ACF 15-day changes considers utility related delays. Utilities would be expected to be aware of any regional cumulative capacity issues with needed upgrades, and it is reasonable to expect them to factor these loads in to their estimated completion of utility-side upgrades as part of the extension process. Because these cumulative demands are already expected to be considered, there are no additional changes necessary in response to these comments.

h) Infrastructure Delay Extension – Hydrogen Fueling Infrastructure Lead Time

Comment Summary: Commenters state the long lead time for hydrogen infrastructure development is not currently accounted for under the Infrastructure Delay Extensions.

Commenter: [117-15d]

Agency Response: No changes were made in response to these comments. Staff disagree that hydrogen infrastructure is not accounted for under the extension; as part of the ACF 15-day changes, staff added "delay in manufacture and shipment of ZEV fueling infrastructure equipment" as a reason for which a fleet owner could apply for an Infrastructure Delay Extension for construction-related delays. This provision is specifically fuel neutral and would necessarily include hydrogen fueling infrastructure equipment. Additionally, the site electrification delay criteria specifies that information about hydrogen stations being installed must be submitted as part of the package, explicitly including such fueling stations in the extension criteria.

i) Infrastructure Delay Extension – Construction Permit Timing Concerns

Comment Summary: Commenter requests that the first two years of the rule implementation do not require permit date of one year ahead of the next compliance deadline for the Infrastructure Construction Delay extension construction permit requirements. Commenter states that considering that the rule will not be adopted until mid-2023, and compliance begins January 1, 2024, fleet owners will only have about six months to obtain construction permits to be eligible for the infrastructure construction delay extension in the first year.

Commenter: [047-15d, 156-15d]

Agency Response: No changes were made in response to these comments. It is highly unlikely that fleets will have no other choices in the first years of implementing the Regulation due to the sufficient flexibility built in to the phased-in approach, allowance to keep vehicles for their existing useful life, or allowance for SLG fleets to keep ICE vehicle indefinitely. Additionally, many fleets will have several locations to choose from, so an extension would not be necessary if any other site could be upgraded to meet compliance obligations. It is unlikely extensions will be needed until a higher percentage of the fleet is upgraded.

j) Infrastructure Delay Extension – Construction Completion Timing Concerns

Comment Summary: Commenter states that utilities cannot provide guarantees of construction timelines or grid upgrades as these needs are subject to other priorities, including responding to storm events, prevention of outages, and other grid priorities. To implement ZEV airline ground support equipment at the scale that CARB is proposing, the respective airport authority, the airlines, and the utility would need to develop a comprehensive and methodical plan to ensure the charging infrastructure can meet the full level of expected demand for the 100 percent milestone.

Commenter: [121-15d]

Agency Response: No changes were made in response to these comments. The extension criteria do not specify that utilities must provide a guarantee, only an estimated completion. The period of time granted under a site electrification delay would be up to three years based on this estimate and could be extended to up to a total of five years with updated information if the estimated completion date ends up being incorrect. Fleet owners would likely need to develop comprehensive and methodical plans in conjunction with utilities and other related parties to meet the Regulation's compliance obligations.

k) Infrastructure Delay Extension – Clarity on Vehicle Purchases

Comment Summary: Commenter states they appreciate clarity on the Infrastructure Delay Extension that would enable fleets to proceed with purchasing ICE vehicles where necessary to ensure fleets can continue to provide services to their communities.

Commenter: [124-15d]

Agency Response: No changes were made in response to these comments. The commenter is incorrectly interpreting the language; the Regulation specifies in section 2013(n)(3) that "fleet owners may request a temporary extension to count an ICE vehicle being replaced as a ZEV purchase when determining compliance with the ZEV purchase requirements…." This language explicitly does not allow an ICE vehicle to be purchased under the extension; instead, it treats an existing ICE vehicle that would have needed to be replaced as a ZEV purchase, and only until the extension period granted is over. This ensures a fleet would not be considered out of compliance if the fleet had planned on making a ZEV purchase to meet their compliance obligation but could not place the ZEV in service due to delays in infrastructure. In contrast, for example, the language in 2013(n)(2) for the Daily Usage Exemption states "Fleet owners may … purchase a new ICE vehicle," which explicitly allows for an ICE purchase instead of a ZEV.

l) Infrastructure Delay Extension – Allow Delay of ZEV Purchases

Comment Summary: Commenter requests that the Infrastructure Construction Delay extension allow the delay of ZEV purchases and that the language "fleet owners may only request the following extensions for ICE vehicles being replaced at the site experiencing the delay" is unclear in this context. Commenter requests that section 2013.1(c)(1)(D) be removed as it implies that fleet owners are required to purchase vehicles they are unable to use if they do not have the charging or fueling infrastructure in place.

Commenter: [047-15d, 156-15d]

Agency Response: No changes were made in response to these comments. The intent of the provision is to provide a delay during which a fleet owner would not be considered out of compliance; the intent is not to excuse a fleet owner from making a good faith effort to comply with the Regulation, which would include going forward with vehicle orders and timing the delivery of such vehicles with the end of the utility's anticipated delay. The fleet owner would be expected to begin using the infrastructure to fuel ZEVs at the time the delay ends, and the project completes; delaying the required purchases until the project is finished could result in un- or under-utilized fueling infrastructure while awaiting a ZEV to be built and would only serve to unnecessarily delay essential emissions reductions.

m) Infrastructure Delay Extension – Require Fleets to Submit Estimated Construction Completion Date

Comment Summary: Commenter requests that, as part of the exemption application to CARB, fleets be required to identify the date by which they plan to complete the necessary customer-side construction because utility construction does not begin until the customer has installed all the required infrastructure on their side and a delay in customer-side construction may change the estimated project completion date.

Commenter: [155-15d]

Agency Response: No changes were made in response to these comments. This information is not necessary to include in the Regulation; utilities can request this information from their customers to better estimate a project completion date. Utilities are expected to provide the best estimate of a project's completion they can give based on the information they have. If a fleet owner refuses to provide such requested information to a utility and does not perform their required upgrades in a timely manner, a granted extension period would simply end, and the fleet would potentially be out of compliance with the Regulation and subject to enforcement action.

n) Infrastructure Delay Extension – Include Grid Criteria

Comment Summary: Commenter states CARB should amend the existing Infrastructure Delay Extension to consider grid reliability as a core feasibility element.

Commenter: [060-15d, 115-15d]

Agency Response: No changes were made in response to these comments. The grid's reliability should not have a significant effect on the transition to ZEVs. For more discussion on these concerns, please see responses to issues raised in section “Grid Capacity and Resilience – Grid Reliability” in “Infrastructure and Grid Concerns” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.” For these reasons, and the unneeded additional complexity it would add to the extension verification and application process, it is not necessary to consider grid reliability as a core element of the extension.

o) Infrastructure Delay Extension – Limit Unnecessary Exemptions

Comment Summary: Commenter requests the infrastructure delay may build a 5-year delay lag into the Regulation and allow fleets to use older, more polluting technology.

Commenter: [152-15d]

Agency Response: No changes were made in response to these comments. The Infrastructure Delay Extension would necessarily delay compliance due to recognized challenges with infrastructure delays in the near-term. However, the compliance mechanism is to only count existing vehicles as ZEVs until the delay period is over; the fleet owner would be expected to place in service the ZEVs that the infrastructure would serve at the end of the delay period. This prevents fleet owners from waiting to the end of the delay period, then ordering ZEVs which would take even longer to be built and delivered.

p) Infrastructure Delay Extension – Utility Relationship Concerns

Comment Summary: Commenter states that the new provisions in Section 2015.3(c) wrongly assume that there is always a direct relationship between the fleet owner and the utility provider and would require airlines to provide documentation such as executed contracts, permits, and other documentation that may not be within the purview of an airport lessee. In many cases, the airport serves as the airlines' utility provider, while the airport manages the agreement with the utility provider.

Commenter: [121-15d]

Agency Response: No changes were made in response to these comments. If the airport is the utility provider for the airline, the language for the extension is still applicable, and sufficient.

q) Infrastructure Delay Extension – Utility Responsibility Concerns

Comment Summary: Commenters representing POUs that would represent the utility party in the Infrastructure Delay Extension state requirements that "electric utility provider determines it cannot provide the requested power to the site where ZEVs will be charged or refueled before the fleet's next ZEV compliance deadline," the fleet owner's obligation to deploy ZEVs "that can be supported by the utility.," and Section 2015.3(c)(2)(C)(3), are unclear and could be interpreted to mean a utility must track or monitor fleet owner exemption requests and compliance plans. The language should be modified to specify the information that is provided to the fleet owner does not require a POU analysis of customer compliance plans, but rather, the fleet owner is making this determination based on its own independent judgement, and to modify language in 2015.3(c)(2)(C)(4) to recognize that utilities do not know the fleet make-up in terms of vehicle size and composition; they are only aware of the total load needed. Commenter suggests striking "provided by the utility" from 2013.1(c)(2)(C)(3.).

Commenter: [133-15d]

Agency Response: No changes were made in response to these comments. The language was included to ensure a fleet had provided sufficient information to the utility, consistent with the fleet's compliance obligations, for the utility to determine what load it can serve to the fleet, and when that load can be delivered. The intent is not for utilities to track individual fleet compliance plans for the fleet owner. Therefore, no change is necessary to modify the language to state this. Utilities would necessarily need to know the total load required by a fleet, which is informed by the number and type of ZEVs, their fueling capability, and the number and type of ZEV fueling infrastructure equipment needed to serve those ZEVs that are expected to be deployed by the fleet over a specific timeframe necessary for the fleet owner to comply with the Regulation. This information is expected to be shared with the utility by the fleet owner.

r) Infrastructure Delay Extension – Remove 2030 Limit

Comment Summary: Commenter suggests not limiting ZEV infrastructure delay to 2030 because these requests might be required past 2030.

Commenter: [044-15d, 071-15d, 124-15d, 138-15d]

Agency Response: No changes were made in response to these comments. See rationale for why sunsetting the provision in 2030 is necessary in Chapter A.(B)14., section 2013.1(c)(2), of the ACF 15-Day Notice.

s) Infrastructure Delay Extension – Include All Construction Delays

Comment Summary: The commenters request that Infrastructure Delay expand the list of "circumstances beyond the fleet owner's control" to include any circumstances that may materially affect construction projects.

Commenter: [007-15d, 120-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Infrastructure Delay Extension – Include All Construction Delays" in "Exemptions and Extensions – Infrastructure Delays" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

t) Infrastructure Delay Extension – Allow Internal Combustion Engine Vehicle Purchases

Comment Summary: The commenters request that the infrastructure extensions provide the ability to purchase a new ICE vehicle.

Commenter: [106-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Infrastructure Delay Extension – Allow Internal Combustion Engine Vehicle Purchases" in "Exemptions and Extensions – Infrastructure Delays" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

u) Infrastructure Delay Extension – Master Response

Comment Summary: The commenters suggest allowing Infrastructure Delays to apply to multiple projects for greater site selection flexibility.

Commenter: [125-15d, 138-15d, 169-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Infrastructure Delay Extension – Master Response” in “Exemptions and Extensions – Infrastructure Delays” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

v) Infrastructure Delay Extension – Allow Permit Applications to Qualify

Comment Summary: The commenters propose that fleet owners qualify for Infrastructure Delay Extension with construction permit applications rather than construction permits.

Commenter: [122-15d, 135-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Infrastructure Delay Extension – Allow Permit Applications to Qualify” in “Exemptions and Extensions – Infrastructure Delays” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

w) Infrastructure Delay Extension – Allow More Time for Extension

Comment Summary: The commenters state more time is needed for Infrastructure Delay Extensions.

Commenter: [111-15d, 117-15d, 130-15d, 138-15d, 153-15d, 158-15d, 170-15d, 171-15d, 173-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Infrastructure Delay Extension – Allow More Time for Extension” in “Exemptions and Extensions – Infrastructure Delays” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

x) Infrastructure Delay Extension – Include Delays Due to Real Estate Acquisition, Landlord Negotiation, or Lease Updates

Comment Summary: The commenters request additional flexibility in the Infrastructure Construction Delay provision for delays due to real estate acquisition, landlord negotiation, or lease updates when non-owned property is involved.

Commenter: [138-15d, 160-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Infrastructure Delay Extension – Include Delays Due to Real Estate Acquisition, Landlord Negotiation, or Lease Updates” in “Exemptions and Extensions – Infrastructure Delays” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

y) Infrastructure Delay Extension – Include Delays in Obtaining Permits

Comment Summary: The commenters state that delays in obtaining permitting should be accounted for in infrastructure delays.

Commenter: [058-15d, 135-15d, 175-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Infrastructure Delay Extension – Include Delays in Obtaining Permits” in “Exemptions and Extensions – Infrastructure Delays” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

14. Exemptions and Extensions – Mutual Aid and Exemptions Pursuant to Declared Emergency Events

a) Mutual Aid Assistance Exemption – Milestone Alignment Concerns

Comment Summary: Commenter states the mutual aid exemption fleet ZEV threshold is not aligned with the ZEV Milestones pathway and requires more ZEVs sooner than the Milestones would.

Commenter: [169-15d]

Agency Response: No changes were made in response to these comments. The mutual aid exemption adds flexibility to the ZEV Milestone pathway and is not intended to align with it. The purpose of the exemption is to allow fleets to maintain at least one quarter of their fleet as ICE vehicles for added flexibility when responding to mutual aid scenarios. In the early years of the Regulation, as the commenter states, the ZEV Milestones Option would require less than 25 percent of the fleet to be ZEVs. This means the fleet owner would have more than 75 percent of the fleet that are still ICE vehicles to respond to mutual aid scenarios and would be able to use those vehicles instead of purchasing the required 25 percent ZEVs. Nothing in the language requires the exemption requirements to align with the ZEV Milestones Option requirements.

b) Mutual Aid Assistance Exemption – Out-of-State Aid Concerns

Comment Summary: Commenter asks how the mutual aid exemption will apply to out-of-state fleets performing mutual aid. Commenters state the Regulation appears to imply that an out-of-state vehicle/vehicle fleet operating in California to assist in a state of emergency would become subject to ACF after 30 days. The inclusion of this provision further puts Californians at risk as it discourages out-of-state entities from providing aid in emergency situations, which in dire situations can last much longer than 30 days.

Commenter: [117-15d, 169-15d]

Agency Response: No changes were made in response to these comments. The SLG Regulation expressly does not include out-of-state government fleets operating in California, nor does the HPF Regulation. The HPF Regulation explicitly exempts vehicles from other states operated in California pursuant to declared emergency events. Fleets that have designated backup vehicles can operate an unlimited number of emergency response miles. The Regulation already provides sufficient relief for out of state vehicles brought to California to assist during mutual aid situations, therefor no changes were made.

c) Mutual Aid Assistance Exemption – Unique Redlines from Comment Letter 155

Comment Summary: Redlines for Mutual Aid Exemption. Section 2015.3(f)(2): add "or 50 vehicles, whichever is greater" and "or an explanation from the fleet owner stating why a compatible mobile fueling option is not practicable for the mutual aid scenarios to which the fleet owner reasonably expects to respond."

Commenter: [155-15d]

Agency Response: No changes were made in response to these comments. Adding "or 50 vehicles, whichever is greater" would potentially allow many more exemptions and would provide an unlevel playing field. For example, a 100-truck fleet would potentially be eligible to purchase ICE vehicles for half of the fleet, while a 50-truck fleet would potentially be eligible to purchase ICE vehicles for the entire fleet. This change would also have an emissions disbenefit. Adding "or an explanation from the fleet owner stating why a compatible mobile fueling option is not practicable for the mutual aid scenarios to which the fleet owner reasonably expects to respond" is too subjective of a requirement and would result in enforceability issues.

d) Emergency Provisions – Expand to Non-Declared Emergencies, Remove Mutual Aid Agreements, and Allow Fleets to Set Their Own Internal Combustion Engine Vehicle Cap

Comment Summary: The commenters express concern about the ACF Regulation's unintended consequences on public utilities and their ability to provide essential services, particularly during emergency events. They argue that the Regulation lacks necessary exemptions and impairs their ability to respond to emergencies and service needs crucial to heavy equipment and emergency systems operation.

Commenter: [115-15d, 117-15d, 130-15d, 169-15d]

Comment Summary: The commenters recommend that CARB revise the Mutual Aid Assistance exemption, allowing the public agency's governing board or the agency itself to determine individual needs and adjust the ZEV threshold and ICE caps through public action.

Commenter: [079-15d, 113-15d, 169-15d]

Comment Summary: The commenters suggest removing the 25 percent ICE cap for the mutual aid provision or submitting an alternative cap based on individual fleet needs, arguing that a one-size-fits-all cap is unreasonable.

Commenter: [133-15d, 155-15d, 169-15d]

Comment Summary: The commenters request that CARB extend the Mutual Aid Assistance exemption eligibility to various utilities even without mutual aid agreements and expand the provision to non-declared emergency events, as emergencies often cannot wait for state declarations.

Commenter: [113-15d, 173-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Emergency Provisions – Expand to Non-Declared Emergencies, Remove Mutual Aid Agreements, and Allow Fleets to Set Their Own Internal Combustion Engine Vehicle Cap" in "Exemptions and Extensions – Mutual Aid and Exemptions Pursuant to Declared Emergency Events" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

e) Mutual Aid Assistance Exemption – Mobile Fueling Issues

Comment Summary: The commenters raise various concerns about the mobile fueling requirement of the Mutual Aid Assistance exemption.

Commenter: [055-15d, 104-15d, 125-15d, 133-15d, 136-15d, 155-15d, 169-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Mutual Aid Assistance Exemption – Mobile Fueling Issues" in "Exemptions and Extensions – Mutual Aid and Exemptions Pursuant to Declared Emergency Events" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

f) Mutual Aid Assistance Exemption – Remove Gross Vehicle Weight Rating and Vehicle Type Limits

Comment Summary: The commenters request the removal of weight class restrictions from the Mutual Aid Assistance exemption.

Commenter: [169-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Mutual Aid Assistance Exemption – Remove Gross Vehicle Weight Rating and Vehicle Type Limits" in "Exemptions and Extensions – Mutual Aid and Exemptions Pursuant to Declared Emergency Events" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

g) Mutual Aid Assistance Exemption – Remove Zero-Emissions Vehicle Threshold Requirement

Comment Summary: The commenters state that the 75 percent ZEV threshold in section 2015.3(f)(2) "Mutual Aid Assistance" should be removed or adjusted.

Commenter: [079-15d, 117-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Mutual Aid Assistance Exemption – Remove Zero-Emissions Vehicle Threshold Requirement" in "Exemptions and Extensions – Mutual Aid and Exemptions Pursuant to Declared Emergency Events" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

15. Exemptions and Extensions – Vehicle Delivery Delay

a) Vehicle Delivery Delay Extension – Purchase or Order Date Clarity

Comment Summary: Commenter states that A4A and its members appreciate CARB's acknowledgement of potential delivery delays for equipment. For airlines, while there are ZEV options that are operationally feasible, many of the suppliers have limited capacity that would be quickly consumed as all airlines work to changeover their fleet at the same time. Currently, airlines are already seeing extended timelines for the delivery of GSE. A4A also recommends that CARB revise the last sentence of Section 2015.3(d)(1)(B)(3) as it does not differentiate between an order date and a purchase agreement date.

Commenter: [121-15d]

Agency Response: No changes were made in response to these comments. The language that was added, as referenced in Section D (Section 2015.3, #24) of the Notice of Public Availability of Modified Text and Availability of Additional Documents (ACF 15-Day Notice) for the Regulation, states that "The purchase agreement shows the new ZEV was ordered at least one year prior to the next upcoming ZEV Fleet Milestone" and "If the order was placed before January 1, 2024, the purchase agreement must show the order was placed on or before [INSERT EFFECTIVE DATE]." Therefore, the purchase agreement must reflect an order date as specified in Section 2015.3(d)(1)(B)(3).

b) Vehicle Delivery Delay Extension – Increase Time to Reorder Due to Manufacturer Cancellation

Comment Summary: Commenters suggest aligning SLG and HPF related to manufacturer cancellations and increase the HPF timeframe to order a new ZEV from 180 days to one year.

Commenter: [122-15d]

Agency Response: No changes were made in response to these comments. In section 2015.3(d)(2), the language was modified to allow fleet owners up to 180 days, and a full year (365 consecutive days) for government fleet owners, to enter into a new purchase agreement under the Vehicle Delivery Delay Extension if the manufacturer cancels the purchase agreement for reasons outside of the fleet owners' control. This change is necessary to provide fleets with sufficient time to enter into a new purchase agreement if a manufacturer cancels an order as this is considered circumstance outside of the fleet owner's control. It also recognizes that the public fleet bid process may necessitate additional time. In addition, language was added stating that if no ZEV is available, the fleet owner may apply for the ZEV Purchase Exemption. This change is necessary to direct the fleet owner to the appropriate exemption that would cover their new circumstance should it occur.

c) Vehicle Delivery Delay Extension – Include Consideration of Manufacturer Restrictions

Comment Summary: Commenters suggest modifying the Vehicle Delivery Delay provision to allow circumstances where an owner is unable to enter into an agreement to purchase ZEVs due to manufacturer restrictions or requirements, including requirements that sufficient infrastructure be in place at the time of entering into the purchase agreement, because this real-world example is out of a fleet owner's control.

Commenter: [122-15d]

Agency Response: No changes were made in response to these comments. To the extent a manufacturer is requiring unreasonable requirements from the fleet owner, the fleet owner would be expected to find another manufacturer. The Regulation allows sufficient flexibility to select the easiest to electrify vehicles first.

d) Vehicle Delivery Delay Extension – Remove Delivery in California Requirement

Comment Summary: Commenter suggests removing "in California" from the purchase agreement requirements of the Vehicle Delivery Delay provision to recognize that vehicles purchased under lease agreement or bundled service agreements may not be delivered to California but would be ultimately placed by the fleet in service in California and should be granted an extension for delay in delivery of such vehicles.

Commenter: [122-15d]

Agency Response: No changes were made in response to these comments. This language is consistent with the manufacturer requirement in ACT where the manufacturer would not generate credit toward their compliance requirements unless the vehicle is sold and delivered to California; therefore, manufacturers have incentive to deliver vehicles to California, and this is not anticipated to be an issue.

e) Vehicle Delivery Delay – Master

Comment Summary: The commenters express concern about fleets being considered non-compliant if ZEV deliveries take longer than a year, suggesting that Regulation requirements should be based on vehicle purchases instead of deliveries. They request adjustments to consider project-specific timelines and allowing ICE vehicle purchases when ZEV deliveries take longer than one year.

Commenter: [111-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Vehicle Delivery Delay Extension – Vehicle Delivery and Order Timeline Concerns" in "Exemptions and Extensions – Vehicle Delivery Delays" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

16. Exemptions and Extensions – Waste and Wastewater

a) Waste and Wastewater Fleets – Allow Fleet Owner Compliance Choice

Comment Summary: Commenter requests the waste and wastewater provision be clarified and allow fleet owners to select either a purchase requirement or the ZEV Milestones Option because public agencies would need to adhere to two different Regulations which requires additional reporting and planning strategies based on the supportive function of each vehicle.

Commenter: [107-15d, 113-15d]

Agency Response: No changes were made in response to these comments. The SLG purchase requirement already allows fleets to purchase ICE vehicles of any type until January 1, 2027, as half of the fleet's annual purchases, and can continue to operate existing ICE vehicles as long as they want. The Waste and Wastewater provision under the ZEV Milestones Option is limited to delay required ZEV purchases for roughly three years for most affected vehicles, but only for the number of vehicles in the fleet as of January 1, 2024. That provision also allows ICE purchases of any kind as long as fleets are meeting their ZEV Milestone requirement. Allowing fleets to delay purchases until 2030 would be counter to the intent of the provision and the Board's direction to recognize investments already made to comply with SB 1383 and would significantly delay deployments of ZEVs in these fleets.

b) Waste and Wastewater Fleets – Modify “Garbage” to “Waste”

Comment Summary: Commenter states the term "garbage vehicle configurations" should be modified to "waste fleet vehicle configurations" for consistency with commenter's suggested updated "waste fleet" definition that would include non-garbage related SB 1383 services, like composting.

Commenter: [175-15d]

Agency Response: No changes were made in response to these comments. Because no changes were made to expand the waste fleet definition, the suggested update to the configurations is not necessary.

c) Waste and Wastewater Fleets – Provision Restricts Use of Senate Bill 1383 Gas

Comment Summary: Commenters state the Waste and Wastewater Fleets provision restricts their ability to utilize the RNG that will soon be generated due to SB 1383.

Commenter: [117-15d]

Agency Response: No changes were made in response to these comments. Please see the section called, “Alternative Fuels and Combustion Vehicles – Rule Conflicts with Organic Waste Diversion” in the section on “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

d) Waste and Wastewater Fleets – Include Licenses or Permits and Non-Municipal Contracts

Comment Summary: Commenter states the waste definition should not only include fleets contracted with a municipality, as some jurisdictions do not have contracts and instead use license or permit systems, and many contracts are not with municipalities but are with counties or solid waste agencies (joint powers authorities) and should be modified to include these.

Commenter: [175-15d]

Agency Response: No changes were made in response to these comments. The intent of the language is to have a verifiable paper trail and contractual agreement to provide services. Contracts can include various forms of agreements, including licensing or permitting systems. The intent of requiring the contract with a municipality was to include the various local governments that would be subject to SB 1383 requirements, which was expected to include cities and counties. Joint powers authorities are legally created entities that allow two or more entities to jointly exercise public powers, and thus would be included in the intent of the "municipalities" term. The language that such entities be mandated to procure products created by organic waste diversion through SB 1383 sufficiently limit this definition to the intended audience.

e) Waste and Wastewater Fleets – Include Other Senate Bill 1383 Activities

Comment Summary: Commenter states the waste fleet definition should not be limited to supporting biomethane production, but all SB 1383 related activities including composting and rendering operations.

Commenter: [080-15d, 151-15d, 163-15d, 169-15d, 175-15d]

Agency Response: No changes were made as result of this comment. Although organic waste diversion can be interpreted more broadly to include agricultural and forestry waste, the Board's direction was to narrow the focus on those fleets involved in diverting organics to facilities that have invested in anaerobic digestion technologies, such as those at wastewater treatment facilities or stand-alone digesters. The Board decided the provision should not be broader and would not apply to diesel vehicles to ensure emissions reductions are achieved.

f) Waste and Wastewater Fleets – Include Specialty and Weight-Sensitive Vehicles

Comment Summary: Commenter requests that CARB extend the 'Waste and Wastewater Fleet Option' to specialty and/or weight sensitive vehicles fueled with biomethane.

Commenter: [135-15d]

Agency Response: No changes were made in response to these comments. The Board directed staff to include a provision to recognize fleets that have already made investments in biomethane vehicles and infrastructure related to implementation of SB 1383. Including other vehicle types or industries would be counter to Board direction. The provision already includes these types of vehicles if the fleet is an eligible wastewater fleet, and certain refuse vehicles if an eligible waste fleet. Additionally, specialty vehicles as defined in the Regulation are already on the latest timeline of the ZEV Milestones Option, so would not benefit from being added to the provision, which moves eligible vehicles to the Group 3 timeline under ZEV Milestones.

g) Waste and Wastewater Fleets – Include Other Industries

Comment Summary: Commenter states other industries ill-suited for electrification should be allowed into the Waste and Wastewater Fleet Option.

Commenter: [151-15d, 160-15d, 177-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Alternative Fuels and Combustion Vehicles – General Comments" in "Alternative Fuels and Combustion Vehicles" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

h) Waste and Wastewater Fleets – 2024 Fleet Limit Concerns

Comment Summary: Commenter states that the 15-day regulatory language does not provide the Board-directed flexibility to fleets for use of wastewater-derived renewable biomethane that will be produced post-2024 and instead limits the vehicles fueled by biomethane to those in the fleet as of January 1st, 2024, which is before the SB 1383 facilities have been built.

Commenter: [146-15d]

Agency Response: No changes were made in response to these comments. Staff are mindful of the importance of backsliding on GHG reductions and anticipate that biomethane demand in the transportation sector is expected to decline over time but recognize that biomethane can displace fossil fuels in other sectors on the path to carbon neutrality. The Waste and Wastewater Provision was designed to avoid the proliferation of new CNG fueling infrastructure with the foresight that biomethane would soon be directed away from use directly as a combustion fuel, and instead be used in other hard-to-decarbonize sectors or be used as a feedstock to produce hydrogen for FCEVs and to produce electricity to charge BEVs.

i) Waste and Wastewater Fleets – Remove 10-Year Contract Limit

Comment Summary: Commenter suggests removing the requirement to have a 10-year contract for waste fleets because it is arbitrary and unnecessary to fulfill the purpose of the exemption, as some agreements are for seven years, or one year with automatic renewals.

Commenter: [175-15d]

Agency Response: No changes were made in response to these comments. These timeframes were drafted with input from directly affected stakeholders at the December 12, 2022, public workshop. The Board determined that the proposed timeframes were sufficient.

j) Waste and Wastewater Fleets – Waste and Wastewater Fleet Implementation

Comment Summary: The commenters request extensions for waste and wastewater fleets to use RNG generated from diverted organic waste.

Commenter: [060-15d, 117-15d, 177-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Waste and Wastewater Fleets – Waste and Wastewater Fleet Implementation" in section "Exemptions and Extensions – Waste and Wastewater" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

17. Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption

a) Zero-Emissions Vehicle Purchase Exemption – Add Commenters' Specific Vehicle Types to the Initial List

Comment Summary: Commenters suggest adding their specific vehicle types to the ZEV Purchase Exemption list of configurations that would be initially listed.

Commenter: [046-15d, 122-15d]

Agency Response: No changes were made in response to these comments. The vehicle configurations selected were determined to be the most common body types of the vehicles reported in the LER, which is explained in more detail in Chapter I.D. of the ACF ISOR. It is not feasible for every possible vehicle configuration that may not currently be available as a ZEV to be initially listed given the wide variety of specification combinations and customization options. If a vehicle configuration is deemed unavailable to purchase through the exemption application process, it would then be added to the ZEV Purchase List.

b) Zero-Emissions Vehicle Purchase Exemption – Add Water Standards to Safety Criteria

Comment Summary: Commenter suggests adding "water standards" to the ZEV Purchase Exemption list of safety standards that, if violated, would result in a determination that a ZEV is not available to purchase for a particular fleet.

Commenter: [124-15d]

Agency Response: No changes were made in response to these comments. The intent of the safety provision language is to address vehicle-specific safety issues and ensure that there aren't there any conflicts with existing health and safety laws, such as OSHA or NHTSA requirements. This provision was not intended to cover potential violations of safety laws if the vehicle could not perform. In fact, the premise that the vehicle cannot perform the needed duties is unfounded for most vehicle types and duty cycles. Please see responses to issues raised in section "Zero-Emissions Technology – General" in "Zero-Emissions Vehicle Technology Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

c) Zero-Emissions Vehicle Purchase Exemption – Require More Vehicle Characteristics in the Application Information to Be Submitted

Comment Summary: Commenter states that the documentation evaluated by the CARB Executive Officer under the fleet-specific ZEV Purchase Exemption application should include evidence of battery capacity, range, compatibility with auxiliary equipment, payload, delivery date commitments, and maintenance/warranty support.

Commenter: [155-15d]

Agency Response: No changes were made in response to these comments. The information to be submitted with an exemption application contains characteristics that directly relate to the primary intended function of the vehicle. These characteristics are essential to the basic functionality of the configuration. Factors such as battery capacity, range, compatibility with auxiliary equipment, payload, delivery date commitments, and maintenance/warranty support do not prevent a vehicle from performing its primary intended function and are not necessary to be included for the evaluation of an exemption application.

d) Zero-Emissions Vehicle Purchase Exemption – Add “Available” Definition

Comment Summary: Commenter requests adding a definition for “available” because changing “commercially available” to “available” in the revised language does not assist with complying entities’ understanding of CARB’s decision-making processes.

Commenter: [100-15d, 139-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Zero-Emissions Vehicle Purchase Exemption – Add ‘Commercial Availability’ Definition” in section "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

e) Zero-Emissions Vehicle Purchase Exemption – Reduce 18-Month Model Year Period to 12 Months

Comment Summary: Commenters state that the model year requirement of considering a vehicle available of 18 months should be reduced to 12 months or less because manufacturer business practices do not guarantee when a model will be available and are consistently marketed as being sooner than they will actually be available.

Commenter: [113-15d]

Agency Response: No changes were made in response to these comments. The 18-month period accounts for the varying timeframes between the calendar year and the model year used by manufacturers. A manufacture is authorized to use a model year for up to two years prior to the final production date for that model year.

f) Zero-Emissions Vehicle Purchase Exemption – Add Zero-Emissions Vehicle Reliability Assessment

Comment Summary: Commenter states that the availability criteria must include an assessment of ZEV reliability.

Commenter: [007-15d]

Agency Response: No changes were made in response to these comments. The ZEP Certification requirement was added to the availability criteria as part of the ACF 15-day changes to ensure ZEV reliability, which addresses this comment.

g) Zero-Emissions Vehicle Purchase Exemption – Staff Not Qualified to Determine What Bodies Fleets Can Use

Comment Summary: Commenters state that CARB staff are not qualified to determine what bodies fleets can use and that they should not be determining if a body will meet a fleet's needs, as bodies are specialized and take years to refine, and CARB staff being involved in this determination would void long-term contracts and specifications fleets use to meet operational needs.

Commenter: [033-15d, 113-15d]

Agency Response: No changes were made in response to these comments. Exemption requests are evaluated based on the information gathered from fleet owners or manufacturers and what a fleet owner claims to be necessary for fleet operations in their exemption application. CARB is not determining what bodies fleets can use, but rather identifying, where possible, an available ZEV or body that can be installed on a ZEV or NZEV chassis that correlates with the information submitted with an exemption application.

h) Zero-Emissions Vehicle Purchase Exemption – Reduce 18-Month Model Year Period to 0 Months

Comment Summary: Commenters state the criteria for considering a ZEV available to purchase should require that a manufacturer offer a ZEV for sale immediately, rather than considering ZEVs with model years within the next 18 months to be available.

Commenter: [079-15d]

Agency Response: No changes were made in response to these comments. Similar to ICE vehicles, it is normal for ZEV manufacturers to offer for sale a vehicle with a model year that is not immediately available to determine supply needs to fulfill a higher number of orders. Purchasing a model year that is not immediately available requires a contractual purchase agreement with manufacturer fulfillment obligations and it would therefore be unreasonable to deem these vehicles as unavailable. Additionally, requiring that the ZEVs or NZEVs offered for sale have a model year 18 months or less from the date the fleet owner submitted the complete exemption request, to be considered available to purchase, is a reasonable time period and comparable to ICE vehicles offered for sale.

i) Zero-Emissions Vehicle Purchase Exemption – Clarify Useful Life Applicability

Comment Summary: Commenter states the Regulation should state that the ZEV Purchase Exemption lasts for the useful life of the vehicle, so that it's clear that the exemption does not expire when the vehicle configuration is removed from the ZEV Purchase Exemption List.

Commenter: [135-15d, 175-15d]

Agency Response: No changes were made in response to these comments. Vehicles purchased pursuant to exemptions under the Model Year Schedule already have full useful life. Language in the ZEV Milestones Option guarantees a full useful life for ICE vehicles purchased pursuant to the ZEV Purchase Exemption by not requiring the waiver of provisions of Health and Safety Code 43021(a) for vehicles purchased pursuant to exemptions. The SLG requirements also contain no useful life turnover requirements.

j) Zero-Emissions Vehicle Purchase Exemption – Concerns Over Next Higher Weight Class Requirement

Comment Summary: Commenter states the ZEV Purchase Exemption should not require the purchase of a vehicle in the next higher weight class for potential cost, availability, and infrastructure concerns. Commenters also cite issues if a vehicle currently doesn't require a commercial driver license and the next weight class above would require one.

Commenter: [007-15d, 008-45d, 044-15d, 055-15d, 104-15d, 124-15d, 125-15d, 130-15d, 133-15d, 138-15d]

Agency Response: No changes were made in response to these comments. The ZEV Purchase Exemption is structured to allow fleets to purchase an ICE vehicle only if a ZEV or NZEV that can perform the same function is not available. When reviewing current market ZEV offerings, the Regulation allows for the inclusion of a ZEV offered in the next higher weight class as part of the exemption process to account for potential payload reductions that a ZEV manufacture may inherently need to factor in for the design and production of the same ZEV truck in a lower weight class. If a ZEV in the next higher weight class can equivalently perform the primary intended function of the vehicle configuration, than the Regulation considers this vehicle to be available as a ZEV and there is no need for an exemption. This inclusion is necessary to assist in ZEV acquisition as it results in more ZEV options that are available to purchase that can meet fleet needs. Additionally, a fleet would need to weigh licensing requirements with vehicle choice in its business decision.

k) Zero-Emissions Vehicle Purchase Exemption – Manufacturers to Certify the Vehicle Meets Daily Range and Payload Requirements

Comment Summary: Commenters state the exemption process should put the burden of proof on the manufacturer to certify that its vehicle meets daily range and payload requirements rather than the fleet owner/end user being forced to compile voluminous information for an exemption.

Commenter: [100-15d, 160-15d]

Agency Response: No changes were made in response to these comments. Daily range and payload requirements vary by fleet, and it would not be feasible for a manufacturer to certify that a ZEV meets these specific requirements due to the variation in fleet operations. Manufacturers also typically advertise or inform fleet owners of a vehicle's range and payload capabilities prior to establishing a purchase agreement and fleet owners have the option of selecting a ZEV appropriate to their specific requirements in the instance that more than one available ZEV meets the fleet's needs. In consideration of this factor, it is more reasonable for fleets to demonstrate that a ZEV is not capable of meeting daily range and payload requirements.

l) Zero-Emissions Vehicle Purchase Exemptions – Remove Manufacturer Attestation Requirement

Comment Summary: Commenter states that it should be CARB's responsibility to identify whether or not manufacturers have available configurations instead of fleet's obtaining manufacturer attestations.

Commenter: [033-15d, 111-15d]

Agency Response: No changes were made in response to these comments. Manufacturers work closely with their customers when ordering and designing trucks to the fleet's specifications, and are capable of producing a wide range of unique configurations based on the specific requests of a fleet owner. It would therefore be impossible for CARB to identify every vehicle configuration that is available from manufacturers because manufacturers often require fleets to request a vehicle configuration in order for it to be produced.

m) Zero-Emissions Vehicle Purchase Exemption – Require Manufacturers to Provide Statements

Comment Summary: Commenters state the ZEV Purchase Exemption requirement that fleets supply statements from manufacturers or authorized dealers that they do not offer ZEV or NZEV chassis or vehicles in the needed configuration is unreasonable, because manufacturers will not supply statements that a vehicle configuration is not available unless required by Regulations, and suggest language is added to require manufacturers to supply these statements.

Commenter: [055-15d, 113-15d, 158-15d]

Agency Response: No changes were made in response to these comments. Some form of statement from the manufacturer is reasonable to request from fleet owners. Written correspondence is preferred, but not expressly required in the Regulation. The intent of this provision is to require a statement to verify that a vehicle configuration cannot be produced. These statements do not necessarily need to be in formal written correspondence. To the extent the manufacturer does not provide that, communication with the manufacturer could suffice, such as an email, as long as the documentation shows that needed vehicle configuration cannot be produced by the manufacturer.

n) Zero-Emissions Vehicle Purchase Exemption – Inconsistency in the Required Number of Manufacturer Statements

Comment Summary: Commenter states that language is not consistent when CARB allows two manufacturers must be available to consider a ZEV configuration to be available in one part and one manufacturer in the other part.

Commenter: [013-15d]

Agency Response: No changes were made in response to these comments. The requirement for fleet owners to provide statements from two manufacturers is necessary as a first step to ensure the ZEV or NZEV is not available for purchase by requiring the fleet owner to communicate their need for the vehicle configuration to an existing ZEV or NZEV manufacturer. Only one manufacturer or authorized dealer that offers a ZEV or NZEV in the needed vehicle configuration as a result of the exemption application process is necessary because the vehicle configurations on the ZEV Purchase List do not have a minimum required threshold of manufacturers that must be producing the configuration.

o) Zero-Emissions Vehicle Purchase Exemption – Require Engine Hour Tracking

Comment Summary: Commenter states that tracking engine hours for exempt vehicles could help identify configurations initially listed on the ZEV Purchase Exemption List with low miles driven and excessively high engine hours that could likely benefit from electrification when stationary, such as through an ePTO.

Commenter: [172-15d]

Agency Response: No changes were made in response to these comments. Retrofitting ICE vehicles with ePTO is not a sufficient compliance response considering that the primary goal of this Regulation is to deploy ZEVs. In addition, the ZEV Purchase Exemption List is a streamlined approach that would be expected to respond to ZEV market conditions, not availability at the individual ZEV level. Collecting engine hours and requiring those to be reported for each ICE vehicle purchased using the ZEV Purchase Exemption List would introduce unneeded complexity. If a purchase exemption is granted to buy an ICE vehicle, nothing in the Regulation prevents a fleet owner from installing an ePTO system on the vehicle, and there are incentive funds available for this purpose. Collecting this data would not serve to advance the goals of the ACF Regulation and would introduce unnecessary administrative burden.

p) Zero-Emissions Vehicle Purchase Exemption – Include Appeal Process

Comment Summary: Commenter states fleet owners should be given an opportunity to respond to CARB's determinations for the ZEV Purchase Exemption or include an appeals process. Commenter suggests adding an appeal process to deal with disagreements over facts that should be limited to 45 days for CARB to respond to, with an automatic approval if no response is received in that timeframe.

Commenter: [112-15d, 113-15d, 125-15d, 133-15d, 155-15d, 160-15d, 173-15d]

Agency Response: Changes were made in response to these comments. The ZEV Purchase Exemption criteria was updated in the ACF 15-day changes to provide additional clarity and structure to avoid the need to include an open-ended appeals process. Additionally, in the unlikely case a manufacturer misrepresents their products offering and in fact do not meet the criteria in the Regulation, fleet owners can contact implementation staff to inform them of the issues and the offered ZEV would not be considered available to purchase. Additionally, the Regulation was modified in the ACF 15-day changes to indicate that CARB has 45 days to respond to complete exemption applications; otherwise, the exemption is automatically approved.

q) Zero-Emissions Vehicle Purchase Exemption – Allow Additional Specifications in Evaluating a Vehicle's Ability to Meet Fleet Needs

Comment Summary: Commenter asks the ZEV Purchase Exemption include a requirement that the manufacturer shall provide a specification sheet for the offered vehicle, including evidence of battery capacity range, fully loaded weight and dimensions, compatibility with and run time of auxiliary equipment where applicable, payload, a delivery date for the vehicle within 18 months, and a list of service centers located near the fleet. The purpose of the addition would be to allow fleets to respond to this information and explain why it would not fit their needs.

Commenter: [079-15d, 124-15d, 133-15d]

Agency Response: No changes were made in response to these comments. The exemption is intended to address situations in which a vehicle configuration is not available, or the available ZEV does not meet fleet needs related to the primary intended function of the vehicle. Battery capacity range, fully loaded weight and dimensions, compatibility with and run time of auxiliary equipment where applicable, payload, a delivery date for the vehicle within 18 months, and a list of service centers located near the fleet do not directly relate to the primary intended function of the vehicle. As a result, the specified characteristics are not necessary to be included in a fleet owner's evaluation in assessing whether a ZEV meets fleet needs or not nor is it necessary to mandate that a manufacturer provide that information.

r) Zero-Emissions Vehicle Purchase Exemption – Add Vehicle Quantity Criteria

Comment Summary: Commenter requests that the availability criteria require that a ZEV be available in sufficient quantities to provide for a competitive bidding environment and avoid price manipulation by vehicle manufacturers and dealers.

Commenter: [037-15d, 071-15d, 136-15d]

Comment Summary: Commenter states that it is necessary to include language stating that a single vehicle meeting the configuration needs will remove the exception which holds the Fleet Owner captive to a closed market and unable to consider or negotiate price.

Commenter: [111-15d]

Agency Response: No changes were made in response to these comments. The ACT Regulation, which requires all manufacturers to produce and sell ZEVs beginning in 2024, will create the needed market competition to ensure multiple ZEVs will be available from multiple manufacturers. Likewise, if a ZEV in a needed configuration is available for purchase, it would be unreasonable to make the determination that it is unavailable based on the quantity offered by a manufacturer, or the number of manufacturers offering the configuration. Fleets are encouraged to contact multiple manufacturers before purchasing a ZEV to evaluate market availability and urge manufacturers to produce more ZEV products. Requiring a specific threshold number of vehicles to be available for purchase could also unintentionally exclude low-volume manufacturers.

s) Zero-Emissions Vehicle Purchase Exemption – Extend Removal of Available Vehicles from List to One Year

Comment Summary: Commenter states the ZEV Purchase Exemption List should have a one-year window before vehicles determined as available to purchase are removed from the list to account for service contract negotiation time.

Commenter: [169-15d, 175-15d]

Agency Response: No changes were made in response to these comments. The 180-calendar day period is a sufficient and reasonable timeframe as it ensures the availability of the vehicle configuration before the list exemption expires in the event a manufacturer rescinds an offer or other unanticipated circumstances occur that cause the vehicle configuration to no longer be available. Extending this timeframe to one year would be excessive and unnecessarily delay ZEV deployment.

t) Zero-Emissions Vehicle Purchase Exemption – Define Truck Types on List

Comment Summary: Commenter states that many of the truck types considered in Section 2015.3(e)(1)(A) are undefined, making it unclear if a particular type of ground support equipment falls within the list. Commenter states that the rulemaking must consider this logistical challenge.

Commenter: [121-15d]

Agency Response: No changes were made in response to these comments. The Regulation establishes a list of the most common body types used in the trucking industry and was not meant to be all-inclusive. Expanding this list is not necessary nor reasonable. Should all of the vehicle configurations initially to be placed on the ZEV Purchase List be defined, every configuration to be added in the future would also need to be defined, which is not reasonable given the wide variety of specification combinations and customization options. Additionally, the selected vehicle configurations are commonly understood by industry whereas many other specialty configurations can have a variety of identifications despite being configured similarly that the Regulation is not intending to define.

u) Zero-Emissions Vehicle Purchase Exemption – Make List Available on Implementation Start Date

Comment Summary: Commenters state the ZEV Purchase Exemption list needs to be available on January 1, 2024, not January 1, 2025, because it will create an administrative burden on fleets applying for exemptions before the list is available. Commenters also request the list have a date and timestamp for updates and have the frequency of updates specified in the Regulation language.

Commenter: [079-15d, 113-15d, 133-15d, 138-15d, 139-15d]

Agency Response: No changes were made in response to these comments. Fleets can opt into the ZEV Milestones Option which provides full flexibility to manage their vehicle upgrades. Under this option, the requirement for upgrading vehicles in Milestone Group 1, which consists of vehicle configurations that are currently widely available as ZEVs, begins on January 1, 2025. Therefore, there is unlikely to be a need for list-purchase exemptions until the Milestone Group 2 or Group 3 requirements for vehicles begin, which are currently not as widely available as ZEVs. Fleet owners may be able to claim exemptions for these vehicle configurations if placed on the list. There would be no reason to do it earlier based on known vehicle availability. The list would not apply in fleet specific cases, where fleets could still apply for a fleet-specific exemption if the criteria is met starting January 1, 2024.

January 1, 2025 was selected as the date in which the ZEV Purchase List is to be established because applications to comply with the first 2025 compliance dates for replacing vehicles will be coming in during 2024. The information from these applications will help the Executive Officer to populate the list and will save time and investment for fleet owners applying for the extension in the future. The Board determined this timeframe is reasonable.

The relevant time and date information for the list updates may also be supplied voluntarily and do not need to be explicitly stated in the regulatory language. The ZEV Purchase List's posted expiration dates, in which a vehicle configuration is to be removed from the list, is specified in the Regulation language as the first day of the month after 180 calendar days after posting the determination that a ZEV no longer meets the specified criteria. The list will be updated as exemption applications are processed, which are submitted by fleets on a case-by-case basis and not on a consistent or predictable schedule. It would therefore be infeasible and unreasonable to provide a specific schedule for updates.

Additionally, the list is anticipated to be ready by 2025, because the requirement for vehicles to be considered available to purchase is contingent on a vehicle's ZEP Certification, which starts in 2024. It would be impractical to make a list prior to 2025 because it will take time for vehicles to go through the certification process.

v) Zero-Emissions Vehicle Purchase Exemption – Do Not Remove Configurations from List Before 2025

Comment Summary: Commenter states the listed vehicle configurations on the ZEV Purchase Exemption list should not be removed from the list prior to January 1, 2025.

Commenter: [175-15d]

Agency Response: No changes were made in response to these comments. Should the ZEV Purchase List be posted on a date that would permit the possibility of the removal of a vehicle configuration prior to January 1, 2025, the fleet owner would be notified at least 180 days in advance of removal. This notice's timeframe provides sufficient time for a fleet owner to plan appropriately for acquisition of the ZEV, if applicable. It is also possible configurations would not be removed prior to January 1, 2025.

w) Zero-Emissions Vehicle Purchase Exemption – Update List Based on Milestone Benchmark Schedule

Comment Summary: Commenter states that the ZEV Purchase List should be updated on a predictable review schedule in anticipation of milestone timeline benchmarks.

Commenter: [139-15d]

Agency Response: No changes were made in response to these comments. The ZEV Purchase List includes expiration dates for each vehicle configuration that inform fleet owners in advance of the duration of time in which they may continue purchasing the ICE vehicle equivalent to allow for appropriate planning. It is the fleet owner's responsibility to verify the availability status of vehicle configurations as needed and prepare appropriately for milestone timeline benchmarks. The list will also be updated as exemption applications are processed, which are submitted by fleets on a case-by-case basis and not on a consistent or predictable schedule.

x) Zero-Emissions Vehicle Purchase Exemption – Add "Complete Vehicle" Definition

Comment Summary: Commenter requests a definition for the term "complete vehicle" to support CARB's ability to decide as to whether granting a ZEV availability exemption is or is not warranted by addressing availability of technology and model options. Commenter suggests adding the language "a 'complete vehicle' is defined as functioning vehicle that has the primary load carrying device or container (or equivalent equipment) attached. Examples of equivalent equipment would include fifth wheel trailer hitches, firefighting equipment, and utility booms."

Commenter: [135-15d]

Agency Response: No changes were made in response to these comments. The definition of configuration as modified by the ACF 15-day changes is sufficient to implement the ZEV Purchase Exemption while balancing the need to keep the criteria and process streamlined, per the Board's direction at the first hearing. A definition for "complete vehicle" is therefore not necessary.

y) Zero-Emissions Vehicle Purchase Exemption – Expand Vehicle Configurations on Initial List

Comment Summary: Commenter requests that the ZEV Purchase Exemption List be expanded to include configurations with attention to vehicles that will not have ZEV options for multiple years.

Commenter: [135-15d]

Agency Response: No changes were made in response to these comments. The ZEV Purchase Exemption List is intended to contain vehicle configurations commonly understood by the industry that will not have ZEV options for multiple years. It is not feasible for every possible vehicle configuration that may not have ZEV options for multiple years to be initially listed given the wide variety of specification combinations and customization options. If a needed vehicle configuration is deemed unavailable to purchase through the exemption application process, it would then be added to the ZEV Purchase List.

z) Zero-Emissions Vehicle Purchase Exemption – Unique Redlines from Comment Letter 135

Comment Summary: Redlines related to ZEV Purchase Exemption. Section 2015: add "'Available to purchase and/or commercially available' means a vehicle that comes in the configuration required to perform the work or necessary services the fleet owner achieves with the existing ICE vehicle it is intended to replace that is not a low-volume manufacturer as described by 49 USC § 30114(b)(7), that is able to deliver the vehicle within six months of an order, and has the ability to provide timely mechanical service to the vehicle throughout the state. Such a vehicle shall meet each of the following criteria: 1) the vehicle cost does not exceed 1.5 times that of a new vehicle it is intended to replace; 2) the vehicle fulfills the duty cycle and work needs of the vehicle it is intended to replace without requiring the purchase of additional vehicles or equipment; and 3) the vehicle complies with the requirements of 13 CCR section 1956.8 and 17 CCR section 95663 as amended by the Zero-Emission Powertrain Certification Regulation." Section 2015: add "A "complete vehicle" is defined as functioning vehicle that has the primary load carrying device or container (or equivalent equipment) attached. Examples of equivalent equipment would include fifth wheel trailer hitches, firefighting equipment, and utility booms."

Commenter: [135-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in sections "Zero-Emissions Vehicle Purchase Exemption – Add 'Commercial Availability' Definition" and "Zero-Emissions Vehicle Purchase Exemption – Add 'Complete Vehicle' Definition" in section "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses" and the "15-Day Comment Period Public Comments with Agency Responses," respectively.

aa) Zero-Emissions Vehicle Purchase Exemption – Unique Redlines from Commenter Letter 155

Comment Summary: Redlines for ZEV Purchase Exemption. Section 2015.3(e)(2)(D): add "4. Documentation from the manufacturer or authorized dealer shows evidence of battery capacity, range, compatibility with and run time of existing equipment where applicable, and payload; a commitment to deliver the vehicle within 18 months, and a list of service centers within reasonable proximity to the fleet; 5. Based on the documentation in subparagraph (4), the ZEV or NZEV meets the fleet's required specifications; 6. The ZEV or NZEV is not offered solely from manufacturers or authorized dealers that have failed to deliver on commitments to fleets on at least two separate occasions." Section 2015.3 (e)(2)(E): add "and meets the fleet's required specifications," add "along with the information upon which the determination was based. The fleet owner shall have 30 days to review the information and respond if the information does not show the identified ZEV or NZEV is available and meets the fleet's required specifications. The Executive Officer shall review the fleet owner's response, if applicable, and within 14 calendar days, issue an approval or denial of the exemption application. If the exemption application is denied," and remove "deny the exemption request, and."

Commenter: [155-15d]

Agency Response: No changes were made in response to these comments. The Vehicle Delivery Delay addresses situations in which manufacturers cancel orders. A manufacturer may be unable to meet initial order obligations due to a number of circumstances that may be outside of their control, and it would be unreasonable to deem a vehicle configuration as unavailable based on these often-unpredictable factors and events. The ZEV Purchase List would also be much more difficult and complicated to maintain if failed commitments by manufacturers were to be considered. The related redlines for section 2015.3(e)(2)(D) are therefore unnecessary.

Regarding requiring manufacturer or authorized dealer to show evidence of and produce a ZEV with the vehicle characteristics specified in the redlines for section 2015.3(e)(2)(D), please see responses to issues raised in section " Zero-Emissions Vehicle Purchase Exemption – Require More Vehicle Characteristics in the Application Information to Be Submitted" in section "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "15-Day Comment Period Public Comments with Agency Responses."

Regarding requiring a ZEV to meet fleet needs related to the primary intended function of the vehicle as part of the redlines for section 2015.3(e)(2)(E), please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Add Fleet Specification Criteria" in section "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

The public feedback solicitation process involves manufacturers and authorized installers responding to the vehicle information submitted by a fleet owner. It is unnecessary to supply the information used to determine if an offered ZEV meets the needed specifications, per the redlines for section 2015.3(e)(2)(E), as the fleet owner applicant would already have this information.

Regarding incorporating an appeal process into the ZEV Purchase Exemption per the redlines in section 2015.3(e)(2)(E), please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Include Appeal Process" in section "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "15-Day Comment Period Public Comments with Agency Responses."

bb) Zero-Emissions Vehicle Purchase Exemption – Unique Redlines from Comment Letter 44

Comment Summary: Redlines to the ZEV Purchase Exemption. Section 2013.1(d)(2)(C)(5): add "including public health standards."

Commenter: [044-15d]

Agency Response: No changes were made in response to these comments. The Regulation has a number of exemptions and extension provisions that address emergency response capability concerns including those relating to meeting public health standards. Additional flexibilities are therefore not necessary to be incorporated into the ZEV Purchase Exemption. Routine operations to prevent public health risks also do not constitute emergency operations.

cc) Zero-Emissions Vehicle Purchase Exemption – Clarify Process and Criteria

Comment Summary: The commenters request transparency and clarification in the ZEV Purchase Exemption process and criteria.

Commenter: [007-15d, 144-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Clarify Process and Criteria" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

dd) Zero-Emissions Vehicle Purchase Exemption – Create Availability List Instead of Unavailability List

Comment Summary: The commenters request that CARB create a ZEV availability list instead of an unavailability list.

Commenter: [018-15d, 022-15d, 023-15d, 026-15d, 027-15d, 028-15d, 029-15d, 030-15d, 032-15d, 034-15d, 036-15d, 040-15d, 041-15d, 043-15d, 045-15d, 049-15d, 051-15d, 054-15d, 059-15d, 061-15d, 062-15d, 064-15d, 067-15d, 115-15d, 118-15d, 128-15d, 130-15d, 134-15d, 140-15d, 142-15d, 150-15d, 157-15d, 166-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Create Availability List Instead of Unavailability List" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

ee) Zero-Emissions Vehicle Purchase Exemption – Add Manufacturer Criteria

Comment Summary: The commenters request that criteria related to manufacturers producing ZEVs be incorporated into the ZEV Purchase Exemption criteria.

Commenter: [007-15d, 071-15d, 079-15d, 112-15d, 113-15d, 117-15d, 121-15d, 133-15d, 135-15d, 136-15d, 137-15d, 169-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Add Manufacturer Criteria" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

ff) Zero-Emissions Vehicle Purchase Exemption – Required Documentation Is Too Onerous

Comment Summary: The commenters express concerns about the documentation required to be submitted under the exemption process being too onerous.

Commenter: [033-15d, 160-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Required Documentation Is Too Onerous" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

gg) Zero-Emissions Vehicle Purchase Exemption – Add Process for Vehicles with Weight Limits

Comment Summary: The commenters request that a process be added for vehicles with weight limits.

Commenter: [008-15d, 139-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Add Process for Vehicles with Weight Limits" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

hh) Zero-Emissions Vehicle Purchase Exemption – Add Public Fleet Exemption Process

Comment Summary: The commenters request the addition of a separate exemption process for public fleets.

Commenter: [130-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Zero-Emissions Vehicle Purchase Exemption – Add Public Fleet Exemption Process” in “Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

ii) Zero-Emissions Vehicle Purchase Exemption – Add Delivery Time Criteria

Comment Summary: The commenters request that criteria related to delivery time of ordered ZEVs be incorporated into the ZEV Purchase Exemption criteria.

Commenter: [037-15d, 079-15d, 139-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Zero-Emissions Vehicle Purchase Exemption – Add Delivery Time Criteria” in “Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

jj) Zero-Emissions Vehicle Purchase Exemption – Add "Commercial Availability" Definition

Comment Summary: The commenters request a formal definition for "commercial availability."

Commenter: [037-15d, 055-15d, 125-15d, 135-15d, 160-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Zero-Emissions Vehicle Purchase Exemption – Add ‘Commercial Availability’ Definition” in “Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

kk) Zero-Emissions Vehicle Purchase Exemption – Add Process for Infrastructure Availability Issues

Comment Summary: The commenters request an exemption process for infrastructure availability issues.

Commenter: [008-15d, 079-15d, 139-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Zero-Emissions Vehicle Purchase Exemption – Add Process for Infrastructure Availability Issues” in “Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

ll) Zero-Emissions Vehicle Purchase Exemption – Add Fleet Specification Criteria

Comment Summary: The commenters request that fleet specification criteria for ZEVs be incorporated into the ZEV Purchase Exemption criteria.

Commenter: [007-15d, 008-15d, 037-15d, 055-15d, 079-15d, 112-15d, 113-15d, 121-15d, 125-15d, 133-15d, 139-15d, 175-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Add Fleet Specification Criteria" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

mm) Zero-Emissions Vehicle Purchase Exemption – Add Cost Criteria

Comment Summary: The commenters request that cost criteria be incorporated into the ZEV Purchase Exemption criteria.

Commenter: [007-15d, 008-15d, 018-15d, 022-15d, 023-15d, 026-15d, 027-15d, 028-15d, 029-15d, 030-15d, 032-15d, 034-15d, 036-15d, 037-15d, 040-15d, 041-15d, 043-15d, 045-15d, 047-15d, 049-15d, 051-15d, 054-15d, 059-15d, 062-15d, 064-15d, 067-15d, 113-15d, 115-15d, 128-15d, 134-15d, 139-15d, 140-15d, 142-15d, 150-15d, 156-15d, 157-15d, 166-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Add Cost Criteria" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

nn) Zero-Emissions Vehicle Purchase Exemption – Add Range Criteria

Comment Summary: The commenters request that criteria for range be incorporated into the ZEV Purchase Exemption criteria.

Commenter: [139-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Add Range Criteria" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

oo) Zero-Emissions Vehicle Purchase Exemption – Allow Fuel of Choice

Comment Summary: The commenters request that the ZEV Purchase Exemption permit fleet owners to purchase ZEVs according to their preferred fuel choice.

Commenter: [169-15d, 175-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Allow Fuel of Choice" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

pp) Zero-Emissions Vehicle Purchase Exemption – Add Safety Criteria

Comment Summary: The commenters request that criteria related to safety be incorporated into the ZEV Purchase Exemption criteria.

Commenter: [007-15d, 008-15d, 044-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Add Safety Criteria" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

qq) Zero-Emissions Vehicle Purchase Exemption – Add Third Party Assessment of Availability

Comment Summary: The commenters request the addition of a third-party assessment of availability.

Commenter: [055-15d, 113-15d, 125-15d, 139-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Add Third Party Assessment of Availability" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

rr) Zero-Emissions Vehicle Purchase Exemption – Add Zero-Emissions Powertrain Certification Criteria

Comment Summary: The commenters request that ZEP certification criteria be incorporated into the ZEV Purchase Exemption criteria.

Commenter: [037-15d, 139-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Add Zero-Emissions Powertrain Certification Criteria" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

18. Public Regulatory Process and Outreach Concerns

a) Process Concerns – Workshop Materials

Comment Summary: Commenter states numerous workshops did not provide materials and instead had "preview drafts" which inhibit thoughtful discussion of the Regulation.

Commenter: [169-15d]

Agency Response: No changes were made in response to these comments. First, staff notes for the most recent public workshop commenter cites, staff posted draft regulatory text weeks before the workshop to allow stakeholders time to review and provide feedback at the workshop. The slide deck presented was to facilitate discussion of said Regulation text.

b) Process Concerns – Fifteen Days Not Enough Review Time

Comment Summary: Commenters state that the 15-day review period for changes is not enough time and recommends a higher number, including 30 or 45 days.

Commenter: [103-15d, 158-15d, 169-15d]

Agency Response: No changes were made in response to these comments. CARB complied with legal requirements to properly notice changes to the Regulation and release them for public comment for 15 days. See Government Code § 11346.8(c).

c) Process Concerns – Implementation Workgroup

Comment Summary: Commenter requests an implementation workgroup which will display CARB guidance in a public workshop process to provide transparency.

Commenter: [169-15d]

Agency Response: No changes were made in response to these comments. CARB staff plan to assess various aspects of the Regulation in collaboration with stakeholders during implementation, which is consistent with other fleet Regulations implemented by CARB.

d) Process Concerns – Implementation Timing

Comment Summary: Commenter states the timeframe between the ACF 15-day changes and Board adoption is too close to the rule's implementation and leaves little time for making key decisions.

Commenter: [169-15d]

Agency Response: No changes were made in response to these comments. CARB disagrees with this comment. This rulemaking was promulgated in accordance with the APA.

e) Process Concerns – No Time for Additional Changes

Comment Summary: Commenter states the current process does not provide time for a second 15-day comment period which limits the opportunity for further changes and questions the worth of the first 15-day comment period.

Commenter: [169-15d]

Agency Response: No changes were made in response to these comments. The Board determined the first ACF 15-day changes were sufficient when the Board adopted the package at the second Board hearing.

f) Process Concerns – Workshop Timing

Comment Summary: Commenter states that workshops did not provide enough time for a detailed back and forth discussion to fully address issues.

Commenter: [169-15d]

Agency Response: No changes were made in response to these comments. Staff worked with fleet managers and representatives for four years over the course of regulatory development. During the rulemaking process, CARB staff met with communities in evenings and nearly all public meetings were recorded and held online. In addition to the numerous workshops, workgroups, and other meetings held prior to the October 2022 Board hearing, an additional workshop and two workgroup meetings were held after the October 2022 Board hearing. In preparation for a second Board hearing on April 27, 2023, CARB staff provided a rulemaking package with significant updates based on stakeholder input, for a 15-day public comment period from March 23, 2023, to April 7, 2023.

g) Additional Public Process Needed Prior to Board Approval

Comment Summary: The commenters express concerns about the public process needed prior to Board approval.

Commenter: [105-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Additional Public Process Needed Prior to Board Approval" in "Public Regulatory Process and Outreach Concerns" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

h) Periodic Review of Regulatory Implementation Needed

Comment Summary: The commenters suggest that the Board should revisit the progress of Regulation implementation periodically, such as biennially, and include market assessment, infrastructure cost and development, ZEV cost, TCO, vehicle availability, supply chain, and other business impacts in collaboration with stakeholders. They also request that CARB assess the number and type of exemptions used annually and consider future amendments. Moreover, the commenters request that CARB and CEC track the development of California's capacity to power and support the ZEVs resulting from ACF and ACT implementation, develop publicly available real-time data on whether charging infrastructure construction is on pace to meet ZEV needs, and modify the rules if the tracking data shows that infrastructure cannot support ZEVs deployed by ACT and ACF. They also call for CARB, CEC, and CPUC to work closely with utilities and fleet customers to ensure providers can provide the energy and infrastructure needed.

Commenter: [110-15d, 124-15d, 171-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Periodic Review of Regulatory Implementation Needed” in “Public Regulatory Process and Outreach Concerns” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

i) Public Regulatory Process and Outreach Concerns - Periodic Review of Regulatory Implementation Needed

Comment Summary: The commenters express public process concerns relative to needing a periodic review of regulatory implementation.

Commenter: [110-15d, 124-15d, 171-15d]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Periodic Review of Regulatory Implementation Needed" in "Public Regulatory Process and Outreach Concerns" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

19. Miscellaneous Issues

a) Support

Comment Summary: Commenters support the Regulation as is.

Commenter: [056-15d, 057-15d, 065-15d, 076-15d, 077-15d, 091-15d, 092-15d, 093-15d, 094-15d, 095-15d, 096-15d, 097-15d, 098-15d, 099-15d 102-15d, 109-15d, 127-15d, 152-15d, 154-15d, 164-15d]

Agency Response: No changes were made in response to these comments. Thank you for the support.

b) General Opposition

Comment Summary: The commenters oppose the Regulation.

Commenter: [024-15d, 145-15d]

Agency Response: No changes were made in response to these comments. These comments are not directed to the 15-day changes to the ACF Regulation, so no response is required. The ACF Regulation is required to meet California’s clean air goals.

c) Excessive Late Reporting Violations

Comment Summary: Commenter states that single, separate violations for late reporting can be excessive.

Commenter: [169-15d]

Agency Response: No changes were made in response to these comments. The Health and Safety Code and other authority citations under which the Regulation would be enforced were established by the Legislature; CARB is obligated to comply with the statutory requirements. Enforcement of CARB Regulations is also subject to established CARB enforcement policy and statutorily requires consideration of appropriate mitigating factors.

d) 15-Day Changes do not Address Concerns

Comment Summary: Commenter generally states that the changes and revised language under the ACF 15-day changes are insufficient, or do not address their concerns.

Commenter: [008-15d, 053-15d, 055-15d, 058-15d, 060-15d, 079-15d, 115-15d, 117-15d, 125-15d, 126-15d, 147-15d, 161-15d]

Agency Response: No changes were made in response to these comments. Changes made in the 15-day process addressed the Board's direction, stakeholder concerns, and were determined to be sufficient.

e) 15-Day Changes Are Out of Scope Allowed per Government Code section 11346.8(c)

Comment Summary: The commenters state that certain ACF 15-day changes to the Regulation are out of scope because the Board did not direct the changes in the first Board hearing, and are therefore not allowed, per Government Code section 11346.8(c), quoting "(c) No state agency may adopt, amend, or repeal a Regulation which has been changed from that which was originally made available to the public pursuant to Section 11346.5, unless the change is (1) non-substantial or solely grammatical in nature, or (2) sufficiently related to the original text that the public was adequately placed on notice that the change could result from the originally proposed regulatory action."

Commenter: [132-15d, 133-15d, 169-15d]

Agency Response: No changes were made in response to these comments. The commenter omitted the last half of section (2), stated here in full for context: "(2) sufficiently related to the original text that the public was adequately placed on notice that the change could result from the originally proposed regulatory action. If a sufficiently related change is made, the full text of the resulting adoption, amendment, or repeal, with the change clearly indicated, shall be made available to the public for at least 15 days before the agency adopts, amends, or repeals the resulting Regulation." The exemptions and extensions were included in the 45-Day Notice, discussed during the first Board Hearing and sufficiently related edits were made to said exemptions and extensions during the ACF 15-Day Notice period. Staff have fully complied with the resulting obligation to make the related changes available for the public, for 15 days before the agency adopts, amends, or repeals the resulting Regulation, the full text of the resulting adoption, amendment, or repeal, with the change clearly indicated. CARB has complied fully with the requirements of this government code section.

f) Delay the Approval of the Advanced Clean Fleets Regulation

Comment Summary: The commenters state that CARB should postpone the Regulation due to various reasons, such as conducting further analysis, gathering more information, allowing advancements in technology and infrastructure, waiting for economic recovery, and facilitating necessary grid upgrades.

Commenter: [115-15d, 117-15d, 120-15d, 158-15d]

Agency Response: No changes were made in response to these comments. To meet various statutory goals, the Governor's goals, and other emissions reduction requirements, it is necessary to achieve these reductions as soon as possible. Sufficient economic, technological feasibility, infrastructure, and emissions analysis were conducted to support the Regulation timeframe and structure, and appropriate exemptions or extensions are included to address edge cases and provide flexibility. The Regulation timeframe was carefully balanced with achieving needed emissions reductions with a feasible phased-in timeframe for fleets. Delaying approval and implementation of the Regulation would result in reduced health and economic benefits and increase the burden of compliance on fleets to meet the same end goals in a more compressed timeframe.

g) Identical Submissions to 45-Day Comment Letters

Comment Summary: The commenters submitted comments identical to ones submitted during previous open comment periods.

Commenter: [006-15d, 073-15d, 106-15d, 110-15d, 117-15d, 132-15d, 135-15d, 137-15d, 149-15d, 160-15d, 170-15d]

Agency Response: No changes were made in response to these comments. This letter is a duplicate submission. See responses to the previously submitted comment letter from the commenter or organization in the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

20. Out of Scope and Irrelevant Comments

a) Irrelevant or Off-Topic Comments

Comment Summary: Comment is off topic or irrelevant and not directed at ACF or to the procedures followed by the agency in proposing or adopting ACF.

Commenter: [109-15d, 117-15d, 121-15d]

Agency Response: No changes were made in response to these comments. This comment is not directed at the ACF Regulation or the process by which it was adopted and therefore CARB is not required to respond.

b) Comments Out of Scope Not Directly Addressing the 15-Day Changes

Comment Summary: The commenters make assertions that are not directly related to the ACF 15-day changes.

Commenter: [001-15d, 003-15d, 005-15d, 007-15d, 008-15d, 009-15d, 010-15d, 011-15d, 012-15d, 014-15d, 015-15d, 016-15d, 017-15d, 018-15d, 019-15d, 020-15d, 021-15d, 022-15d, 023-15d, 025-15d, 026-15d, 027-15d, 028-15d, 029-15d, 030-15d, 031-15d, 032-15d, 033-15d, 034-15d, 035-15d, 036-15d, 037-15d, 038-15d, 039-15d, 040-15d, 041-15d, 042-15d, 043-15d, 044-15d, 045-15d, 046-15d, 047-15d, 048-15d, 049-15d, 050-15d, 051-15d, 052-15d, 053-15d, 054-15d, 058-15d, 059-15d, 060-15d, 061-15d, 062-15d, 063-15d, 064-15d, 065-15d, 066-15d, 067-15d, 068-15d, 070-15d, 071-15d, 074-15d, 075-15d, 078-15d, 079-15d, 081-15d, 082-15d, 083-15d, 084-15d, 085-15d, 086-15d, 087-15d, 088-15d, 089-15d, 090-15d, 095-15d, 100-15d, 101-15d, 103-15d, 104-15d, 109-15d, 110-15d, 111-15d, 112-15d, 113-15d, 115-15d, 116-15d,117-15d, 118-15d, 119-15d, 120-15d, 121-15d, 122-15d, 125-15d, 128-15d, 131-15d, 133-15d, 134-15d, 135-15d, 136-15d, 137-15d, 138-15d, 140-15d, 141-15d, 142-15d, 143-15d, 148-15d, 149-15d, 150-15d, 153-15d, 154-15d, 155-15d, 156-15d, 157-15d, 158-15d, 159-15d, 160-15d, 162-15d, 165-15d, 166-15d, 167-15d, 171-15d, 172-15d, 173-15d, 174-15d, 175-15d, 176-15d, 177-15d]

Agency Response: No changes were made in response to these comments. The commenters make assertions that are not directly related to the ACF 15-day changes.

Second Board Hearing Public Comments with Agency Responses

1. Zero-Emissions Vehicle Technology Issues

a) Zero-Emissions Technology – Service Impacts

Comment Summary: Commenter states that water agencies will not be able to transition to ZEVs without severely impacting service and reliability.

Commenter: [124-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Technology – General" in "Zero-Emissions Vehicle Technology Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

b) Zero-Emissions Technology – Don't Delay for Hydrogen Fuel Cell Vehicles

Comment Summary: Commenter states that CARB should focus on the electrification of all types of vehicles and not rely on hydrogen as part of the picture or a reason for a delay in implementation.

Commenter: [001-WT2, 008-WT2]

Agency Response: No changes were made in response to these comments. The intent of the Regulation is to transition fleets to ZEV consistent with Governor Newsom's Executive Order N-79-20 and public health needs identified in both the State SIP Strategy and the Climate Change Scoping Plan. ZEVs are defined as having no tailpipe emissions. Both FCEV and BEV are ZEVs and are treated equally in the Regulation.

a) Zero-Emissions Technology – Vehicle Safety Concerns

Comment Summary: Commenters state there are unknown and unquantified safety concerns for ZEVs hauling fuel and what happens if they crash.

Commenter: [130-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Technology – Vehicle Safety Concerns" in section "Zero-Emissions Vehicle Technology Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

b) Zero-Emissions Technology – Not Really Zero-Emissions due to Upstream Emissions

Comment Summary: Commenter states ZEVs aren't really zero because of upstream emissions from vehicle and battery production and electricity production.

Commenter: [117-OT2]

Agency Response: No changes were made in response to these comments. CARB has fulfilled its statutory obligations by conducting a full and robust EA, which included evaluations of upstream fuel cycle emissions which are insignificant in comparison to the tailpipe emissions reductions from this Regulation. Further, note that California has a number of separate requirements on transportation fuel production and feedstock collection to reduce upstream emission impacts. Additional information on lifecycle emissions analysis on ZEVs compared to liquid fuels is provided in Chapter IV.3. of this FSOR. For more information on lifecycle analysis and upstream emissions see CEQA EA Master Response 4 and RTC 270-4.

c) Zero-Emissions Technology – Severe Weather Impacts On Battery

Comment Summary: Commenter states that severe weather more quickly degrades a battery charge, and these conditions could render fleets inoperable at the worst possible times. Commenter does not specify what weather.

Commenter: [144-OT2]

Agency Response: No changes were made in response to these comments. Please see the response to weather impacts raised in section "Zero-Emissions Technology – Cold Weather" in section "Zero-Emissions Vehicle Technology Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

d) Zero-Emissions Technology – Charging Times

Comment Summary: The commenters state that electric trucks take too long to charge, resulting in the need for more truck drivers and additional trips.

Commenter: [120-OT2, 130-OT2, 154-OT2, 201-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Technology – Charging Times" in section "Zero-Emissions Vehicle Technology Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

e) Zero-Emissions Technology – Commercial Vehicles

Comment Summary: The commenters indicate that some commercial vehicle segments will be more challenging to electrify than passenger cars, suggesting that different approaches may be needed.

Commenter: [121-OT2, 133-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Technology – Commercial Vehicles" in section "Zero-Emissions Vehicle Technology Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

f) Zero-Emissions Technology – Availability

Comment Summary: The commenters argue that specific types of vehicles are not available to suit their operational needs and that many vehicles listed on Appendix J of the ISOR may be open for order but not delivered in the ordered quantities. They claim that CARB's assertion of many commercially available ZEV trucks is incorrect, and that ZE truck production will not meet the demand when the ACF mandates begin. They emphasize concerns about vehicle availability at scale and the uncertainty of obtaining ZEVs in various classifications to remain compliant.

Commenter: [006-WT2, 009-WT2, 130-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Technology – Availability" in section "Zero-Emissions Vehicle Technology Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

g) Zero-Emissions Technology – Battery Recycling

Comment Summary: The commenters state that investments in battery recycling will be necessary due to the rule, questioning how the State will handle battery recycling from the influx of ZEVs. They request CARB to inform them of plans for managing hazardous waste disposal of ZEV batteries in coordination with the Department of Toxic Substances Control and EPA.

Commenter: [127-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Zero-Emissions Technology – Battery Recycling” in section “Zero-Emissions Vehicle Technology Issues” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

h) Zero-Emissions Technology – Materials Mining

Comment Summary: The commenters express concerns about battery minerals and components being imported from China, impacting national security, and involving environmental impacts, child labor, and slave labor. They also mention concerns about the required mining and associated energy for battery production.

Commenter: [117-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Zero-Emissions Technology – Materials Mining” in section “Zero-Emissions Vehicle Technology Issues” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

i) Zero-Emissions Technology – Range and Work Capacity

Comment Summary: The commenters state that ZEV technology is not ready for use due to limited range, work capacity, or capability. They argue that electric trucks cannot maintain enough charge for a full work shift, internal combustion engines are superior in loaded power and range, and ZEVs are not capable of performing the same job functions as current trucks. They also mention that available ZEVs do not meet GVWR, towing, or range specifications, and express concerns about inconsistencies in supply chains and disruptions in the timely delivery of goods due to inadequate range and performance of heavy-duty vehicles. They believe that the aggressive implementation schedule of ACF is questionable due to the commercial availability of ZEVs for various duty cycles.

Commenter: [010-WT2, 012-WT2, 057-OT2, 060-OT2, 069-OT2, 120-OT2, 130-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Zero-Emissions Technology – Range and Work Capacity” in section “Zero-Emissions Vehicle Technology Issues” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

j) Zero-Emissions Technology – Emergency Response

Comment Summary: The commenters express concerns about the availability of EVs during emergency events, both declared and undeclared, as EVs cannot be independently powered or carry fuel without electricity, which may not be available during emergencies.

Commenter: [121-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Zero-Emissions Technology – Emergency Response” in section “Zero-Emissions Vehicle Technology Issues” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

k) Zero-Emissions Vehicle Technology – General

Comment Summary: The commenters express concerns regarding ZEVs’ technological capabilities, emphasizing the need for a greater than one-to-one replacement rate to meet operational needs compared to conventional trucks. They argue that heavy- duty ZEVs are not yet able to serve the transportation industry effectively and raise questions about their reliability and development progress. The commenters request that CARB assess the feasibility of manufacturing ZEVs with equal capacity and power to conventional vehicles, which would enable one-to-one replacements. They point out specific cases, such as garbage trucks, where ZEV technology is not ready for large-scale adoption. The commenters also highlight the lack of evidence supporting the notion that ZEV development can achieve the necessary variety of vehicle configurations, sizes, and uses for fleets to comply with ACF within the proposed timelines.

Commenter: [006-WT2, 010-OT2, 049-OT2, 059-OT2, 064-OT2, 066-OT2, 069-OT2, 084-OT2, 144-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Zero-Emissions Vehicle Technology – General” in “Zero-Emissions Vehicle Technology Issues” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

l) Zero-Emissions Vehicle Technology – Vehicle Weight

Comment Summary: The commenters express concerns about the weight of ZEVs, stating that the added weight impacts payload capabilities, road conditions, and overall vehicle performance. They mention that motor coaches operating at maximum gross vehicle road weight capacity would have reduced luggage capacity and difficulties servicing the same number of riders as ICE vehicles. Moreover, they argue that pairing battery weight with existing payload specs often exceeds axle GVWR, forcing a choice between retaining operation time and payload capacity, and that choosing payload could lead to a 25 percent to 65 percent reduction in operation time.

Commenter: [010-WT2, 012-WT2, 059-OT2, 120-OT2, 201-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Zero-Emissions Vehicle Technology – Vehicle Weight” in “Zero-Emissions Vehicle Technology Issues” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

2. Infrastructure and Grid Concerns

a) Grid Capacity and Resilience – Grid Capacity

Comment Summary: The commenters express concern about grid capacity.

Commenter: [004-OT2, 013-WT2, 084-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Grid Capacity and Resilience – Grid Capacity" in "Infrastructure and Grid Concerns" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

b) Grid Capacity and Resilience – Grid Capacity During Emergencies and for Essential Services

Comment Summary: The commenters express concern about grid capacity and resilience during emergencies and for essential services.

Commenter: [006-WT2, 031-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Grid Capacity and Resilience – Grid Capacity During Emergencies and for Essential Services" in "Infrastructure and Grid Concerns" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

c) Grid Capacity and Resilience – Grid Reliability

Comment Summary: The commenters express concern about grid reliability.

Commenter: [009-WT2, 012-OT2, 031-OT2, 130-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Grid Capacity and Resilience – Grid Reliability" in "Infrastructure and Grid Concerns" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

d) Infrastructure Availability – General

Comment Summary: The commenters express general concerns about infrastructure availability.

Commenter: [019-WT2, 059-OT2, 060-OT2, 064-OT2, 066-OT2, 067-OT2, 069-OT2, 084-OT2, 126-OT2, 130-OT2, 144-OT2, 201-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Infrastructure Availability – General" in "Infrastructure and Grid Concerns" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

e) Infrastructure Availability – Rural and Remote Area Accessibility

Comment Summary: The commenters express concern about the accessibility of infrastructure in rural and remote areas.

Commenter: [015-OT2, 060-OT2, 133-OT2, 144-OT2, 154-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Infrastructure Availability – Rural and Remote Area Accessibility” in “Infrastructure and Grid Concerns” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

f) ACF Resolution – Include Grid Reliability

Comment Summary: The commenters express concern about the need to include grid reliability in the Resolution.

Commenter: [070-OT2]

Agency Response: No changes were made to the draft Resolution based on this comment. Grid reliability is discussed in the Resolution in a section, called "Infrastructure and Grid Readiness."

g) Funding for Infrastructure

Comment Summary: The commenters express concern about the need for infrastructure funding.

Commenter: [076-OT2]

Agency Response: No changes were made in response to these comments. The recently convened IPAG public meetings identified the need to provide greater support for small fleets and small businesses statewide through the Carl Moyer Program’s incentives for infrastructure. Other programs related to funding for infrastructure are in section “Funding for Infrastructure” in “Funding and Incentive Program Issues” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

h) Use of Generators – Air District Permitting

Comment Summary: Commenter states that they were considering temporary ZEV charging solutions that use a propane generator, but that it may not be permitted by a local air district.

Commenter: [006-OT2]

Agency Response: No changes were made in response to this comment. California's 35 local Air Pollution Control or Management Districts are responsible for addressing emissions from stationary sources through permits and local rules. Alternatives to propane generators are ZE mobile ZEV fueling providers that utilize batteries or fuel cells as a source of power.

3. Alternative Fuels and Combustion Vehicles

a) Combustion Vehicles – Require Cleanest Combustion First

Comment Summary: Commenters state that the Regulation should, when exemptions to purchase ICE vehicles are granted, require fleets to prioritize the most stringent HD Omnibus standard vehicles available in ranking order, starting with the 20 milligram engines, then stepping down to 50+ milligram legacy diesel engines, to prevent the proliferation of diesel.

Commenter: [093-OT2]

Agency Response: No changes were made in response to these comments. The ISOR evaluated a concept called "Best Available Control Technology Concept" in Chapter IX.B.8. This alternative was rejected because it adds administrative burden to account for cleaner engines that are already accounted for in the HD Omnibus Regulation and would not achieve any new reductions by including them in the proposed Regulation. Please see responses to issues raised in section “Alternative Fuels” in “Infrastructure and Grid Concerns” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses” in the chapter on “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

b) Alternative Fuels and Combustion Vehicles – Regulation Forces Legacy Diesel Trucks Over New Renewable Natural Gas Trucks

Comment Summary: The commenter states ACF stops RNG-invested fleets and forces them to remain on diesel vehicles which are dirtier because of its ZEV requirements.

Commenter: [117-OT2]

Agency Response: No changes were made in response to these comments. The commenter is mistaken, nothing in the Regulation forces a fleet to remain on diesel. In fact, it is the contrary, the Regulation is designed for an almost two-decade long phase-in of ZEV into existing combustion fleets regardless of fuel type. Please refer to the section “Alternative Fuels and Combustion Vehicles – Compressed Natural Gas is Cleaner Than Diesel” in the chapter on “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

c) Alternative Fuels and Combustion Vehicles – Require Outdated “Low-NOx” Standard When Granted an Exemption

Comment Summary: Commenter requests that fleets be required to purchase the cleanest vehicles when granted an exemption. Another commenter states that the vehicles need to meet the certified to 0.02 NOx standards and to buy vehicles with engines meeting the 2027 0.02g NOx HD Omnibus standard during 2024-2026 when using the ZEV Purchase Exemption. Also, biomethane must be used for power.

Commenter: [073-OT2, 114-OT2,156-OT2]

Agency Response: No changes were made in response to these comments. The ZEV Purchase Exemption already requires the purchase of the cleanest engine certified to the most stringent emission standard technically achievable. The 2027 “Optional low-NOx” standard has been superseded by the HD Omnibus Regulation and the complementary Clean Truck Check program that work together to ensure the California Certified engine is the lowest emitting ICE vehicle in use on California’s roadways. Please see responses to issues raised in section “Alternative Fuels and Combustion Vehicles – Require “Optional Low NOx”

Combustion Vehicles Combusting Biomethane When Zero-Emission Vehicles Are Not Available" in the chapter on "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

d) Alternative Fuels and Combustion Vehicles – Include Natural Gas as a Zero-Emission

Comment Summary: The commenters request that California's future fleet policies broaden the definition of qualified technologies to encompass primary technologies currently powering the industry, such as natural gas. They argue that these technologies deserve inclusion and support in the state's policies.

Commenter: [010-WT2, 012-WT2, 030-WT2, 130-OT2]

Agency Response: No changes were made in response to these comments. The intent of the Regulation is to transition fleets to ZEV consistent with Governor Newsom's Executive Order N-79-20 and public health needs identified in both the State SIP Strategy and the Climate Change Scoping Plan. Please refer to Chapter II.E.1. of the ACF ISOR for a discussion on the CNG. As discussed in Chapter IX.B.8. of the ACF ISOR, the number of Class 2b through 8 CNG vehicles projected for 2025 is relatively small at approximately one percent of California's inventory. Expanding the market for CNG fleets could lead to stranded CNG fueling infrastructure assets as the ZEV market expands and more models become available.

e) Alternative Fuels and Combustion Vehicles – Allow Hydrogen Combustion as Bridge Technology for Infrastructure Development

Comment Summary: Commenter states that ACF should give special consideration of the infrastructure accelerating potential of zero carbon hydrogen fuel combustion engines stating that [H2ICE] technology would support CARB's zero carbon goals while facilitating hydrogen refueling infrastructure development and lower the costs of future fuel cell truck operations for fleets.

Commenter: [119-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Alternative Fuels and Combustion Vehicles – Low Carbon Intensity Fuels (Renewable Hydrogen)" in the chapter on "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

f) Alternative Fuels and Combustion Vehicles – Expand Market for Biomethane

Comment Summary: The commenter wants to work with CARB and CalRecycle on what to do with digester gases other than for transportation as they move towards electrification of their fleet. Finally, they state that CARB's assistance is crucial for the success of food waste diversion projects.

Commenter: [010-OT2, 021-OT2, 129-OT2, 131-OT2, 149-OT2]

Agency Response: No changes were made in response to these comments. However, the Board recognizes that the successful implementation of the food waste diversion requirements and methane emissions reductions mandated by SB 1383 are critical to the State's climate goals. The Board further recognizes that multiple reliable uses for non-fossil biomethane will be needed for successful implementation of the state's climate neutrality goals. The Board also recognizes the need for coordination meetings with other state agencies such as CEC, CPUC, State Water Resources Control Board, CalRecycle, CDFA, CNRA, Cal OSHA and other relevant stakeholders such as the California Association of Sanitation Agencies, California Air Pollution Control Officers Association, to implement SB 1383 and SB 1440.

g) Alternative Fuels and Combustion Vehicles – Do Not Allow Natural Gas Trucks when ZEV are Unavailable

Comment Summary: Commenter states that CARB should not allow the purchase of fracked gas vehicles when ZEVs are not available because natural gas trucks may have even worse consequences for climate and air quality than the very diesel trucks that this rule intends to phase out.

Commenter: [026-WT2, 111-OT2, 116-OT2]

Agency Response: No changes were made in response to these comments. Staff disagree; the Board determined flexibility was warranted in the Regulation for edge-case scenarios where ZEVs are not able to meet fleet needs. The Regulation takes a technology neutral approach to allowing purchase of ICE vehicles when exemptions are granted, which ensures that fleets have all relevant options for ICE vehicle purchases like they do today when not purchasing ZEVs. The Regulation will allow the purchase of a new combustion engine when granted an exemption, if it meets California's certification standard regardless of the fuel type. The Regulation will already phase out combustion as much as possible. The HD Omnibus regulation also ensures that combustion vehicles sold in California meet the same emissions standards, so there would be no difference in NOx emissions between a diesel and CNG truck sold starting in 2024. Concerns about natural gas and fracking is a fuel issue, and is addressed as part of the LCFS Regulation. LCFS assigns fuel pathways a CI score which considers how the fuel was made and transported for use, including what type of feedstocks, as well as manufacturing and production methods were used, including fracking. The commenter should be aware, most of the natural gas consumed in California's transportation sector is from renewable feedstocks because of the LCFS and federal Renewable Identification Number credits.

h) Alternative Fuels and Combustion Vehicles – Require Renewable Hydrogen in Hydrogen Fuel Cell Vehicles

Comment Summary: Commenters state the Regulation should not include hydrogen powered trucks, or if included, require the hydrogen fuel that powers FCEVs to be clean hydrogen not produced from methane due to the impacts of fossil produced hydrogen.

Commenter: [102-OT2]

Agency Response: No changes were made in response to these comments. However, staff agrees and explicitly states this in Chapter II.D.1 of the ISOR, "Electricity and hydrogen are currently the primary fuels for ZEVs, and both fuels must be produced using low carbon technology and feedstocks to minimize upstream emissions as the LCFS calculates life-cycle CI of fuel-vehicle systems."

i) Alternative Fuels and Combustion Vehicles – Add Senate Bill 1383 to the Last Paragraph in the Resolution

Comment Summary: The commenter states that the ACF Resolution should add reference to SB 1383 in the very last sentence.

Commenter: [070-OT2, 010-OT2, 118-OT2, 122-OT2, 123-OT2, 146-OT2, 152-OT2]

Agency Response: No changes were made in response to these comments. However, the draft Board Resolution 23-13 was changed in response to these comments. "SB 1383" was added before "SB 1440" of the last paragraph, for further clarification.

j) Alternative Fuels and Combustion Vehicles – Include Renewable Gases for Electricity Generation and Reliability to the Last Paragraph in the Resolution

Comment Summary: Commenter states that the ACF resolution should include biomethane, renewable hydrogen, other renewable gases as critical for electricity reliability in the long term. The commenter also states that “SB 1440 is limited to residential and small business uses, which are also supposed to be electrified in the coming decade. So that, at least in its current form, is really not the right long-term home either.”

Commenter: [070-OT2]

Agency Response: No changes were made in response to these comments. The commenter correctly notes that buildings will increasingly be electrified in the coming years as directed by the Scoping Plan. However, as explained in Chapter II.D.1.a of the ISOR, California has the potential to produce approximately 90.6 billion cubic feet per year of RNG from dairy, landfill, municipal solid waste, and wastewater treatment facility sources, this represents only four to five percent of California’s total annual consumption of natural gas. Furthermore, there is nothing in this Regulation precluding RNG from getting directed towards existing natural gas generation facilities.

k) Alternative Fuels and Combustion Vehicles – Modify the Resolution to Not Force Biomethane into the Pipeline

Summary: Commenters request staff to modify the resolution so that it does not choose a predetermined priority like pipeline injection for the RNG that commenters produce.

Commenter: [010-OT2]

Agency Response: No changes were made in response to these comments. The Board directed staff to prioritize policy discussions related to SB 1440 and SB 1383 implementation and discussions on how to transition biomethane into hard to decarbonize sectors, or as a feedstock to produce hydrogen for FCEV fuel and to produce electricity to charge BEVs. This framework provides at least three viable options, not just one as the commenter suggests.

l) Alternative Fuels and Combustion Vehicles – Regulation Conflicts with SB 1383

Summary: Commenters state that the Regulation and SB 1383 conflict and that this rule prohibits an agency from complying with SB 1383.

Commenter: [131-OT2, 136-OT2]

Agency Response: No changes were made in response to these comments. Please see the section called, "Alternative Fuels and Combustion Vehicles – Rule Conflicts with Organic Waste Diversion" in the chapter on in the chapter on "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

4. Cost Comments

a) Costs – Cost of the Regulation

Comment Summary: The commenters state that the cost of the Regulation is excessive and may have negative effects on the economy, cost of living, vulnerable communities, businesses, or transportation system. The negative consequences may include fleets going out of business, loss of jobs, increased costs for customers, and more investment in vehicles and infrastructure. Commenters cite the impending economic slowdown.

Commenter: [004-OT2, 060-OT2, 084-OT2, 120-OT2, 144-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Costs – Cost of the Regulation" in "Cost Comments" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

b) Costs – Zero-Emission Vehicle Costs

Comment Summary: The commenters express concern that ZEVs are currently unaffordable for many due to their high cost compared to combustion-powered vehicles. They note that ZEVs may require significant incentives and tax credits to be economical at the point-of-sale, which could place a financial burden on fleet owners. Some commenters disagree with the idea that the cost of ZEVs will come down over time, discuss cost increases for ZEVs, or that manufacturers will keep prices high when there is no competition.

Commenter: [019-WT2, 066-OT2, 120-OT2, 126-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Costs – Zero-Emission Vehicle Costs" in "Cost Comments" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

c) Costs – State and Local Government Issues

Comment Summary: The commenters state that the Regulation will increase costs for local governments, leading to increased taxes, rates, or use of the city's general fund to recoup costs. Commenter cites concerns with the proposal and their typical two-year or five-year budget cycles.

Commenter: [006-OT2, 062-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Costs – State and Local Government Issues" in "Cost Comments" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

d) Costs – Infrastructure Costs

Comment Summary: The commenters raise concerns about the significant infrastructure costs required to support the deployment of ZEVs, including the costs for chargers, necessary site upgrades, and utility-side upgrades. The commenters also question where the funding for these costs will come from, given that the infrastructure requirements far exceed the state's ability to fund and support them.

Commenter: [006-OT2, 126-OT2, 201-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Costs – Infrastructure Costs" in "Cost Comments" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

e) Costs – Small Fleets

Comment Summary: The commenters state that the proposed Regulation will negatively impact small fleets and small, family- owned businesses, potentially putting them out of business. They explain that smaller fleets may not be able to afford the cost of new vehicles, ZEVs, or necessary supporting infrastructure.

Commenter: [010-WT2, 012-WT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Costs – Small Fleets" in "Cost Comments" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

f) Costs – Supply Chain Issues

Comment Summary: The commenters state that the Regulation will have negative impacts on the transportation sector, supply chains, and the cost of living in California. They also state the existing or future supply chain issues will increase costs of ZEVs or ZEV infrastructure, or that the Regulation will exacerbate these issues. They express concern that the Regulation will exacerbate existing and future supply chain issues which will impact the movement of critical goods like food, water, and medical supplies.

Commenter: [130-OT2, 201-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Costs – Supply Chain Issues" in "Cost Comments" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

5. 100 Percent ZEV Sales Issues

a) 100 Percent ZEV Sales Requirement and Fleet Size Applicability Thresholds

Comment Summary: Commenters are suggesting lowering the HPF fleet size applicability threshold below the originally proposed 50 trucks down to 10 tractors.

Commenter: [017-OT2, 020-WT2, 031-WT2, 033-WT2, 034-WT2, 041-OT2, 044-OT2, 053-OT2, 081-OT2, 102-OT2, 103-OT2, 104-OT2, 105-OT2, 106-OT2, 107-OT2, 108-OT2, 109-OT2, 110-OT2, 112-OT2, 113-OT2, 148-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "100 Percent ZEV Sales Requirement and Fleet Size Applicability Thresholds" in section "100 Percent ZEV Sales Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

b) Feasibility of 100 Percent ZEV Sales Requirement by 2036

Comment Summary: The commenter states that the advancement of the 100 Percent ZEV Sales Requirement to 2036 will make the already challenging ACF implementation timeline even more challenging.

Commenter: [119-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Feasibility of 100 Percent ZEV Sales Requirement by 2036" in section "100 Percent ZEV Sales Issues" of the "15-Day Comment Period Public Comments with Agency Responses."

6. Drayage Truck Requirements Issues

a) Drayage - Cost of the Regulation

Comment Summary: The commenter states that the upfront costs of the Regulation are tremendous. The commenter states that robust and focused funding from state partners, such as CARB, will allow a transition of this magnitude to move forward.

Commenter: [035-WT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in sections "Drayage – Cost of the Regulation," "Drayage – Incentives," "Costs – Costs of the Regulation," "Costs – Cost Passthrough," "Costs – LCFS

Assumptions," and "Costs – Supply Chain Issues" in "Cost Comments" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

b) Drayage – Daily Usage Exemption

Comment Summary: The commenter requests a daily use exemption for drayage trucks.

Commenter: [059-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Drayage – Daily Usage Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

c) Drayage – Expand the Drayage Truck Definition

Comment Summary: The commenters request that the definition of a drayage truck be expanded to include additional vehicle types, specifically car carriers.

Commenter: [074-OT2, 077-OT2, 078-OT2, 079-OT2, 080-OT2, 081-OT2, 103-OT2, 107-OT2, 109-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Drayage – Expand the Drayage Truck Definition" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

d) Drayage – Exemption – Combustion Vehicles Ordered Pre-2024

Comment Summary: The commenter states the January 1, 2024, deadline for drayage should allow for the registration of combustion vehicles purchased prior to the deadline that are not delivered until after deadline.

Commenter: [201-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Drayage – Exemption – Combustion Vehicles Ordered Pre-2024" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

e) Drayage – Infrastructure Availability – Retail

Comment Summary: The commenter states there is a lack of publicly available infrastructure and urges targeted investment in the San Diego region to progress the development of ZE infrastructure to support small fleets and independent operators.

Commenter: [035-WT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Drayage – Infrastructure Availability - Retail" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

f) Drayage – Less Stringent Regulation

Comment Summary: The commenters request that CARB makes the drayage Regulation less stringent by pushing out the regulatory deadline.

Commenter: [013-OT2, 157-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Drayage – Less Stringent Regulation" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

g) Drayage – One Visit Requirement

Comment Summary: The commenter states concern about the impact of the one visit per year requirement on the State's ability to handle cargo throughput and recommend removing it to add flexibility during unanticipated cargo surges.

Commenter: [035-WT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Drayage – One Visit Requirement" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

h) Drayage - Reporting

Comment Summary: The commenter suggests modifying Section 2014.1(a)(8) so that all Class 7 through 8 trucks which visit a California seaport must register in the CARB Online System and indicate whether they are drayage trucks or dedicated use trucks.

Commenter: [035-WT2]

Agency Response: No changes were made in response to these comments. The reporting requirements are specifically for drayage trucks as defined in the Regulation. Dedicated use trucks are excluded from the registration requirements.

i) Drayage – Supply Chain Issues

Comment Summary: The commenters state the proposed Drayage Regulation will negatively impact the drayage trucking industry and the overall supply chain, and subsequently raise the cost of goods. Commenter states that the drayage requirements could cause a mode shift from rail to trucks causing more diesel trucks to be on the road.

Commenter: [013-OT2, 014-OT2, 154-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Drayage – Supply Chain Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

j) Drayage - Support

Comment Summary: This comment is supportive of the process, stakeholder engagement, or actions in the rulemaking.

Commenter: [033-WT2]

Agency Response: No changes in response to this comment. CARB staff appreciate the supportive comment and thank the commenter.

k) Drayage – Vehicle Exemptions for Auto Transports

Comment Summary: The commenters state concern about the vehicle exemptions, specifically the auto transport vehicles.

Commenter: [013-OT2, 014-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Drayage – Vehicle Exemptions for Auto Transports" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

l) Drayage – Zero-Emissions Vehicle – Mileage is Not Feasible

Comment Summary: The commenter states that there are currently no ZEV models that can make a round trip shipment to the ports. Commenter states that the extra charging time needed as a result will cause significant delays in deliveries.

Commenter: [013-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Drayage – Zero-Emissions Vehicle – Mileage is Not Feasible" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

7. High Priority Fleet Issues

a) High-Priority Fleets – NZEVs Should Not be Equal to ZEVs

Comment Summary: Commenter states that NZEVs should not be considered as ZEVs in the Regulation at any point.

Commenter: [148-OT2]

Agency Response: No changes were made in response to these comments. NZEVs offer flexibility for fleets as a bridge technology to introduce and experiment with ZE technology until the state of the ZEV market has advanced to the point of fulfilling the needs of their fleet. Forcing fleets to transition solely to ZEVs too early may be counterproductive in certain market segments as fleets may begin applying for additional exemption requests, delaying the introduction of ZE technology into their operation. The current NZEV provision was also chosen to be consistent with similar provisions within the ACT Regulation.

b) High-Priority Fleets - Lower Fleet Size Threshold Over Time

Comment Summary: Commenters request that the ACF Regulation needs to be stricter by lowering the fleet size threshold over time.

Commenter: [007-WT2]

Agency Response: No changes were made in response to these comments. No changes were made in response to these comments. Please see responses to issues raised in section "100 Percent ZEV Sales Requirement and Fleet Size Applicability Thresholds" of section "100 Percent ZEV Sales Issues" in the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

c) High-Priority Fleets – Add Averaging, Banking, and Trading

Comment Summary: The commenters suggest including an ABT mechanism in the Regulation, allowing fleets to trade credits generated by purchasing ZEVs.

Commenter: [052-OT2, 083-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "High-Priority Fleets – Add Credit Averaging, Banking, and Trading" of section "High Priority Fleet Issues" in the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

d) High-Priority Fleets – Do Not Count Backup Vehicle Mileage During Power Shut-Offs or Emergencies

Comment Summary: The commenters suggest updating the HPF backup vehicle provision by not including mileage accrued during a power shut-off or other emergency events.

Commenter: [058-OT2]

Agency Response: No changes were made in response to these comments. A provision that excludes mileage accrued during certain events is not necessary and may be difficult to implement and enforce. Most PSPS and outage events last only a few hours and do not typically occur with high frequency. Implementing such a provision would also require fleets to track vehicle use times and mileage during applicable events while CARB would have to verify whether events occurred and that the vehicle was operated during the event, increasing burden on both sides.

If backup vehicle mileage exemptions during emergency events become necessary, the Board has a long history of supporting amendments to Regulations if rule adjustments are needed.

e) High-Priority Fleets – Keep 50 Vehicle Threshold

Comment Summary: The commenters state that lowering the threshold from 50 trucks down to 10 would only exacerbate many issues with ZEVs.

Commenter: [032-WT2, 144-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "High-Priority Fleets – Keep 50 Vehicle Threshold" of section "High Priority Fleet Issues" in the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

f) High-Priority Fleets – Only Allow Near-Zero-Emissions Vehicle if No Zero-Emissions Vehicle is Available

Comment Summary: The commenters request permitting NZEV purchases only if a fleet genuinely cannot purchase and deploy ZEVs.

Commenter: [052-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "High-Priority Fleets – Only Allow Near-Zero-Emissions Vehicle if No Zero-Emissions Vehicle is Available" of section "High Priority Fleet Issues" in the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

g) High-Priority Fleets – Reduce Flexibility Between Zero-Emissions Vehicle Milestone Groups

Comment Summary: The commenters recommend not permitting fleets to rely exclusively on lighter duty vehicles to meet their compliance requirements so they may focus on Class 8 vehicles.

Commenter: [083-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "High-Priority Fleets – Reduce Flexibility Between Zero-Emissions Vehicle Milestone Groups" of section "High Priority Fleet Issues" in the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

h) Rental Vehicle Provision – Match Rental Demand to Supply

Comment Summary: Commenter states rental customers are the end users, as rental companies purchase ZEVs to become a conduit for ZEVs to the end users. The ACF Regulation should be changed to reflect this reality.

Commenter: [047-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Rental Vehicle Provision – Match Rental Demand to Supply" of section "High Priority Fleet Issues" in the "15-Day Comment Period Public Comments with Agency Responses."

i) Rental Vehicle Provision - Subtract Exempt Vehicles from Rental Fleet Obligations

Comment Summary: Commenter states that some fleets have been expressly exempted from ACF due to the unique nature of their vehicle usage and that rental companies should appropriately subtract rentals provided to exempt entities from the denominator of the rental company's ACF ZEV Milestones Option requirements for their fleet.

Commenter: [047-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Rental Vehicle Provision - Count All Zero-Emissions Vehicle Rentals Toward Compliance" of the "15-Day Comment Period Public Comments with Agency Responses."

j) Rental Vehicle Provision – Count All Zero-Emissions Vehicle Rentals Toward Compliance

Comment Summary: Commenter states rentals of a ZEV should count towards compliance to drive rentals of ZEVs that would otherwise not be rented.

Commenter: [047-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Rental Vehicle Provision - Count All Zero-Emissions Vehicle Rentals Toward Compliance" of the "15-Day Comment Period Public Comments with Agency Responses."

8. State and Local Government Issues

a) State and Local Government – Small Fleets – Include Financial Hardship Exemption

Comment Summary: Commenter states the Regulation should include an automatic exemption for small public entities based on fiscal hardship.

Commenter: [024-OT2, 055-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "State and Local Government – Small Fleets – Include Financial Hardship Exemption" in section "State and Local Government Issues" of the "15-Day Comment Period Public Comments with Agency Responses."

b) State and Local Government – Small Fleets – Include Smaller Counties

Comment Summary: Commenters state that small counties under 50,000 in population should be fully exempt, or be granted a 10-year delay, from the Regulation.

Commenter: [055-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “State and Local Government – Small Fleets – Include Smaller Counties” in section “State and Local Government Issues” of the “15-Day Comment Period Public Comments with Agency Responses.”

c) State and Local Government – Small Fleets – Include Fleets that Purchase Single Vehicles in a Year

Comment Summary: Commenter states the small fleet delayed implementation schedule in SLG Regulation should be extended to agencies that purchase less than two vehicles in a calendar year.

Commenter: [024-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “State and Local Government – Small Fleets – Include Fleets that Purchase Single Vehicles in a Year” in section “State and Local Government Issues” of the “15-Day Comment Period Public Comments with Agency Responses.”

d) State and Local Government – 13th Year Limit – Remove Limit

Comment Summary: Commenters state the 13th model year restriction should be removed from the SLG Regulation requirements.

Commenter: [004-WT2, 005-WT2, 008-OT2, 009-OT2, 012-OT2, , 020-OT2, 121-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “State and Local Government – 13th Year Limit – Remove Limit” in section “State and Local Government Issues” of the “15-Day Comment Period Public Comments with Agency Responses.”

e) State and Local Government – 13th Year Limit – Conflicts with Truck and Bus

Comment Summary: Commenter states that the 13th year provision creates an additional issue because certain vehicles would then be in violation of California’s Truck and Bus Regulation, which requires any vehicle with a GVWR over 14,000 to be taken out of service after 13 years. Effectively, it would create a period of time where the utility would be unable to operate the vehicle in question while waiting for a decision on the exemption request.

Commenter: [002-OT2, 068-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “State and Local Government – 13th Year Limit – Conflicts with Truck and Bus” in section “State and Local Government Issues” of the “15-Day Comment Period Public Comments with Agency Responses.”

f) State and Local Government – Delay Start Date

Comment Summary: The commenters ask for a delay in the start date of the SLG requirements.

Commenter: [024-OT2, 055-OT2, 124-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "State and Local Government – Delay Start Date" in "State and Local Government Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

9. Definitions Issues

a) Definition of Common Ownership and Control - Include Vehicles in the Fleet for One Year or Longer

Comment Summary: Commenters ask that the common ownership definition be limited to only relationships where businesses exclusively control contracted vehicle operations for a period of one year or longer.

Commenter: [001-OT2, 068-OT2]

Agency Response: No changes were made in response to these comments. The California fleet includes vehicles under common ownership or control, and, by definition, if a vehicle is operated in California at any time during a calendar year, it is considered part of the California fleet for the entire calendar year. The rationale for including fleet owners or controlling parties with combination fleets operated under common ownership or control totaling more than 50 vehicles is to maintain a level playing field with other regulated parties who own their trucks and compete for the same business. There is a wide range of business models for entities that compete for the same contracts and work in the trucking industry. Controlling parties are positioned to have visibility and control over the fleet as a whole that the owner-operators of these vehicles do not have. If vehicles under common ownership and control were only counted as part of the California fleet if they were in that fleet for at least a year, a loophole would be created whereby fleets could rotate the hiring and operating or hiring and directing the operation of vehicles for less than a year, but still effectively have 50 or more vehicles under their common ownership or control. This would reduce the total number of ZEVs and thus would reduce the expected emissions benefits from ACF.

Vehicles that are owned or managed on a day-to-day basis by the same person or entity are effectively under the control of that entity, whether in the fleet for a year, or more or less than a year. The controlling entity is therefore positioned to manage the composition of the whole fleet and should be responsible for compliance. This ensures that entities with a vehicle ownership model are treated the same as entities that use a common ownership and control model. This approach maintains a level playing field for companies using different vehicle ownership or control models and minimizes the potential for regulated parties to circumvent the rule requirements by changing their business model.

Entities with larger fleets and revenues are expected to have more flexibility to identify vehicles or routes in the fleet that can be transitioned to ZEs and are considered to be those best suited for transitioning to ZEVs before other fleets that more frequently tend to purchase used vehicles on the secondary market. Fleets that own, operate, or direct 50 or more vehicles, whether in that fleet for a year, or more or less than a year, also represent a substantial portion of the market and typically have multiple locations that may allow for infrastructure investments to likely be more prioritized. Additionally, the LER results largely support that the appropriate threshold is represented by the applicability criteria, as it incorporates approximately 70 percent of larger trucks that have a disproportionate impact on emissions.

b) Definition of Emergency Operations

Comment Summary: The commenters are requesting to expand the definition of "emergency operations" to include non-declared events such as localized storms, natural disasters, and site-specific fire events in schools, hospitals, or data centers, or other events that may cause prolonged or widespread network outages.

Commenter: [008-OT2, 018-WT2]

Agency Response: No changes were made in response to these comments. The definition of Emergency Operations as written in the ACF Regulation is consistent with other CARB Regulations. Please see responses to issues raised in the section “Definition of Emergency Operations / Emergency Support Vehicle” in the “Definition Issues” section of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

c) Definition of Emergency Support Vehicle and Exemption Process

Comment Summary: The commenters are requesting a clearer definition on the “emergency support vehicle” along with the exemption process.

Commenter: [127-OT2]

Agency Response: No changes were made in response to these comments. See the response to the issues raised in the section called “Definition of Emergency Operations / Emergency Support Vehicle” in the “Definition Issues” section of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

10. Provisions, Reporting, and Recordkeeping Issues

a) Recordkeeping – ZEV Requirements

Comment Summary: Commenter states the requirement fleets keep documentation that a ZEV operates within California within a given model year conflicts with IRP requirements and limits ZEV flexibility in the interstate fleet.

Commenter: [071-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in the section “Recordkeeping – ZEV Requirements” in the

"Provisions, Reporting, and Recordkeeping Issues" section of the "15-Day Comment Period Public Comments with Agency Responses."

11. Exemptions and Extensions – General

a) Alternative Compliance Options Until More ZEVs Available

Comment Summary: The commenters generally suggest CARB allow alternative compliance options until more vehicles become available.

Commenter: [071-OT2]

Agency Response: No changes were made in response to these comments. The Regulation already has considerable flexibility for fleets to plan their compliance strategies. Please see responses to issues raised in the section "Allow Alternative Compliance Options Until More ZEVs Available" in the "Exemptions and Extensions – General" section of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

b) Do Not Allow Natural Gas Vehicles

Comment Summary: Commenter states opposition to inclusion of exemptions for natural gas vehicles or requests a limit in exemptions for such vehicles.

Commenter: [033-WT2, 072-OT2, 074-OT2, 081-OT2, 106-OT2, 112-OT2, 125-OT2, 134-OT2, 141-OT2, 145-OT2]

Agency Response: No changes were made in response to these comments. The board directed staff to allow more time for fleets to transition to ZEVs that comply with SB 1383 requirements. This allows waste and wastewater fleets time to shift the biomethane collected into harder-to-decarbonize sectors other than transportation. This approach provides a more gradual shift, ensuring that these fleets do not lose out on their investments in natural gas vehicles, while still working towards the state's environmental objectives.

c) Exemption Should be a Last Resort

Comment Summary: Commenter states that exemptions and extensions in the Regulation should only be granted as a last resort if no other options are available.

Commenter: [083-OT2]

Agency Response: No changes were made in response to these comments. The exemptions and extensions included in the Regulation are specifically designed such that fleet owners would not have other choices and are meant to address situations outside of the fleet owner's control. The Board determined they provide appropriate flexibility while balancing the emissions and health goals of the Regulation.

d) EPA Certified Engines Instead of California Certified Engines

Comment Summary: Commenter requests the removal of the requirement to purchase California-certified engines as EPA- certified engines should be permissible.

Commenter: [059-OT2]

Agency Response: No changes were made in response to these comments. The Board approved the change to require fleets to purchase California certified engines when new engines are purchased so that all engines added to the fleet starting 2024 would meet the most stringent emissions standards deemed feasible.

e) Exemption Data Request

Comment Summary: Commenter would like CARB to post the number of exemptions granted.

Commenter: [063-OT2]

Agency Response: No changes were made in response to these comments. It is common practice to share implementation data on Regulations thorough CARB's website as long as confidential business and personally identifiable information is not. Data can be posted as a comma separated value file which would allow a user to import using various software programs and be used in data dashboards.

f) No Flexibilities Should be Granted

Comment Summary: Commenter states that no other vehicle should be allowed for purchase other than ZEVs.

Commenter: [023-OT2]

Agency Response: No changes were made in response to these comments. The Board recognizes the importance of transitioning to ZEVs, and it also acknowledges the need for flexibility in certain sectors. Therefore, certain exemptions have been placed in the ACF Regulation to accommodate situations where ZEVs do not meet specific operational requirements. The exemptions have been carefully designed to balance the need for flexibility in unique circumstances where the fleet owner would not be able to comply for circumstances beyond their control and otherwise achieve the maximum emissions reduction and health benefits.

g) No Time Frames on Exemptions and Extension

Comment Summary: Commenters state exemptions and extensions should be allowed to be extended as needed without specific time frames.

Commenter: [126-OT2]

Agency Response: No changes were made in response to these comments. The Board determined that the time for the exemption process is adequate. The time frames have been established to prevent misuse of exemptions and extensions, as well as to avoid creating loopholes for fleets.

h) Exempt Water Agencies

Comment Summary: The commenters state that the ACF Regulation fails to acknowledge the constraints experienced by rural and mountain county water purveyors who are considered first responders and should be exempt from the rule. The commenter requests that CARB acknowledge water purveyors (agencies) as first responders and exempt them from the Regulation.

Commenter: [006-WT2]

Agency Response: No changes were made in response to these comments. Please see discussion on why such exemptions are not appropriate in section “Exempt Water Agencies” in “Exempt Vehicles or Fleets” of the “15-Day Comment Period Public Comments with Agency Responses.”

i) Consequence if Approval or Denial Not Provided Within 45 Days

Comment Summary: Commenter states the response timeframe language for the Executive Officer responding to complete exemption or extension requests should include language stating the exemption or extension would be deemed approved if no response was received within 45 days.

Commenter: [133-OT2]

Agency Response: No Changes were made in response to these comments. Please see responses to issues raised in section “Consequence if Approval or Denial Not Provided Within 45 Days” in “Exemptions and Extensions – General” of the “15-Day Comment Period Public Comments with Agency Responses.”

j) Include a “Catch All” Exemption for Scenarios Not Contemplated by the Regulation

Comment Summary: The commenters propose a "catch-all" process to delay compliance requirements on a fleet-specific basis for reasons not contemplated by the Regulation, emphasizing the need for flexibility to address complex scenarios when unique needs or circumstances do not fit within simplified exemption criteria.

Commenter: [052-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Include a “Catch All” Exemption for Scenarios Not Contemplated by the Regulation” in “Exemptions and Extensions – General” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

k) Criteria and Process are Too Complex

Comment Summary: The commenter has concerns the extensions necessitate onerous and detailed applications from small business owners.

Commenter: [130-OT2]

Agency Response: No changes were made in response to these comments. The HPF Regulation targets larger fleets of 50 or more vehicles or with $50 Million in annual revenues, which are not small fleets. Please see responses to issues raised in section "Criteria and Process 15-Day Changes Are Too Complex" in "Exemptions and Extensions – General" of the "15-Day Comment Period Public Comments with Agency Responses."

l) Exemptions Offload Responsibility to Truck Owners

Comment Summary: The commenters state the many exemptions in this proposal are designed to offload responsibility for nonperformance to truck owners. CARB, utilities, and municipalities face no penalties for the extreme goals of the proposed Regulation.

Commenter: [019-WT2]

Agency Response: No changes were made in response to these comments. The Regulation is designed to meet Governor's EO N-79-20 and many other objectives which are described in Chapter II. A of the Staff Report. The exemptions and extensions are designed to assist a fleet owner who is experiencing circumstances outside of their control, and for edge cases while maintaining a level the playing field during an almost two-decade long transition to ZE. The provisions in this Regulation were designed to be flexible while fair, and to help facilitate communication between fleet owners and the growing number of manufacturers in the medium-to heavy-duty ZEV ecosystem.

12. Exemptions and Extensions – Daily Usage

a) Daily Usage Exemption – Master Response

Comment Summary: The commenters suggest the need for exemptions when ZEVs are available but not operationally feasible or cannot meet duty cycles.

Commenter: [121-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Daily Usage Exemption – Master" in "Exemptions and Extensions – Daily Usage" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

b) Daily Usage Exemption – Include Additional Usage Factors

Comment Summary: The commenters suggest modifying the daily use exemption criteria to include additional relevant usage factors such as the effects of temperature and weight on the performance of ZEVs compared to conventional vehicles.

Commenter: [012-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Daily Usage Exemption – Include Additional Usage Factors" in "Exemptions and Extensions – Daily Usage" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

c) Daily Usage Exemption – Allow Three Highest Values

Comment Summary: The commenters argue against excluding the three highest values from calculations for Daily Usage Exemption.

Commenter: [004-WT2, 005-WT2, 008-OT2, 009-OT2, 020-OT2, 068-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Daily Usage Exemption – Allow Three Highest Values" in "Exemptions and Extensions – Daily Usage" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

13. Exemptions and Extensions – Non-Repairable Vehicles

a) Non-Repairable Vehicles – Allow New Vehicle Purchase Instead of Used

Comment Summary: Commenters state the Non-Repairable Vehicle Exemption should allow purchase of new vehicles.

Commenter: [068-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Non-Repairable Vehicles – Allow New Vehicle Purchase Instead of Used" in section "Exemptions and Extensions – Non-Repairable Vehicles" of the "15-Day Comment Period Public Comments with Agency Responses."

b) Non-Repairable Vehicles – Allow Exemption to Apply to Non-Repairable Engine or Vehicle

Comment Summary: Commenter states that the Non-Repairable Vehicle Exemption should allow for either the engine or the vehicle to be considered non-repairable and qualify for the exemption.

Commenter: [068-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Non-Repairable Vehicles – Allow Exemption to Apply to Non-Repairable Engine or Vehicle" in section "Exemptions and Extensions – Non-Repairable Vehicles" of the "15-Day Comment Period Public Comments with Agency Responses."

14. Exemptions and Extensions – Infrastructure Delays

a) Infrastructure Delay Extension – Construction Permit Timing Concerns

Comment Summary: Commenter states many fleets with EV plans that are well underway won't be able to secure construction permits prior to December 31st of this year, which is the deadline necessary for the construction exemptions for near-term drayage model year and Group 1 ZEV Milestone deadlines.

Commenter: [151-OT2]

Agency Response: No changes were made in response to these comments. The Board determined this was sufficient time for fleets to take advanced action ahead of compliance deadlines. The Regulation was modified so the Infrastructure Delay provision was expanded to include utility delays in site electrification; if this is the case, this delay would be known prior to obtaining construction permits. Fleets with multiple locations would not be able to request an extension unless they were able to show that every location experienced a delay, reducing the likelihood that the fleet would need the extension. The commenter does not provide specific examples, and the comment is speculative that such timeframes could not be met. For additional discussion, see section "Infrastructure Delay Extension – Construction Permit Timing Concerns" in section "Exemptions and Extensions - Infrastructure Delays" of "15-Day Comment Period Public Comments with Agency Responses."

b) Infrastructure Delay Extension – Include Lack of Access to Public Charging

Comment Summary: Commenter states the Infrastructure Delay Provision needs to account for lack of access to public charging.

Commenter: [059-OT2, 069-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Infrastructure Delay Extension – Include Lack of Access to Public Charging" in section "Exemptions and Extensions – Infrastructure Delays" of the "15-Day Comment Period Public Comments with Agency Responses."

c) Infrastructure Delay Extension – Allow Alternative Infrastructure Exemption Based on Fleet Plan

Comment Summary: The commenters propose an alternative infrastructure exemption with an interim compliance plan where CARB reviews and verifies infrastructure plans from each regulated fleet, demonstrating their progress on projects. If approved by CARB, the fleet could achieve "Interim Compliance" and delay site-associated vehicle purchases.

Commenter: [071-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Infrastructure Delay Extension – Allow Alternative Infrastructure Exemption Based on Fleet Plan" in section "Exemptions and Extensions – Infrastructure Delays" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

d) Infrastructure Delay Extension – Allow More Time for Extension

Comment Summary: The commenters state more time is needed for the Site Electrification Delay and request the Board give the EO discretion to allow fleets more than 5 years should no alternative charging solutions exist.

Commenter: [001-OT2, 069-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Infrastructure Delay Extension – Allow More Time for Extension" in "Exemptions and Extensions – Infrastructure Delays" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

15. Exemptions and Extensions – Mutual Aid and Exemptions Pursuant to Declared Emergency Events

a) Emergency Provisions – Expand to Non-Declared Emergencies, Remove Mutual Aid Agreements, and Allow Fleets to Set Their Own Internal Combustion Engine Vehicle Cap

Comment Summary: The commenters express concern about ACF's unintended consequences on public utilities and their ability to provide essential services, particularly during emergency events. They argue that the Regulation lacks necessary exemptions, impairing their ability to respond to emergencies and service needs crucial to heavy equipment and emergency systems operation.

Commenter: [002-OT2, 006-WT2, 008-OT2, 024-OT2, 049-OT2, 055-OT2, 138-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Emergency Provisions – Expand to Non-Declared Emergencies, Remove Mutual Aid Agreements, and Allow Fleets to Set Their Own Internal Combustion Engine Vehicle Cap" in "Exemptions and Extensions – Mutual Aid and Exemptions Pursuant to Declared Emergency Events" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

b) Mutual Aid Assistance Exemption – Master Response

Comment Summary: The commenters state has concerns that partner agencies will not have the capacity to send vehicles to support mutual aid events.

Commenter: [049-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Mutual Aid Assistance Exemption – Master Response" in "Exemptions and Extensions – Mutual Aid and Exemptions Pursuant to Declared Emergency Events" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

c) Mutual Aid Assistance Exemption – Mobile Fueling Issues

Comment Summary: The commenters would like CARB to consider the practicality of ZEV mobile fueling requirements of the Mutual Aid Assistance provision.

Commenter: [049-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Mutual Aid Assistance Exemption – Mobile Fueling

Issues" in "Exemptions and Extensions – Mutual Aid and Exemptions Pursuant to Declared Emergency Events" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

16. Exemptions and Extensions – Waste and Wastewater

a) Waste and Wastewater Fleets – Provision Restricts Biomethane Use

Comment Summary: Commenters state the Waste and Wastewater Fleets provision restricts their ability to utilize the RNG that will soon be generated due to SB 1383.

Commenter: [010-OT2, 021-OT2, 123-OT2, 129-OT2, 131-OT2, 136-OT2, 149-OT2]

Agency Response: No changes were made in response to these comments. The Board directed staff to include a provision for waste and wastewater fleets that recognized investments already made to address SB 1383 compliance. The Board adopted the Regulation with the proposed Waste and Wastewater Fleet Option included. The Board also adjusted the Resolution to specifically include SB 1383 where they direct staff to prioritize policy discussions related to SB 1440 (and now SB 1383) implementation and discussions on how to transition biomethane into hard to decarbonize sectors, or as a feedstock to produce hydrogen for FCEV fuel and to produce electricity to charge BEVs.

b) Waste and Wastewater Fleets – Oppose Extension

Comment Summary: Commenter opposes the delay given to waste and wastewater fleets, which surrenders emissions benefits.

Commenter: [048-OT2]

Agency Response: No changes were made in response to these comments. The Board directed staff to include a delay for waste and wastewater fleets to recognize investments made in support of biomethane production from diverted organic wastes, and the Board adopted the Regulation with these changes included.

c) Waste and Wastewater Fleets – Include Licenses or Permits and Non-Municipal Contracts

Comment Summary: Commenter states the waste definition should not only include fleets contracted with a municipality, as some jurisdictions do not have contracts and instead use license or permit systems and should be modified to include these.

Commenter: [057-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Waste and Wastewater Fleets – Include Licenses or Permits and Non-Municipal Contracts" in "Exemptions and Extensions – Waste and Wastewater" of the "15-Day Comment Period Public Comments with Agency Responses."

d) Waste and Wastewater Fleets – Allow All Organic Waste Diversion Activities an Extension

Comment Summary: Commenter requests that rendering operations and non-franchise waste fleets providing waste diversion services using alternative fuels such as biodiesel and RD should also receive an extension under the Waste and Wastewater Fleet Option, as they are essential to SB 1383 implementation.

Commenter: [057-OT2, 129-OT2, 136-OT2]

Agency Response: No changes were made as result of this comment. Please see responses to issues raised in sections "Alternative Fuels and Combustion Vehicles – Rule Conflicts with Organic Waste Diversion" in the chapter on "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses" and "Waste and Wastewater Fleets – Include Other Senate Bill 1383 Activities" in "Exemptions and Extensions – Waste and Wastewater" of the "15-Day Comment Period Public Comments with Agency Responses."

17. Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption

a) Zero-Emissions Vehicle Purchase Exemption – Create Manufacturer List

Comment Summary: The commenter request that CARB provide a list of available manufacturers that have market-ready vehicles in the medium to heavy-duty Class 2b through 8.

Commenter: [024-OT2]

Agency Response: No changes were made in response to these comments. Providing a list of vehicle configurations not offered as ZEVs rather than a list of manufacturers that offer market-ready ZEVs is more useful for fleet owners seeking a needed vehicle. Should a list of manufacturers with market-ready vehicles be provided, the fleet owner would need to contact the manufacturer to determine the available ZEVs. Providing a list of configurations that are not offered as ZEVs eliminates this step and directly provides the information that fleet owners require. Additionally, there would be no end date for maintaining such a list with no apparent advantage or purpose for doing so. Whereas a list of vehicle configurations that are not available to purchase as a ZEV is expected to be smaller and will become shorter as more configurations are offered as the market develops.

b) Zero-Emissions Vehicle Purchase Exemption – Create Availability List Instead of Unavailability List

Comment Summary: The commenters request that CARB create a ZEV availability list instead of an unavailability list.

Commenter: [062-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Create

Availability List Instead of Unavailability List" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

c) Zero-Emissions Vehicle Purchase Exemption – Add Cost Criteria

Comment Summary: The commenters request that cost criteria be incorporated into the ZEV Purchase Exemption criteria.

Commenter: [062-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Add Cost Criteria" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

d) Zero-Emissions Vehicle Purchase Exemption – Add Manufacturer Criteria

Comment Summary: The commenters request that criteria related to manufacturers producing ZEVs be incorporated into the ZEV Purchase Exemption criteria.

Commenter: [024-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Add Manufacturer Criteria" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

e) Zero-Emissions Vehicle Purchase Exemption – Concerns Over Next Higher Weight Class Requirement

Comment Summary: The commenters express concerns over not being forced to buy higher class vehicles unnecessarily.

Commenter: [012-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Concerns Over Next Higher Weight Class Requirement" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "15-Day Comment Period Public Comments with Agency Responses."

f) Zero-Emissions Vehicle Purchase Exemption – Include Appeal Process

Comment Summary: The commenters request the inclusion of an appeal process.

Commenter: [049-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Zero-Emissions Vehicle Purchase Exemption – Include Appeal Process" in "Exemptions and Extensions – Zero-Emissions Vehicle Purchase Exemption" of the "15-Day Comment Period Public Comments with Agency Responses."

18. Public Regulatory Process, Funding and Outreach Concerns

a) Outreach Needed for Small Fleets

Comment Summary: Small fleet owners are not sure if they are subject to the ACF Regulation and need help navigating meeting the fleet requirements (e.g., drayage fleets).

Commenter: [035-WT2, 133-OT2]

Agency Response: No changes were made in response to these comments. These comments are not directed at the ACF Regulation or the process by which it was adopted and therefore CARB is not required to respond.. The HPF Regulation does not affect fleets with less than 50 vehicles under control or less than $50 Million in annual revenues. However, CARB offers several support programs that assist fleets of all sizes in their transition to using ZEVs, but include elements focused on smaller fleets. These include increased funding opportunities and loan assistance targeted to small fleets, and a suite of educational resources and events. CARB is also launching a technical assistance program called Cal Fleet Advisor which will offer direct individual assistance on ZEV purchasing, infrastructure planning, funding assistance, and more.

b) Outreach - General

Comment Summary: Commenter states that there is a need for more educational programs so people know about the infrastructure funding that's out there, TCO, and what's happening with infrastructure truck as a service and charging as a service models.

Commenter: [053-OT2]

Agency Response: No changes were made in response to these comments. CARB provides information on the ZEV TruckStop page at https://ww2.arb.ca.gov/sites/default/files/truckstop/zev/zevinfo.html that includes terminology and new ways of operating for many vehicle owners, as well as where to find resources to better understand ZE fueling and plan for infrastructure. The general web page also provides links to: How to subscribe to CARB's GovDelivery email for updates on medium- and heavy-duty ZEV Regulation development and education events; Incentive funding opportunities; the ZEV market; Demonstration and Pilot projects; and Infrastructure information. In addition, CARB hosts day long educational events with the goal of assisting medium- and heavy-duty vehicle owners in their transition to ZE technologies. These free Next-Stop to Zero events includes presentations and roundtable discussions by manufacturers, experienced real-world fleets, funding experts, and various other subject matter experts. Attendees learn about ZE terminology, funding opportunities, the ZEV market, fueling infrastructure planning, and more. Stakeholders may also explore the "Past Events" section to view previous agendas, participants, and recordings of the events. CARB welcomes any input on how to implement the outreach program more effectively and successfully. Staff will continue to engage in stakeholder outreach and education during implementation of the Regulation.

c) Public Process – Provide an Additional Comment Period

Comment Summary: Commenter states it would be appropriate to provide staff time to review the cumulative effects of the EPA proposals and to reopen the public comment period to consider the implications of this proposed national mandate on the ACF requirements.

Commenter: [018-WT2, 138-OT2]

Agency Response: No changes were made in response to these comments. This comment is not directed at the ACF Regulation or the process by which it was adopted and therefore CARB is not required to respond. Notwithstanding that response, EPA has only proposed Phase 3 GHG standards for medium and heavy duty vehicles at this time, and those standards are proposed to take effect in model year 2027. We have established within this rulemaking record the need to take timely action and, while it is good to see EPA pressing for cleaner federal standards, it does not change the need for California to move ahead with standards sooner in 2024.

d) Public Process – Assess ACF Regulation Implementation and Make Amendments as Needed

Comment Summary: Commenter states that follow-up rulemaking be conducted to review progress of the ACF Regulation and make amendments as needed.

Commenter: [009-OT2, 151-OT2]

Agency Response: No changes were made in response to these comments. Per Resolution 23-13, "there is still a need to push for more ZEV deployments beyond the proposed ACF Regulation in future measures as proposed in the 2022 State SIP Strategy including the ZE Truck Measure that will be heard by the Board in 2028." This will provide an opportunity for the public to comment on the proposed ZE Truck Measure and provide any input regarding lessons learned during the early implementation phase of the ACF Regulation. The Board can consider amendments to regulations as needed.

e) Public Process – Establish an Advisory Group

Comment Summary: Commenter requests the establishment of a fleet advisory group.

Commenter: [005-OT2]

Agency Response: No changes were made in response to these comments. However, CARB staff agrees that advisory groups are an asset for effective and successful regulatory implementation. CARB has a long history of creating and using advisory groups to optimize implementation. For example, TRAC was formed to facilitate communication with its stakeholders and to obtain stakeholder feedback on the implementation tools used for the Truck and Bus and the Heavy-Duty Diesel Greenhouse Gas Emissions Reductions Regulations. The goals of TRAC were to help CARB staff fine tune outreach, training, and implementation materials and provide a mechanism for stakeholders to discuss other implementation issues. CARB also formed the Off-Road Implementation Advisory Group to assist staff with outreach and implementation of the Off-Road Regulation. Both the Off-Road Implementation Advisory Group and TRAC had members that included a cross-section of fleets, engine manufacturers, retrofit manufacturers and installers, equipment dealers and manufacturers, other public agencies, trade groups, and industry organizations. In addition, both groups had subcommittees that were formed to address focused implementation topics.

Also related, during the November 19, 2021, Board hearing wherein the Carl Moyer Program cost-effectiveness limits for on-road heavy-duty ZEVs were approved, the Board members expressed strong interest in further accelerating California's transition to ZE heavy-duty vehicles and to advance equity work. Staff hosted the IPAG public meetings in response to that interest. The meetings, led by former Vice Chair Berg and Board members Hurt and Kracov, provided a forum for discussing policy level issues related to the implementation of the Carl Moyer Program for on-road heavy-duty vehicles.

f) Funding for Local Government Fleets

Comment Summary: The commenters express concerns about funding assistance for cities, as most granting organizations require EV charging infrastructure to be publicly accessible, which is incompatible with secure facilities. They ask the Board to consider additional funding for local governments affected by the Regulation, as traditional budgeting processes do not cover high upfront infrastructure costs.

Commenter: [024-OT2, 055-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Funding for Local Government Fleets" in "Funding and Incentive Program Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

g) Funding and Incentive Program Issues

Comment Summary: The commenters emphasize the need for CARB to provide funding to make the Regulation feasible, stating that programs like HVIP and LCFS should be increased without restricting them to small fleets only. They highlight the importance of substantial financial assistance to lower vehicle purchasing costs and achieve price parity for businesses, particularly during the initial phases of ACF implementation. Additionally, the commenters mention the need for complementary measures to ensure adequate infrastructure and incentives, such as the HVIP, are made available. They argue that since the Regulation creates a framework for an entire energy transition in the truck market, grants are necessary to advance the marketplace.

Commenter: [076-OT2, 081-OT2, 126-OT2, 145-OT2, 145-OT2]

Agency Response: No changes were made in response to these comments. The Regulation is not predicated on availability of incentive funds. The Board recently convened a working group called IPAG that explored and welcomed ideas on key issues in providing greater support and access for small fleets and small businesses statewide, improving environmental justice performance of the program, and accelerating ZE truck funding while better partnering vehicle adoption with infrastructure expansions. The IPAG public meetings identified the need to provide greater support for small fleets and small businesses statewide, as well as to further promote program participation by increasing equitable access to ZE technologies for on-road heavy--duty vehicles through the Carl Moyer Program's On-Road Heavy-Duty Voucher Incentive Program and through the Carl Moyer Program's incentives for infrastructure.

Please see responses to issues raised in section "Provide Funding for Advanced Clean Fleets" in "Funding and Incentive Program Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

19. Miscellaneous Issues

a) General – Should Have Parity for Zero-Emissions Vehicle and Near-Zero-Emissions Vehicle Fuel Types

Comment Summary: Commenters state CARB should ensure parity in its Regulation for the use of battery-electric, plug-in hybrid, and FCEVs.

Commenter: [084-OT2]

Agency Response: No changes were made in response to these comments. The Regulation already provides compliance parity by treating BEVs and FCEVs as fully compliant ZEVs. The HPF Regulation also treats plug-in hybrids with a minimum all-electric range, as defined in the Regulation as an "NZEV", with full compliance parity to ZEVs until the 2035 model year, and this flexibility was extended to fleets subject to the SLG Regulation as part of the 15-day changes.

b) General – Safety Concerns

Comment Summary: No amount of wishing for the goals and timelines mandated in this Regulation will make them achievable. This Regulation will have severe detrimental consequences for our state and country. The safety of our residents will be harmed by this Regulation.

Commenter: [013-WT2]

Agency Response: No changes were made in response to these comments. CARB disagrees that the ACF Regulation will have severe detrimental consequences for our state and country, and that the safety of Californians will be compromised. As described in Chapter IV. of the ACF ISOR, the Regulation will result in a number of benefits to health, air quality, climate, energy savings, job creation, and businesses. For example, the Regulation is estimated to result in health benefits savings of $57.8 billion and reduce cardiopulmonary mortalities by 5,519, particularly for people living in communities impacted the most by poor air quality. In addition, the Regulation will dramatically reduce GHGs to help stabilize the climate, which will benefit all communities.

Please see responses to the goal and timeline issue raised in section "Regulation Not Feasible" in "Miscellaneous Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

c) General – Support

Comment Summary: Commenters support the Regulation as is.

Commenter: [002-WT2, 003-WT2, 006-WT2, 011-WT2, 014-WT2, 015-WT2, 016-OT2, 016-OT2, 017-WT2, 018-OT2, 019-OT2, 021-WT2, 022-OT2, 022-WT2, 023-WT2, 024-WT2, 025-OT2, 025-WT2, 026-OT2, 027-OT2, 027-WT2, 028-OT2, 028-WT2, 030- OT2, 032-OT2, 033-OT2, 034-OT2, 035-OT2, 036]

Agency Response: No changes were made in response to these comments. Staff appreciate your support.

d) General – Opposition

Comment Summary: The commenters generally oppose the Regulation.

Commenter: [130-OT2]

Agency Response: No changes were made in response to these comments. Staff thanks commenter for their comment.

e) Resolution – Safety Concerns at Wastewater Treatment Plants Storing Hydrogen

Summary: Commenter is suggesting changes to the draft Resolution to consider safety at wastewater treatment plants that store hydrogen and suggests competing interests between EPA Risk Management Program requirements administered through the California Accidental Release Program is already discouraging the production of green hydrogen from biomethane at treatment plants in California. Specifically, the commenter notes a sanitation district would likely exceed the threshold quantity for storing hydrogen gas onsite, triggering what sanitation districts call a significant and costly regulatory compliance burden.

Commenter: [025-WT2]

Agency Response: No changes were made in response to these comments. However, the Board added the Division of Occupational Safety and Health better known as Cal OSHA, to the last paragraph in the list of other relevant stakeholders CARB will be collaborating with to direct biomethane to other markets besides combustion vehicle fuel.

f) Delay the Approval of the Advanced Clean Fleets Regulation

Comment Summary: The commenters request a delay of the approval of the ACF Regulation.

Commenter: [062-OT2, 010-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Delay the Approval of the Advanced Clean Fleets

Regulation” in “Miscellaneous Issues” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

g) Delay Start Date of the Regulation for High Priority and Federal, State, and Local Government Fleets

Comment Summary: The commenters request to delay the start date of the ACF Regulation for HPF and SLG.

Commenter: [064-OT2, 144-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Delay Start Date of the Regulation for High Priority and Federal, State, and Local Government Fleets” in “Miscellaneous Issues” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

h) Regulation Not Feasible

Comment Summary: The commenters state that the Regulation is not feasible.

Commenter: [005-OT2, 007-OT2, 013-WT2, 019-WT2, 059-OT2, 126-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Regulation Not Feasible” in “Miscellaneous Issues” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

i) Strengthen the Regulation

Comment Summary: The commenters state that they generally want the Regulation to be strengthened.

Commenter: [029-OT2, 039-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section “Strengthen the Regulation” in “Miscellaneous Issues” of the “45-Day Comment Period and First Board Hearing Public Comments with Agency Responses.”

j) The 200 Truck Study was Done Wrong

Comment Summary: Commenter states 200 truck study was done incorrectly and was corrected. Commenter states CNG is cleaner than diesel.

Commenter: [142-OT2]

Agency Response: The commenter is providing only a brief statement about a comprehensive, multi-year, four-phase program, conducted by the University of California at Riverside and West Virginia University who collaborated on one of the world’s largest efforts to test in-use heavy-duty vehicle tailpipe emissions. The 200 Truck Study went through a lengthy review process and corrections were made which is standard practice for engineering studies. The final, published study is corrected, as the commenter notes, and this is the version included in the ACF record as part of the ACF 15-Day Notice. The study shows CNG and diesel engines both emit above the standards and are still emitting criteria pollutants. For further discussion on why CNG is not cleaner than diesel, please see responses to issues raised in section "Alternative Fuels and Combustion Vehicles – Compressed Natural Gas is Cleaner Than Diesel" in section "Alternative Fuels and Combustion Vehicles" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

k) Rule Should Be Based on Tailpipe Emissions, Not Truck Age

Comment Summary: The commenter states technology to deliver cleaner tailpipe emissions is changing rapidly and that the proposed Regulation should measure emissions, not the age of vehicles.

Commenter: [019-WT2]

Agency Response: No changes were made in response to these comments. Measuring in use emissions for each fleet would add unnecessary complexity to the regulation and would impose unnecessary administrative burden on fleet owners and CARB staff. This approach is not necessary to achieve the same results as the Regulation.

l) ACF Regulation Not Feasible for Fleets Based in Baja California

Comment Summary: Commenter states that fleets based in Baja California that are affected by ACF are not able to transition as quickly as California fleets that have access to funding, infrastructure, and private capital that is not available to fleets in Baja.

Commenter: [201-OT2]

Agency Response: No changes were made in response to these comments. CARB staff have held several meetings with representatives from both sides of the Mexican border. CARB expanded the exemptions and extensions of the ACF regulation in the 15 day changes in part to address these and other related concerns. The ACF Regulation addresses concerns with the inability to install infrastructure when a fleet owner experiences delays beyond their control, through the Infrastructure Delay provision. In addition, certain issues may be addressed by the Daily Usage Exemption. This temporary exemption from the ZEV addition requirement allows the purchase of a new ICE vehicle of a given configuration if a new ZEV is available but it cannot be placed anywhere in the California fleet while meeting the daily usage needs of any existing vehicle in the fleet provided the eligibility criteria is met.

m) Align Advanced Clean Fleets with Advanced Clean Trucks

Comment Summary: The commenters state that the ACF Regulation should be aligned with the ACT Regulation.

Commenter: [140-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Align Advanced Clean Fleets with Advanced Clean

Trucks" in "Miscellaneous Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

n) Periodic Review of Regulatory Implementation Needed

Comment Summary: The commenters request a periodic review of regulatory implementation.

Commenter: [005-OT2, 015-OT2, 063-OT2, 124-OT2, 126-OT2, 133-OT2, 139-OT2]

Agency Response: No changes were made in response to these comments. Please see responses to issues raised in section "Periodic Review of Regulatory Implementation Needed" in "Public Regulatory Process and Outreach Concerns" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

o) Change ACT Requirements

Comment Summary: The commenters request changes to ACT requirements as follows: match ACT to ACF, smooth sales requirements, and update the schedule to match the latest technology and obtain more federal funding through IRA.

Commenter: [046-OT2, 056-OT2, 067-OT2]

Agency Response: No changes were made in response to these comments. The Board did not direct staff to consider amending ACT, and this would require additional analysis which would not be directed at meeting the goals of ACF. However, the Board approved the ACF Resolution, which includes a commitment to align ACT to be consistent with the 2022 SIP in a future rulemaking.

p) Add Truck Types and Fleet Sizes Not Included in the ACF Regulation

Comment Summary: Commenters recommend that the Board adopt additional rules to address trucks not covered by ACF, such as those truck types not covered by the ACF Regulation and those in smaller fleets.

Commenter: [046-OT2, 056-OT2]

Agency Response: No changes were made in response to these comments. ACF covers all truck types owned by affected fleets that are over 8,500 lbs. GVWR. The Board has already adopted the State Implementation Plan that includes a future Zero-Emissions Truck Measure to be brought before the Board for consideration in 2028. This measure will evaluate various strategies that could facilitate a smoother and more equitable transition to ZEVs for truck owners not covered by ACF. The Board will be evaluating the most effective proposals. For more information, please refer to the February 10, 2023, Memorandum to the Board.[190]

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[190] CARB, Advanced Clean Fleets Regulation High Priority Fleet Size Analysis, 2023 (web link: https://ww2.arb.ca.gov/sites/default/files/2023-02/HPF%20Fleet%20Size%20Board%20Memo_ADA.pdf, last accessed March 2023).

q) Wait to Vote Until FCEV Technology Matures

Comment Summary: The commenter requests the Board wait to vote just a few more years for FCEV technology to be ready and available.

Commenter: [201-OT2]

Agency Response: No changes were made in response to this comment. Please see responses to issues raised in section "Zero-Emissions Technology – Battery Technology Not Ready" in "Zero-Emissions Vehicle Technology Issues" of the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses."

r) Duplicate Submission

Comment Summary: The commenters submitted comments identical to ones submitted during previous open comment periods.

Commenter: [018-WT2]

Agency Response: No changes were made in response to these comments. This letter is a duplicate submission. See responses to the previously submitted comment letter from the commenter or organization in either the "45-Day Comment Period and First Board Hearing Public Comments with Agency Responses" or the "15-Day Comment Period Public Comments with Agency Responses."

s) Supports Other Commenters – 128-OT2

Comment Summary: Commenter supports comments made by both CASA and Clean Water SoCal and the wastewater sector.

Commenter: [128-OT2]

Agency Response: The comments supported by the commenter are already summarized and responded to in other parts of this FSOR and do not require a different response here. See agency responses to commenters 122-OT2 and 123-OT2.

20. Out of Scope and Irrelevant Comments

a) Irrelevant

Comment Summary: Comment is off topic or irrelevant and not directed at the ACF Regulation or to the procedures followed by the agency in proposing or adopting ACF.

Commenter: [029-WT2, 041-OT2, 098-OT2, 130-OT2]

Agency Response: No changes were made in response to these comments. These comments is not directed at the ACF Regulation or the process by which it was adopted and therefore CARB is not required to respond.

b) Out of Scope - Zero-Emission Powertrain Certification

Comment Summary: The commenters request that CARB revisit the ZEP Certification program/Regulation to set performance standards for batteries and components used in electric trucks.

Commenter: [119-OT2]

Agency Response: No changes were made in response to these comments This comment is not directed at the ACF Regulation or the process by which it was adopted and therefore CARB is not required to respond. However, the ZEP Certification Regulation does require that the manufacturer offer a 3-year, 50,000-mile warranty.

c) Out of Scope – Safety Concerns

Comment Summary: Commenter requests that this rulemaking ensure that commercial vehicles are designed in a way that makes them safer for pedestrians and those outside the vehicle.

Commenter: [016-WT2]

Agency Response: No changes were made in response to these comments. This comment is not directed at the ACF Regulation or the process by which it was adopted and therefore CARB is not required to respond.

d) Out of Scope – Environmental Justice for Workers

Comment Summary: CARB must commit to environmental justice for workers across transportation sector, including those in manufacturing.

Commenter: [153-OT2]

Agency Response: No changes were made in response to these comments. This comment is not directed at the ACF Regulation or the process by which it was adopted and therefore CARB is not required to respond. However, many of CARB's statewide heavy-duty demonstration and pilot projects include training and skill-building related to the project's infrastructure and vehicle maintenance and repair, including providing pathways for participants towards clean transportation jobs.

V. Peer Review

Health and Safety Code section 57004 sets forth requirements for peer review of identified portions of rulemakings proposed by entities within the California Environmental Protection Agency, including CARB. Specifically, the scientific basis or scientific portion of a proposed Regulation may be subject to this peer review process. Here, CARB determined that the rulemaking did not contain a scientific basis or scientific portion subject to peer review, and thus no peer review as set forth in section 57004 needed to be performed.

ACF is not based on new scientific principles or bases under the statutes. The Regulation is premised on established science and the application of technological principles. It is not premised on new scientific principles or research and is therefore not subject to the requirements for peer review under section 57004 of the Health and Safety Code. The Regulation requires fleet medium- and heavy-duty manufacturers to produce and sell ZEVs and requires large businesses, fleets, and government agencies to purchase and report information on their vehicles and how they use them.

Requirements to purchase or turnover fleets to ZEVs do not establish "a regulatory level, standard, or other requirement for the protection of public health or the environment," such as an ambient air quality standard or toxic exposure level. As such, it does not have a "scientific basis" or "scientific portions" that form the foundations of a regulatory standard or level. The scientific studies and assessments used to analyze the potential environmental impacts of these Regulations, such as the findings that diesel particulate is a toxic air contaminant and that GHGs contribute to climate change, were developed previously and subject to public review.

The technological factors CARB considered for these Regulations are all aspects of engineering design. They reflect the application of established scientific and engineering principles to develop appropriate and feasible emission control standards and related requirements and performing engineering evaluations of technical feasibility and costs. They did not involve analysis of new scientific findings or the development of new scientific theories.

Moreover, the scientific studies and assessments used to analyze the potential health and environmental impacts of these Regulations, such as the findings that engine emissions are air contaminants and that GHGs contribute to climate change, were developed previously and subjected to peer review.

Subjecting CARB's application of engineering principles in developing the Regulations would result in repetitious review of established science. As the California Environmental Protection Agency has concluded in its guidance for conducting peer review and determining when review is required, Regulations that rely on established science that is used in substantially the same context or manner as when it was previously subject to peer review, including Regulations that rely on technical, economic, or technological issues, such as pollution control standards and manufacturing requirements for vehicle emission standards including these, are not subject to review under Health and Safety Code section 57004. (California Environmental Protection Agency, *CalEPA External Scientific Peer Review Program, Guidance for Staff of CalEPA Organizations* (June 2022), page 8.)

Appendix C-1

Original Standard Regulatory Impact Assessment Submitted to Department of Finance

Advanced Clean Fleets Regulation

California Air Resources Board

Date of Release: August 30, 2022
Date of Hearing: October 27, 2022

Appendix C-1

State of California
Air Resources Board

Advanced Clean Fleets Regulation

Standardized Regulatory Impact Assessment

Date of Release: May 18, 2022

California Air Resources Board
1001 I Street

Sacramento, California 95814

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LIST OF ACRONYMS AND ABBREVIATIONS

AB	Assembly Bill
ACC II	Advanced Clean Cars II
ACF	Advanced Clean Fleets
ACT	Advanced Clean Trucks
APS	Air Pollution Specialist
ARE	Air Resources Engineer
ARS	Air Resources Supervisor
ART	Air Resources Technician
ASB	Airport Shuttle Bus
BAU	Business as Usual
BEV	Battery-Electric Vehicle
CARB or Board	California Air Resources Board
CEC	California Energy Commission
CI	Confidence Interval
CO_2	Carbon Dioxide
CO_2e	Carbon Dioxide Equivalents
CPUC	California Public Utilities Commission
DEF	Diesel Exhaust Fluid
DMV	Department of Motor Vehicles
DOF	Department of Finance
EER	Energy Efficiency Ratio
EIA	Energy Information Administration
EMFAC	Emission Factor Inventory Model
EPA	Environmental Protection Agency
ER	Emergency Room
EVSE	Electric Vehicle Supply Equipment
FCEV	Fuel Cell Electric Vehicle
FY	Fiscal Year
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GO-Biz	Governor’s Office of Business and Economic Development
GSP	Gross State Product
GVWR	Gross Vehicle Weight Rating
HDIM	Heavy-Duty Inspection and Maintenance
HVIP	Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project
ICE	Internal Combustion Engine
ICT	Innovative Clean Transit
IPT	Incidence-per-Ton
IRS	Internal Revenue Service
IWG	Interagency Working Group
kWh	Kilowatt-Hour
LCFS	Low Carbon Fuel Standard

MACRS	Modified Accelerated Cost Recovery System
MMT	Million Metric Tons
MY	Model Year
NOx	Oxides of Nitrogen
NZEV	Near-Zero-Emission Vehicle
OAL	Office of Administrative Law
OBD	On-Board Diagnostics
PG&E	Pacific Gas and Electric
PHEV	Plug-In Hybrid Electric Vehicle
PM	Particulate Matter
$PM_{2.5}$	Fine Particulate Matter
ppb	Parts Per Billion
SB	Senate Bill
$SC\text{-}CO_2$	Social Cost of Carbon
SCE	Southern California Edison
SDG&E	San Diego Gas and Electric
SIP	State Implementation Plan
SLCP	Short-Lived Climate Pollutant
SRIA	Standardized Regulatory Impact Assessment
SWCV	Solid Waste Collection Vehicle
tpd	Tons Per Day
TTW	Tank-to-Wheel
VMT	Vehicle Miles Traveled
WTT	Well-to-Tank
WTW	Well-to-Wheel
ZE	Zero-Emission
ZEB	Zero-Emission Bus
ZEV	Zero-Emission Vehicle

1 Introduction

This document details an economic analysis of CARB staff's developing proposal to reduce emissions from Class 2b and larger medium- and heavy-duty vehicles that operate in California. Class 2b-8 vehicles have a manufacturer's gross vehicle weight rating (GVWR) greater than 8,500 lbs. Mobile sources and the fossil fuels that power them are the largest contributors to the formation of ozone, greenhouse gas (GHG) emissions, fine particulate matter ($PM_{2.5}$), and toxic diesel particulate matter. In California, the transportation sector alone accounts for 41 percent of total GHG emissions (50 percent when upstream emissions from fuel are included) and is a major contributor to ground level ozone and particulate matter ($PM_{2.5}$). Statewide, about 12 million Californians live in 19 areas where levels of ozone and $PM_{2.5}$ exceed the national ambient air quality standards (NAAQS) for ozone and $PM_{2.5,}$(nonattainment areas). Exposure to $PM_{2.5}$ and ozone is associated with increased risk of premature mortality, which has been estimated to contribute to 7,500 premature deaths each year in California.[1] The South Coast and the San Joaquin Valley air basins have the most critical air quality challenges. These regions experience some of the nation's highest PM levels and are the only 2 areas in the nation with an "extreme" classification for non-attainment with the federal ozone standard. In addition, 7 other areas in California are in serious or severe non-attainment with the federal ozone standard. Achieving federal air quality standards in these regions, as well as across California, will provide essential public health protection by reducing hospitalizations for heart and lung related causes, decreasing emergency room (ER) visits, and reducing incidences of asthma.

In California, climate change is contributing to an escalation of serious problems, including raging wildfires, coastal erosion, disruption of water supply, threats to agriculture, spread of insect-borne diseases, and continuing health threats from air pollution. Reducing GHG emissions will help put California on a trajectory to avoid the worst impacts of climate change; support a clean energy economy, which provides more opportunities for all Californians; and provide a more equitable future with good jobs and less pollution for all communities.

In addition to regional air pollutant levels, many communities in the state experience measurable harm in the form of negative health impacts from high levels of localized pollution. There is an immediate need to reduce emissions and exposure in these highly impacted, low-income, and disadvantaged communities throughout the state. Heavy-duty vehicle activity is often concentrated in and near these communities.

Zero-emission vehicle (ZEV) technologies eliminate all tailpipe emissions from the operation of the vehicle, which positively affects our air quality and climate challenge. The proposed Advanced Clean Fleets (ACF) regulation, in concert with existing state regulatory and incentive programs, seeks to accelerate the market transition to zero-emission (ZE) trucks and

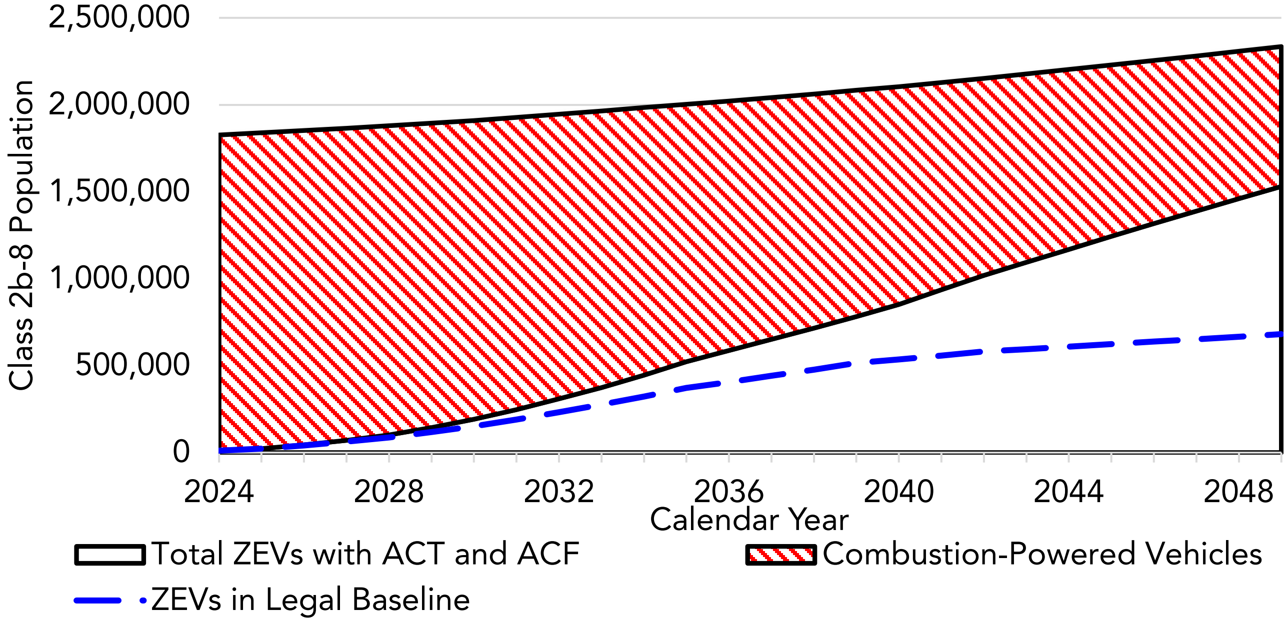
[1] California Air Resources Board, *Revised Proposed 2016 State Strategy for the State Implementation Plan*, 2017 (web link: https://ww3.arb.ca.gov/planning/sip/2016sip/rev2016statesip.pdf, last accessed January 2022).

buses with a particular focus on particular fleets that pose acute health risks or which are particularly well positioned for electrification, contribute towards achieving the California Air Resources Board's (CARB or Board) emissions reductions goals for attaining federal health-based air quality standards, and reduce the local communities' exposure to air toxics and impacts of climate change. The proposed regulation would result in reductions in criteria pollutants, toxic air contaminants, and GHG emissions at the statewide, regional, and local levels. The proposed ACF regulation is one piece of California's holistic plan to address challenging federal air quality mandates, protect the public health of all Californians, and meet climate change goals. Table 1 enumerates the cumulative statewide benefits for emissions, cost savings, and avoided premature deaths expected from full implementation of the proposed regulation through calendar year 2050. Figure 1 shows the proposed regulation would be expected to increase the number of medium- and heavy-duty ZEVs beyond existing regulations from about 320,000 to about 520,000 by 2035 and from about 775,000 to about 1,250,000 ZEVs by 2045 with a growing number of ZEVs over time.

Table 1. Summary of Statewide Cumulative Benefits of Proposed ACF Regulation to 2050

Type of Benefit	**Cumulative Benefit by 2050**	**Section in SRIA**
NOx Reduction	444,000 tons	2.1.2
$PM_{2.5}$ Reduction	9,300 tons	2.1.2
GHG Reduction	267 MMT CO_2e	2.1.2
Estimated Avoided Cardiopulmonary Mortalities	5,888	2.4.1
Health Benefits	$61.7 billion	2.4.1
Social Cost of Carbon	$9.5-$37.4 billion	3.1.7
Net Cost Savings	$12.4 billion	3.1.7

Figure 1. Statewide Population Forecast with the Proposed Regulation



Medium- and heavy-duty ZEVs available today are already capable of meeting the average needs of local and regional trucking operations and a variety of vocational uses. They are expected to continue to improve over time. Several data sources show all truck types average less than 100 miles per day, except for semi-trucks where most average less than 200 miles per day.[2,3] Recent survey responses on daily mileage collected by CARB in 2021 as part of the Large Entity Reporting survey showed similar results for trucks that are owned by the respondents. Responses about broker-dispatched tractors showed a higher daily mileage. Today's medium- and heavy-duty ZEVs have energy storage systems that can meet most of these daily operational requirements. ZEVs also have unique advantages that will eventually lead to paradigm shifts in fleet operational behaviors. This includes quiet operations that enable later work shifts during times with less traffic and more efficient delivery schedules, improved safety on work sites, and less time spent on scheduled maintenance or out-of-service time due to the mechanical simplicity of ZEV systems. Over time, continued technology improvements, projected incremental cost reductions, and infrastructure growth will allow the ZEV market to continue expanding into all transportation service applications, including long-haul trucking.

Although medium- and heavy-duty ZEVs currently have higher upfront capital costs than vehicles powered by internal combustion engines, they have lower fuel and maintenance

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[2] United States Census Bureau, *2002 Vehicle Inventory and Use Survey, 2002* (web link: https://www2.census.gov/library/publications/economic-census/2002/vehicle-inventory-and-use-survey/ec02tv-us.pdf, last accessed January 2022).

[3] California Department of Transportation, *CalTrans Truck Survey, 2018* (web link: http://www.scag.ca.gov/committees/CommitteeDocLibrary/mtf012319_CAVIUS.pdf, last accessed January 2022).

costs that are expected to result in a positive total cost of ownership in most applications where they are suitable. Economic analyses by CARB and numerous third parties have found that medium- and heavy-duty ZEVs result in a lower total cost of ownership when compared to purchasing new gasoline or diesel counterparts in some applications today and in nearly all applications by 2030.[4,5,6,7,8,9,10,11]

Increasing public pressure to address our climate crisis is pushing governments and businesses to reduce California's carbon footprint through the development of sustainability plans and the adoption of carbon reducing incentive programs and regulations. As a result of such climate focused drivers and policies in California and other states, the medium- and heavy-duty ZEV market has developed rapidly over the past several years in the United States.

Today, there are over 100 Class 2b-8 ZEV models commercially available in North America from multiple manufacturers in every vehicle weight class category. As with heavy-duty combustion vehicles, many of these vehicles are manufactured as incomplete cab-and-chassis vehicles that can be equipped with a variety of body types to perform various functions. Currently, for the heaviest trucks in Class 8, there are 4 refuse models, 4 single-unit truck chassis, and 8 truck tractors that are commercially available. Another 4 on-road tractors are expected to be commercially available by 2023. In Class 6-7, there are 22 single-unit truck models and 9 van models that are commercially available. In Class 4-5, there are 19 single-unit truck models and 6 van models commercially available. In Class 2b-3, there are 7 van models and 1 pickup truck that are commercially available with 4 other pickup trucks and at

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[4] California Air Resources Board, *Draft Advanced Clean Trucks Total Cost of Ownership Discussion Document*, 2019 (web link: https://ww3.arb.ca.gov/regact/2019/act2019/apph.pdf, last accessed January 2022).

[5] Atlas Public Policy, *Assessing Financial Barriers to Adoption of Electric Trucks*, 2020 (web link: https://atlaspolicy.com/wp-content/uploads/2020/02/Assessing-Financial-Barriers-to-Adoption-of-Electric-Trucks.pdf, last accessed January 2022).

[6] Hydrogen Council, *Path to Hydrogen Competitiveness – A Cost Perspective*, 2020 (web link: https://hydrogencouncil.com/wp-content/uploads/2020/01/Path-to-Hydrogen-Competitiveness_Full-Study-1.pdf, last accessed January 2022).

[7] ICF International, *Comparison of Medium-Duty and Heavy-Duty Technologies in California*, 2019 (web link: https://caletc.aodesignsolutions.com/assets/files/ICF-Truck-Report_Final_December-2019.pdf, last accessed January 2022).

[8] North American Council for Fuel Efficiency, *Regional Haul*, 2019 (web link: https://nacfe.org/regional-haul/, last accessed January 2022).

[9] North American Council for Fuel Efficiency, *Viable Class 7/8 Electric, Hybrid, and Alternative Fuel Tractors*, 2019 (web link: https://nacfe.org/future-technology/viable-class-7-8/, last accessed January 2022).

[10] University of California Los Angeles, *Zero-Emission Drayage Trucks – Challenges and Opportunities for the San Pedro Bay Ports*, 2019. (web link: https://innovation.luskin.ucla.edu/wp-content/uploads/2019/10/Zero_Emission_Drayage_Trucks.pdf, last accessed January 2022)

[11] Union of Concerned Scientists, *Ready to Work – Now is the Time for Heavy-Duty Electric Vehicles*, 2019 (web link: https://www.ucsusa.org/sites/default/files/2019-12/ReadyforWorkFullReport.pdf, last accessed January 2022).

least 1 van model that are expected to be commercially available in 2022.[12] In addition, all major manufacturers have announced upcoming medium- and heavy-duty ZEV plans and all but 1 have ZEV models in development with plans to launch them commercially prior to 2024. End user companies like Amazon, DHL, and the United States Postal Service have commissioned or self-manufactured purpose-built ZEVs in quantity for their own delivery business use.[13,14,15] Finally, several companies including major truck parts suppliers have a variety of electric vehicle components and drivetrain solutions for vehicle manufacturers to use in their vehicles.

According to CALSTART's Zero-Emission Technology Inventory Analytics, it is estimated that there will be 594 ZE truck and bus models available internationally by the end 2022.[16] This shows that the ZEV market is rapidly expanding internationally, and that these same drivetrains or configurations could be made available in California with minimal additional engineering.

1.1 Regulatory History

CARB is responsible for protecting the public from the harmful effects of air pollution and developing programs and actions to fight climate change. Meeting these public health goals has resulted in a suite of regulations to control the harmful emissions of various air pollutants emitted from the operation of medium- and heavy-duty combustion engine vehicles. The following is a summary of key regulations that apply to fleets that would be affected by the proposed regulation including existing laws that will expand ZEV sales and continue to reduce emissions from new vehicles.

1.1.1 Public Agencies and Utilities Regulation

In 2005, the rule for On-Road Heavy-Duty Diesel-Fueled Public and Utility Fleets was approved by CARB to reduce diesel PM emissions from fleet vehicles operated by public agencies and utilities.[17] The rule required affected owners to equip their heavy-duty vehicles with Best Available Control Technology by December 31, 2012, with later requirements for

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[12] CALSTART, *Zero-emission Technology Inventory (ZETI) Analytics*, 2020 (web link: https://globaldrivetozero.org/tools/zeti-analytics/, last accessed January 2022).

[13] New York Times, *Can Anyone Satisfy Amazon's Craving for Electric Vans?*, 2022 (web link: https://www.nytimes.com/2022/01/18/technology/amazon-electric-vans.html, last accessed January 2022).

[14] Lightning eMotors, *DHL Express Deploys Nearly 100 New Lightning Electric Delivery Vans in U.S.*, 2021 (web link: https://lightningemotors.com/dhl-express-deploys-lightning-electric-vans-in-us/, last accessed January 2022).

[15] Reuters, *U.S. Postal chief commits to 10% of new delivery fleet as electric vehicles*, 2021 (web link: https://www.reuters.com/technology/us-postal-chief-commits-10-new-delivery-fleet-electric-vehicles-2021-02-24/ , last accessed January 2022

[16] CALSTART, *Zero-emission Technology Inventory (ZETI) Analytics*, 2020 (web link: https://globaldrivetozero.org/tools/zeti-analytics/, last accessed January 2022).

[17] California Air Resources Board, *Fleet Rule for Public Agencies and Utilities*, 2005 (web link: https://ww2.arb.ca.gov/our-work/programs/fleet-rule-public-agencies-and-utilities, last accessed January 2022).

designated low population counties. Many of the same parties are included in the proposed regulation.

1.1.2 Drayage Truck Regulation

In 2007, the Drayage Truck regulation was adopted as part of CARB's efforts to reduce PM and oxides of nitrogen (NOx) emissions from diesel-fueled engines and improve air quality associated with freight movement, as well as reduce near-source health risk from facilities where drayage trucks congregate.[18] Drayage trucks are on-road, heavy-duty trucks that transport containerized, bulk or break-bulk goods, empty containers, and chassis to and from seaports and intermodal railyards. The Drayage Truck regulation requires diesel emissions reductions as well as recordkeeping and reporting to help monitor compliance and enforcement efforts. Truck owners are required to register their trucks in the CARB Drayage Truck Registry to ensure their trucks meet emissions standards by the appropriate deadline dates. The Drayage Truck regulation will sunset at the end of 2022. At that time, the drayage fleet will be incorporated into the Truck and Bus regulation, which requires affected vehicles to meet or exceed 2010 or newer engine emissions standards. Drayage trucks are included in the proposed regulation.

1.1.3 Truck and Bus Regulation

In 2008, the Truck and Bus regulation was adopted by CARB as the final prong of the Diesel Risk Reduction Plan to reduce emissions of PM and NOx from heavy-duty trucks and buses over 14,000 lbs. GVWR.[19,20] This regulation affects all vehicles travelling in California that are owned or operated by private or federal entities. It requires retrofit, replacement, or repowering of older diesel vehicles, eventually ensuring that all affected vehicles meet or exceed 2010 or newer model year (MY) engine emissions by January 1, 2023. Federal fleets and a subset of private fleets are included in the proposed regulation.

1.1.4 Innovative Clean Transit Regulation

In December 2018, the Innovative Clean Transit (ICT) regulation was adopted by CARB. The ICT regulation was the first medium- and heavy-duty ZEV fleet rule of its kind and it replaced the existing fleet rule for transit agencies.[21] The regulation requires all public transit agencies to gradually transition to a 100 percent zero-emission bus (ZEB) fleet where most will be ZE by 2040. The regulation also encourages transit agencies to provide innovative first and last mile mobility for transit riders. This regulation includes various exemptions and compliance options to provide safeguards and flexibility for transit agencies through the transition. The

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[18] California Air Resources Board, *Drayage Trucks at Seaports & Railyards*, 2007 (web link: https://ww2.arb.ca.gov/our-work/programs/drayage-trucks-seaports-railyards, last accessed January 2022).
[19] California Air Resources Board, *Truck and Bus Regulation*, 2008 (web link: https://ww2.arb.ca.gov/our-work/programs/truck-and-bus-regulation, last accessed January 2022).
[20] California Air Resources Board, *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles*, 2000 (web link: https:/ww2.arb.ca.gov/sites/default/files/classic/diesel/documents/rrpfinal.pdf, last accessed January 2022).
[21] California Air Resources Board, *Innovative Clean Transit*, 2018 (web link: https://ww2.arb.ca.gov/our-work/programs/innovative-clean-transit, last accessed January 2022).

proposed regulation includes some of the same public agencies that are subject to the ICT regulation if they also operate vehicles that are not transit buses such as a city that provides road maintenance or waste hauling services. The proposed regulation builds upon the structure of the ICT purchase requirements for local and State government fleets.

1.1.5 Zero-Emission Airport Shuttle Bus Regulation

In June 2019, the Zero-Emission Airport Shuttle Bus (ASB) regulation was adopted by CARB. It promotes the development and use of ZE technologies in medium- and heavy-duty airport shuttles that operate on fixed routes at 13 California airports.[22] This regulation requires airport shuttle operators to transition their vehicles to ZEVs beginning in 2027, with a complete transition by the end of 2035. The regulation provides compliance extensions and other flexibilities to ensure service continuity as operators transition to ZE shuttles. The proposed regulation could include some fleet operators that are subject to the ASB regulation.

1.1.6 California and Federal Phase 2 GHG Regulation

CARB staff worked jointly with the U.S. Environmental Protection Agency (EPA) staff and with National Highway Traffic Safety Administration staff on the next phase of federal GHG emissions standards and fuel efficiency standards, respectively, for medium- and heavy-duty engines and vehicles.[23] The federal Phase 2 GHG emissions standards build on the Phase 1 GHG emissions standards, and represent a significant opportunity to achieve further GHG reductions for 2018 (2021 in California) and later MY heavy-duty vehicles . The Phase 2 GHG emissions standards are structured to provide a range of options to manufacturers to reduce emissions for medium- and heavy-duty vehicles using a wide range of technologies, including aerodynamics, more efficient engines, and other technologies. Additionally, the Phase 2 GHG emissions standards provide an opportunity to average, bank, and trade credits, as well as recognize advanced technologies that would apply to plug-in hybrid electric vehicles (PHEV), all-electric vehicles, and fuel cell electric vehicles (FCEV). In 2018, California adopted this federal Phase 2 program with minor changes.[24] There are some synergies in costs and emissions benefits between California Phase 2 GHG and the proposed regulation, because ZEVs could be used to comply with both regulations.

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[22] California Air Resources Board, *Zero-Emission Airport Shuttle*, 2019 (web link: https://ww2.arb.ca.gov/our-work/programs/zero-emission-airport-shuttle, last accessed January 2022).
[23] United States Environmental Protection Agency, *Final Rule for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2*, 2016 (web link: https://www.gpo.gov/fdsys/pkg/FR-2016-10-25/pdf/2016-21203.pdf, last accessed January 2022).
[24] California Air Resources Board, *Staff Report: Initial Statement of Reasons for Proposed Rulemaking Proposed California Greenhouse Gas Emission Standards for Medium- and Heavy-Duty Engines and Vehicles and Proposed Amendments to the Tractor-Trailer GHG Regulation*, 2017 (web link: https://www.arb.ca.gov/regact/2018/phase2/isor.pdf, last accessed January 2022).

1.1.7 The Advanced Clean Trucks Regulation

In January 2021, the Advanced Clean Trucks (ACT) regulation was adopted by CARB. It is a key part of the holistic approach to accelerate a large-scale ZEV transition of medium- and heavy-duty trucks.[25] The regulation has two components including a manufacturer sales requirement and a One-Time Large Entity Reporting requirement:

- ZEV sales: Manufacturers who certify Class 2b–8 chassis or complete vehicles with combustion engines are required to sell medium- and heavy-duty ZEVs as an increasing percentage of their annual California sales from 2024 to 2035. By 2035, ZEV and chassis sales would need to be 55 percent of Class 2b–3 truck sales, 75 percent of Class 4–8 straight truck sales, and 40 percent of truck tractor sales.

- Fleet reporting: Large employers including retailers, manufacturers, brokers, and others were required to report information about vehicles they own, operate, or direct, and fleet owners with 50 or more trucks were required to report about their existing fleet operations by May 1, 2021.

The ZEV sales requirement establishes a supply of medium- and heavy-duty ZEVs, while the Large Entity Reporting requirement provides detailed information about fleets and how they use their vehicles. The ACT regulation includes flexibility for manufacturers to trade credits to meet compliance requirements and to decide which vehicles to sell as ZEVs. The proposed regulation would complement the ACT regulation by ensuring that fleets purchase the ZEVs that manufacturers produce and place them in service.

1.1.8 Heavy-Duty Omnibus Regulation

In September 2021, the Heavy-Duty Omnibus regulation was adopted by CARB. It requires manufacturers to comply with more stringent exhaust emissions standards, test procedures, and other emissions control requirements for 2024 MY and newer California certified heavy-duty engines.[26] The combined requirements will reduce real world in-use emissions. Fleets proposed to be included in the ACF regulation are the same that purchase combustion vehicles impacted by the Heavy-Duty Omnibus regulation. Key elements of the regulation include:

- Lowering NOx and PM emissions standards on existing regulatory cycles as well as a new NOx standard on a new low-load certification cycle. The NOx standards are about 75 percent below current standards beginning in 2024 and 90 percent below current standards in 2027.
- Revamping of the heavy-duty in-use testing program;

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[25] California Air Resources Board, *Advanced Clean Trucks*, 2020 (web link: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks, last accessed January 2022).
[26] California Air Resources Board, *Heavy-Duty Low-NOx Omnibus ISOR*, 2021 (web link: https://ww3.arb.ca.gov/regact/2020/hdomnibuslownox/isor.pdf, last accessed January 2022).

- Improving warranty, useful life, and emissions warranty information and reporting requirements;
- Strengthening the heavy-duty durability demonstration program;
- Improving the emissions averaging, banking, and trading program; and
- Creating powertrain certification test procedures for heavy-duty hybrid vehicles.

1.1.9 ZEV Purchases Required by AB 739

In October 2017, California's Governor signed Assembly Bill (AB) 739 (Chau, Chapter 744, Statutes of 2017), which requires heavy-duty ZEV purchases by State agencies. Beginning in 2025, at least 15 percent of new vehicle purchases with a GVWR of more than 19,000 lbs. must be ZEVs, and at least 30 percent of such purchases must be ZEVs beginning in 2030. These same agencies are proposed to be included in the ACF regulation; ZEVs purchased can be used to comply with both the proposed requirements and AB 739 requirements.

1.1.10 Zero-Emissions Powertrain Certification

In July 2019, CARB adopted the Zero-Emission Powertrain (ZEP) Certification procedures which established new, alternative certification procedures for heavy-duty battery-electric and fuel-cell vehicles and the zero-emission powertrains they use. ZEP Certification establishes a process that can be used to provide additional transparency, consistency, and stability in heavy-duty zero-emission market segments targeted by CARB's technology-forcing regulatory measures or incentives geared to deploying more-commercialized zero-emission vehicles. The Proposed ACF Regulation would make ZEP Certification mandatory for manufacturers subject to the 100 percent ZEV sales requirement.

1.2 Proposed Regulatory Action

The proposed regulation would build on the progress already made in the medium- and heavy-duty ZEV market, support existing policies and regulations through a phased-in fleet transition to ZEVs from 2024 through 2042, and would require all new vehicle sales to be ZEVs starting in 2040. This fleet focused strategy ensures that fleets begin to purchase and deploy medium- and heavy-duty ZEVs offered for sale by truck manufacturers in market segments that are suitable for electrification. The proposed regulation complements and supports the ZEV sales requirements of the ACT regulation by requiring affected public, drayage, and high priority and federal fleet operations to phase in medium- and heavy-duty ZEVs over time. Additionally, the proposed regulation sets a clear end date for combustion-powered new vehicle sales in California. The following is a summary of the proposed ACF requirements:

- State and local public fleets: Phased-in purchase requirement starting with 50 percent of medium- and heavy-duty ZEV purchases in 2024 and 100 percent in 2027. Municipalities in designated low population counties would be excluded until 2027.
- Drayage trucks: Phased-in registration requirements for newly added drayage trucks to be ZEVs starting in 2024, while allowing useful life for legacy trucks. All trucks conducting drayage operations must be ZEVs by 2035.

- High priority and federal fleets: Phased-in schedule with increasing ZEV targets as a percentage of the total vehicle fleet. High priority fleets are well-suited for electrification and include entities with more than $50 million in annual revenues, or those fleets that own, operate, or direct at least 50 trucks and buses under common ownership and control.
- Vehicle sales: 100 percent of medium- and heavy-duty vehicle sales into California must be ZE starting in 2040.

More detail on each element of the proposed regulation is provided below in the following sections. The precise form of these requirements will be further developed through the public process.

1.2.1 State and Local Public Fleets

The proposed public fleet requirement would apply to cities, counties, public utilities, special districts, and the State fleet, but excludes federal agencies. Federal agencies are included in the High Priority fleet group and not the Public fleet portion of the rule to align with the Clean Air Act Section 118 where federal fleet vehicles are to be treated the same as the general vehicle population. A purchase requirement was chosen to closely align with the normal purchase patterns of public fleets to ensure that a public fleet would not be out of compliance if budget fluctuations limited their ability to purchase replacement vehicles. These public entities would be required to make medium- and heavy-duty ZEV purchases starting at 50 percent of purchases in 2024 and 100 percent starting in 2027. However, public fleets based in designated low population counties would be exempt from ZEV purchases until 2027 because they tend to have fewer vehicles, more limited budgets, and they operate in remote areas that are expected to take longer for ZEV infrastructure and support networks to be developed.

The regulation includes flexibility to count early ZEV purchases towards future compliance and to purchase near-zero-emission vehicles (NZEV) if suitable ZEVs are not available. The regulation also includes limited exemptions to allow for internal combustion engine (ICE) vehicle purchases if ZEVs are not suitable to operate as emergency support vehicles outside their normal service territories, are not available to meet daily mileage needs, or if ZEVs and NZEVs are not commercially available in certain body configurations. Annual reporting would be required starting in 2024.

1.2.2 Drayage Trucks

The proposed regulation would require Class 7-8 drayage trucks operating at intermodal seaports and railyards to be ZEVs by 2035. The proposed regulation includes a phased-in approach for drayage trucks with the following requirements:

- All drayage trucks would be required to register in the CARB drayage online reporting system, starting in late 2023.

- Existing drayage trucks with ICEs, could remain in drayage service for a minimum useful life of either (a) 13 years from the MY that the engine and emissions control systems are first certified by CARB or the U.S. EPA or (b) when the vehicle reaches

800,000 vehicle miles traveled or 18 years from the MY that the engine and emissions control systems are first certified for use by, whichever is earlier.

- Trucks with MY engines of 12 years and greater would be required to report their mileage annually.
- Beginning in 2024, any truck added to the CARB drayage online reporting system must be a ZEV.
- All drayage trucks entering seaports and intermodal railyards must be ZEVs by 2035.
- All drayage trucks must visit a regulated seaport or railyard at least once each calendar year to remain in the CARB drayage online reporting system.
- All regulated intermodal seaports and railyards would be required to report drayage truck visits annually.

This approach would build on the structure of the existing drayage truck regulation and meet the goal of a complete transition of California's drayage fleet to ZE by 2035.

1.2.3 High Priority and Federal Fleets

High priority and federal fleets would be required to phase in medium- and heavy-duty ZEVs as percentage of the total fleet that operates in California. Affected California fleets would include all truck owners with an annual revenue greater than $50 million that operate at least 1 truck in California, or those who own, operate, or dispatch 50 or more trucks under common ownership and control and operate at least 1 truck in California. Controlling parties include the motor carrier, broker, or entity that dispatches, directs or otherwise manages the day-to-day operation of multiple fleets under common ownership or control to serve the customers or clients of the controlling party. Controlling parties must include all vehicles that are operated under common ownership or control in addition to their own vehicles that operate in California when determining compliance. All companies that hire or dispatch trucks must verify the fleets they hire comply with the regulation to maintain consistency with other existing fleet rules which have similar requirements.

High priority and federal fleets must phase-in ZEVs as a percentage of their total California fleet starting at 10 percent and increasing to 100 percent based on vehicle body type as shown in Table 2. Vehicles in Group 1 are commonly used for local and regional delivery or passenger transportation and are already suitable for electrification. With this proposed schedule, all covered delivery vans and box trucks that operate in urban areas and frequent warehouses and distribution centers would be ZEVs by 2035, except for the expected small percentage of vehicles using the alternative compliance path. Vehicles in Group 2 and Group 3 are expected to have higher daily mileage needs and more varied use cases. Fewer of these ZEV models are available today and they are given more time to make a complete transition to ZEVs. On these timelines, most tractors that go to warehouses and transport products throughout the state would be ZEVs by 2039 and all other vehicles by 2042. This would result in direct health benefits to communities most impacted by warehouses, distribution centers, and high traffic corridors.

Table 2. High Priority and Federal Fleet ZEV Phase-In Schedule

Group	Percentage of Fleet that Must be ZEV	10%	25%	50%	75%	100%
1	Box trucks, vans, two-axle buses, yard trucks	2025	2028	2031	2033	2035
2	Work trucks, day cab tractors, three-axle buses	2027	2030	2033	2036	2039
3	Sleeper cab tractors and specialty vehicles	2030	2033	2036	2039	2042

Fleets would have the flexibility to meet the ZEV target with any medium- or heavy-duty ZEV in their fleet regardless of body type. For example, a mixed fleet with 100 box trucks and 40 day cab tractors would need 10 ZEVs to comply in 2025. The number of ZEVs required to meet the 2025 target is calculated as 10 percent of the 100 box trucks in this example. The tractors are not counted in 2025 because there is no ZEV target for day cab tractors in that year. However, fleet owners have the flexibility to meet the 10 ZEV requirement with any combination of medium- and heavy-duty vehicles in the fleet. This means the fleet owner can meet the 2025 requirement with 10 ZEV tractors, 10 box trucks, or any combination that totals 10 ZEVs.

The regulation includes limited exemptions to operate or purchase ICE vehicles, such as situations where ZEVs or NZEVs are not commercially available in certain body configurations, available ZEVs would not meet a fleet’s daily needs, and for backup vehicles that operate less than 1,000 total miles per year. Additionally, an exemption from making a complete conversion to ZEVs is included for certain essential service providers if ZEVs are not suitable to operate as emergency support vehicles outside their normal service territories. Additionally, the regulation provides an alternative compliance pathway such that existing internal combustion engine vehicles would be guaranteed their full useful life provided in statute by SB1.

1.2.4 100% ZEV Sales Requirement

Finally, the proposed regulation would include a new requirement on all vehicle manufacturers that 100 percent of all Class 2b-8 new vehicle sales in California must be ZE starting in 2040.

1.2.5 Reporting and Recordkeeping Requirements

Beginning in 2024, affected fleets would need to report and keep records on certain information about their company and all vehicles they operate in California, including vehicles that operate under common ownership and control. Reported vehicle information includes details such as: vehicle information number, body type, fuel type, and other identifying characteristics.

1.3 Statement of the Need for the Proposed Regulation

California needs to continue to build upon its successful efforts to meet critical risk reduction, air quality, and climate goals. Achieving these goals will provide much needed public health protection for the millions of Californians that still breathe unhealthy air, reduce exposure to air toxics, and help to meet current health-based National Ambient Air Quality Standards (NAAQS) across California.[27] Additional $PM_{2.5}$ and NOx reductions from all freight sources, including trucks, are essential to meeting these air quality standards as described in the recent Draft 2022 State Implementation Plan (SIP) Strategy.[28] Additionally, meeting California's GHG emissions reductions targets is needed to slow global warming and achieve climate stabilization. The proposed regulation would contribute to California's holistic strategy to reduce criteria pollutant emissions, reduce exposure to toxic air contaminants, achieve GHG emissions reductions goals, and cleaner technology targets, especially in heavily burdened communities. It would achieve PM, NOx, and GHG emissions reductions from trucks and increase the use of ZE technology which is needed to meet these complementary goals. CARB staff developed the 2020 Mobile Source Strategy (MSS) which lays out a high-level top-down description of the scale of the transition to cleaner mobile source technologies needed to achieve all of California's targets.[29] The MSS assumes its targets will be met through a portfolio of programs; this proposal is an important part of that portfolio.

The proposed regulation is needed to ensure the widespread adoption of ZEVs in the medium- and heavy-duty vehicle sector and to meet the Governor's and CARB's goals of early ZEV transitions in key market sectors. The deployment of medium- and heavy-duty ZEVs meets the goals identified in the 2016 ZEV Action Plan that support the Governor's Executive Orders B-16-12 and B-48-18, which calls for 1.5 million light-, medium-, and heavy-duty ZEVs in California by 2025 and establishes several milestones on the pathway toward this target. The proposed regulation contributes towards the goals established in the Governor's Executive Order N-79-20 and the Board's direction in Resolution 20-19 of making a complete transition of California's medium- and heavy-duty truck and bus fleet to ZE by 2045 with earlier targets for key segments including drayage and last mile delivery. Additionally, the proposed regulation supports the Memorandum of Understanding between states described in the Supporting Existing Policy Section to accelerate ZEV adoption.

The State of California placed additional emphasis on protecting local communities from the harmful effects of air pollution through the passage of AB 617 (C. Garcia, Chapter 136, Statutes of 2017). AB 617 requires CARB to pursue new community-identified actions to reduce air pollution and improve public health in communities that experience

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[27] U.S. EPA, *National Ambient Air Quality Standards*, February 10, 2021 (web link: *https://www.epa.gov/criteria-air-pollutants/naaqs-table*, last accessed January 2022).
[28] California Air Resources Board, *2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy)*, 2022 (web link: https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy, last accessed January 2022).
[29] California Air Resources Board, *2020 Mobile Source Strategy*, 2020 (web link: https://ww2.arb.ca.gov/resources/documents/2020-mobile-source-strategy, last accessed January 2022).

disproportionate burdens from exposure to air pollutants. Despite statewide and regional scale improvements to air quality, disparities in community -scale air pollution and health inequities remain.[30,31,32,33] Community-level impacts from local emissions can be significant, even in areas that meet regional air quality standards. Apte et al. have shown that the top two sources of PM2.5 exposure in California are on-road vehicles and industrial activity, which also contribute most to PM2.5 concentration disparity by race/ethnicity. Despite regional reductions resulting from implementing CARB policies, low-income communities and communities of color still do not enjoy the same benefits because of their proximity to several concentrated emissions sources like ports, railyards, and highways. Similarly, historical land use practices of siting facilities in communities of color, along with residential redlining, have contributed to the exposure disparities that we see today.[34] The proposed regulation would reduce truck emissions and exposure statewide and would be of particular benefit in disadvantaged communities experiencing disproportionate burdens.

The proposed ACF regulation continues to build on earlier regulatory efforts to deploy ZEVs such as the ICT, ASB, and ACT regulations. The proposed regulation would increase the expected number of medium- and heavy-duty ZEVs beyond existing regulations from about 320,000 to about 520,000 by 2035 and from about 775,000 to about 1,250,000 ZEVs by 2045.

More details about how the proposed regulation addresses supporting policy needs can be found in the Supporting Existing Policy Chronology in Section 1.3.4.

1.3.1 Need to Reduce Risk to Communities

Many of the communities near facilities where trucks operate bear a disproportionate health burden due to their proximity to emissions from the combustion engines that power trucks. There are several occurrences across the state where communities contain "groups" or "clusters" of facilities where trucks operate. In many cases, these facilities are in or near communities classified as disadvantaged by the California EPA by using the California

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[30] Apte JS, Chambliss SE, Tessum CW, Marshall JD, *A method to prioritize sources for reducing high PM2.5 exposures in environmental justice communities in California*, CARB research contract number 17rd006, 2019 (web link: https://ww2.arb.ca.gov/sites/default/files/classic/research/apr/past/17rd006.pdf, last accessed January 2022).

[31] Morello-Frosch R, Zuk M, Jerrett M, Shamasunder B, Kyle AD, *Understanding the cumulative impacts of inequalities in environmental health: Implications for policy*, Health affairs (Project Hope) 30:879-887, 2011 (web link: https://pubmed.ncbi.nlm.nih.gov/21555471/, last accessed January 2022).

[32] OEHHA, *Tracking and evaluation of benefits and impacts of greenhouse gas limits in disadvantaged communities: Initial report*, 2017 (web link: https://oehha.ca.gov/media/downloads/environmental-justice/report/oehhaab32report020217.pdf, last accessed January 2022).

[33] Propper R, Wong P, Bui S, Austin J, Vance W, Alvarado Á, et al., *Ambient and emission trends of toxic air contaminants in California*, Environmental Science & Technology 49:11329-11339, 2015 (web link: https://pubs.acs.org/doi/abs/10.1021/acs.est.5b02766, last accessed January 2022).

[34] Pastor M, Sadd J, Hipp J., *Which came first? Toxic facilities, minority move-in, and environmental justice*, Journal of urban affairs 23:1-1, 2001 (web link: https://www.tandfonline.com/doi/abs/10.1111/0735-2166.00072, last accessed January 2022).

Communities Environmental Health Screening Tool to rank California communities based on environmental pollution burden and socio-economic indicators.[35] Exposure to diesel PM is a main contributor to these metrics for many communities ranked in the top 10th percentile statewide.

1.3.2 Need to Reduce $PM_{2.5}$ and NOx Emissions

Progress has been achieved in reducing $PM_{2.5}$ and NOx emissions from mobile sources statewide through implementation of CARB's existing programs. These programs are expected to continue to provide further emissions reductions, helping the State to meet air quality standards. However, challenges remain in meeting the ambient air quality standards for ozone and $PM_{2.5}$; The South Coast and San Joaquin Valley air basins are designated as extreme non-attainment with the ozone NAAQS areas while 7 other areas are in serious or severe non-attainment with the ozone NAAQS. The near-term targets for these areas are a 2023 deadline for attainment of the 80 parts per billion (ppb) 8-hour ozone standard, 2024 for the 35 microgram per cubic meter ($\mu g/m^3$) 24-hour $PM_{2.5}$ standard, and 2025 for the 12 $\mu g/m^3$ annual $PM_{2.5}$ standard. There are also mid-term attainment years of 2031 and 2037 for the more recent 8-hour ozone standards of 75 ppb and 70 ppb, respectively. NOx is a precursor to both ozone and secondary $PM_{2.5}$ formation. Consequently, reductions in NOx emissions provide benefits to help meet both the ozone and the $PM_{2.5}$ standards. Additional $PM_{2.5}$ and NOx reductions from all freight sources, including trucks, are essential to meeting these air quality standards as described in the recent Draft 2022 State SIP Strategy.[36]

1.3.3 Need to Reduce GHG Emissions

To date, California has made significant progress towards meeting the goals of Senate Bill (SB) 32 (Pavley, Chapter 249, Statutes of 2016). SB 32 requires California to reduce GHG emissions to at least 40 percent below 1990 levels by 2030. Significant progress has been made, however more needs to be done.

Short-lived climate pollutants (SLCP) such as black carbon, methane, nitrous oxide, and others are emitted from transportation sources, including from burning fuels such as diesel or natural gas. These are powerful climate forcers that remain in the atmosphere for a much shorter period than longer-lived climate pollutants, such as carbon dioxide (CO_2), but are more potent when measured in terms of Global Warming Potential, which can be tens, hundreds, or even thousands of times greater than CO_2.

1.3.4 Supporting Existing Policy Chronology

CARB staff reviewed and considered air quality attainment goals established by the federal government, the laws passed by the California State Legislature, the State Implementation

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[35] Office of Environmental Health Hazard Assessment, *CalEnviroScreen 4.0*, October 20, 2021. (web link: https://oehha.ca.gov/calenviroscreen/report/calenviroscreen-30, last accessed January 2022).

[36] California Air Resources Board, *2022 State Strategy for the State Implementation Plan (2022 State SIP Strategy)*, 2022 (web link: https://ww2.arb.ca.gov/resources/documents/2022-state-strategy-state-implementation-plan-2022-state-sip-strategy, last accessed January 2022).

Plans (SIP), and the Executive Orders issued by the Governors of California to develop the regulation. The following is a chronological summary of key supporting and existing policies used to guide the development of the proposed regulation:

In 2006, California's Governor signed AB 32, the California Global Warming Solutions Act of 2006 (Núñez, Chapter 488, Statutes of 2006) to address global climate change. AB 32 directed CARB to develop a scoping plan identifying integrated and cost-effective regional, national, and international GHG reductions programs. CARB adopted the AB 32 Scoping Plan in 2008, with subsequent updates in 2013 and 2017, and is currently undertaking the public process to update it for 2022. California's 2017 Climate Change Scoping Plan outlines the State's strategy to achieve its 2030 GHG targets.

In March 2012, California's Governor issued Executive Order B-16-2012 directing California agencies to establish benchmarks for key milestones to help support and facilitate the ZEV market in California.[37] One of those milestones includes deploying over 1.5 million light-, medium-, and heavy-duty ZEVs and PHEVs on the road by 2025. As a result of this Order, multiple State agencies, including CARB, worked to develop and release the 2013 ZEV Action Plan.[38] The 2013 ZEV Action Plan identified over 100 strategies to meet the milestones of the Executive Order and included 4 broad goals to advance the overall light-, medium-, and heavy-duty ZEV market. These 4 goals are:

- Complete needed ZEV infrastructure and planning;
- Expand consumer awareness and demand of ZEVs;
- Transform fleets; and
- Grow jobs and investment in the private sector.

SB 605 (Lara, Chapter 523, Statutes of 2014)[39] required CARB to develop a plan to reduce emissions of SLCPs, and SB 1383 (Lara, Chapter 395, Statutes of 2016)[40] required the Board to approve and begin implementing the plan by January 1, 2018. SB 1383 also sets targets for statewide reductions in SLCP emissions of 40 percent below 2013 levels by 2030 for methane and hydrofluorocarbons, and 50 percent below 2013 levels by 2030 for black

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[37] Office of Governor Edmund G. (Jerry) Brown Jr., *Executive Order B-16-2012*, 2012 (web link: https://www.ca.gov/archive/gov39/2012/03/23/news17472/index.html, last accessed January 2022).
[38] Governor's Interagency Working Group on Zero-Emission Vehicles, *2013 ZEV Action Plan: A roadmap toward 1.5 million zero-emission vehicles on California roadways by 2025*, 2013 (web link: http://opr.ca.gov/docs/Governors_Office_ZEV_Action_Plan_(02-13).pdf, last accessed January 2022).
[39] California Health and Safety Code § 39730, Division 26, *Senate Bill No. 605, Short-lived climate pollutants*, September 21, 2014 (web link: https://leginfo.legislature.ca.gov/faces/billNavClient.xhtml?bill_id=201320140SB605, last accessed January 2022).
[40] California Health and Safety Code § 39730, Division 30, *Senate Bill No. 1383, Short-lived climate pollutants: methane emissions: dairy and livestock: organic waste: landfills*, September 19, 2016 (web link: http://leginfo.legislature.ca.gov/faces/billTextClient.xhtml?bill_id=201520160SB1383, last accessed January 2022).

carbon. Reductions in GHGs from trucks, including SLCPs like black carbon, are needed to achieve the State's multiple GHG emissions reductions targets and related climate goals.

In April 2015, CARB released the "Sustainable Freight Pathways to Zero and Near-Zero Discussion Document" in response to Board Resolution 14-2 which directed CARB to engage with stakeholders to identify and prioritize actions to move California toward a sustainable freight transport system.[41,42] The Discussion Document set out CARB's vision of a clean freight system and listed immediate and potential near-term CARB actions that staff would develop for future Board consideration. The near-term CARB measures identified in the Discussion Document included amending existing freight regulations, including the Cargo Handling Equipment, Locomotive, At-Berth, and Transport Refrigeration Unit regulations to achieve additional emissions reductions.

In July 2015, California's Governor signed Executive Order B-32-15 directing the California State Transportation Agency, CalEPA, and Natural Resources Agency to lead other relevant State departments in developing an integrated action plan by July 2016 that "establishes clear targets to improve freight efficiency, transition to ZE technologies, and increase competitiveness of California's freight system."[43] The 2016 California Sustainable Freight Action Plan included recommendations such as strengthening existing freight regulations as a State agency action to advance the objectives of the Executive Order.

In October 2015, California adopted SB 350 (De León, Chapter 547, Statutes of 2015), the Clean Energy and Pollution Reduction Act, which established GHG reductions targets and ordered the California Public Utilities Commission (CPUC) to direct the 6 investor-owned utilities in the state to "accelerate widespread transportation electrification." The resulting programs developed by the electric utilities, for which $701 million has been authorized, promote the deployment of medium- and heavy-duty ZEVs through incentivizing infrastructure upgrade projects that offset most or all the costs for electrical service upgrades.

In 2016, California's Governor signed SB 32 (Pavley, Chapter 249, Statutes of 2016) which requires CARB to ensure that California's GHG emissions are reduced to at least 40 percent below the 1990 GHG level by 2030.

In March 2017, CARB adopted the Revised Proposed 2016 State Strategies document as part of the SIP which identified several sectors that are key to launching ZE technologies in the on-road, heavy-duty sector: transit buses, delivery trucks, and airport shuttles. The proposed

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[41] California Air Resources Board, *Sustainable Freight Pathways to Zero and Near-Zero Emissions Discussion Document*, 2015 (web link: https://ww2.arb.ca.gov/sites/default/files/2020-09/Sustainable%20Freight%20Pathways%20to%20Zero%20and%20Near-Zero%20Emissions%20Discussion%20Document.pdf, last accessed January 2022).
[42] California Air Resources Board, *Board Resolution 14-2*, 2014 (web link: https://www.arb.ca.gov/board/res/2014/res14-2.pdf, last accessed January 2022).
[43] State of California Executive Order signed by Governor Edmund G. (Jerry) Brown Jr., *Executive Order B-32-15*, 2015 (web link: https://www.ca.gov/archive/gov39/2015/07/17/news19046/index.html, last accessed January 2022).

regulation continues implementation of these strategies to increase heavy-duty ZEV deployments.

In April 2017, SB 1 (Beall, Chapter 5, Statutes of 2017), also known as the Road Repair and Accountability Act of 2017 was signed into law, which provides specified commercial vehicles over 10,000 lbs. GVWR a "useful life" period before such vehicles can be retired, replaced, retrofitted, or repowered through new or amended regulations. The useful life period is specified as the later of either (a) 13 years from the MY that the engine and emissions control systems are first certified or (b) (when the vehicle travels reaches 800,000 vehicle miles traveled or 18 years from the MY that the engine and emissions control systems are first certified for use, whichever is earlier). SB 1 also empowered the California Department of Motor Vehicles (DMV) to enforce the Truck and Bus regulation through vehicle registrations.

In July 2017, AB 617 was signed into law. The bill requires new community-focused and community-driven action to reduce air pollution and improve public health in communities that experience disproportionate burdens from exposure to air pollutants. In response to AB 617, CARB established the Community Air Protection Program. The Program's focus is to reduce exposure in communities most impacted by air pollution. Communities around the state are working together to develop and implement new strategies to measure air pollution, develop plans, and reduce health impacts.

In January 2018, California's Governor issued Executive Order B-48-18 building on past efforts by increasing California's goal to introduce 5 million light-, medium-, and heavy-duty ZEVs on the road by 2030 and setting a target of 250,000 chargers by 2025.[44] Also in 2018, the Governor issued Executive Order B-55-18, which sets a target to achieve carbon neutrality in California no later than 2045 and achieve and maintain net negative emissions thereafter.[45] The proposed regulation directly supports achieving these goals through the required transition to medium- and heavy-duty ZEVs in California in local government, drayage, and high priority and federal transportation sector fleets.

In August 2018, California's Governor sent a letter to CARB directing the agency to pursue conversion of public and private fleets to ZEVs in categories including large employers, delivery vehicles, and transportation service fleets.[46] The proposed regulation addresses this direction by requiring medium- and heavy-duty ZEV purchases for public fleets, conversion of the drayage fleet to heavy-duty ZEVs, and upgrading to medium- and heavy-duty ZEVs in high priority and federal fleets.

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[44] Office of Governor Edmund G. (Jerry) Brown Jr., *Governor Brown Takes Action to Increase Zero-Emission Vehicles, Fund New Climate Investments*, 2018 (web link: https://www.ca.gov/archive/gov39/2018/01/26/governor-brown-takes-action-to-increase-zero-emission-vehicles-fund-new-climate-investments/index.html, last accessed January 2022).

[45] State of California Executive Order signed by Governor Edmund G. (Jerry) Brown Jr., *Executive Order B-55-18*, 2018 (web link: https://www.ca.gov/archive/gov39/wp-content/uploads/2018/09/9.10.18-Executive-Order.pdf, last accessed January 2022).

[46] Signed by Edmund G. (Jerry) Brown Jr., *Governor's Letter to Chair Nichols*, 2018 (web link: https://ww2.arb.ca.gov/sites/default/files/2020-06/zero_emission_fleet_letter_080118_ADA.pdf, last accessed January 2022).

In September 2019, Governor Newsom issued Executive Order N-19-19 which requires every aspect of State government to redouble efforts to reduce GHG emissions and mitigate the impacts of climate change while building a sustainable and inclusive economy.[47] The Executive Order specifically calls for CARB to propose new strategies to increase demand in the primary and secondary markets for ZEVs, and to consider strengthening existing regulations or adopting new regulations to achieve necessary GHG reductions in the transportation sector. The proposed regulation would support these goals by achieving GHG emissions reductions from the deployment of medium- and heavy-duty ZEVs. Additionally, ZEVs deployed early in the proposed regulatory timeline would be expected to be resold, thereby supporting a robust secondary market.

As part of adopting the ACT regulation in June 2020, the Board also approved Resolution 20-19. The resolution required staff to come back to the Board in 2021 with requirements ensuring fleets, businesses, and public entities purchase and operate medium- and heavy-duty ZEVs.[48] The resolution set goals for the fleet requirements to be implemented on a timeline consistent with the ACT regulation and to achieve a smooth transition of California's fleet to ZEVs by 2045 everywhere feasible. The resolution also directs staff to ensure these upcoming regulations emphasize emissions reductions within disadvantaged communities to the maximum extent feasible. The resolution set the following clear goals for transitioning sectors of California's transportation industry to medium- and heavy-duty ZEVs where feasible:

- 100 percent ZE drayage, last mile delivery, and government fleets by 2035;
- 100 percent ZE refuse trucks and local buses by 2040;
- 100 percent ZE-capable vehicles in utility fleets by 2040; and
- 100 percent ZE everywhere else, where feasible, by 2045.

Staff's proposal largely meets the overall goals laid out by the Board with implementation starting in 2024 to align with ACT as originally planned. It would achieve 100 percent ZE drayage trucks by 2035 and most regulated delivery vehicles by 2035 as well, although the proposal will be brought to the Board in 2022. This proposal is a part of a comprehensive strategy to transition all trucks to zero emissions where feasible.

After the ACT regulation was adopted by the Board, 16 states, the District of Columbia, and Province of Quebec signed a Memorandum of Understanding to work collaboratively to advance and accelerate the market for electric medium- and heavy-duty vehicles.[49] The states agreed to work together to set and meet medium- and heavy-duty ZEV sales targets and

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[47] State of California Executive Order signed by Governor Gavin Newsom, *Executive Order N-19-19*, 2019 (web link: https://catc.ca.gov/-/media/ctc-media/documents/ctc-codes/execorder-n-19-19-a11y.pdf, last accessed January 2022).
[48] California Air Resources Board, *Resolution 20-19*, 2020 (web link: https://ww3.arb.ca.gov/regact/2019/act2019/finalres20-19.pdf, last accessed January 2022).
[49] California Air Resources Board, *Press Release 20-18 15 states and the District of Columbia join forces to accelerate bus and truck electrification*, 2020 (web link: https://ww2.arb.ca.gov/news/15-states-and-district-columbia-join-forces-accelerate-bus-and-truck-electrification, last accessed January 2022).

develop action plans that accelerate vehicle electrification. As of January 2022, 5 states have adopted the ACT regulation, with more expected in this year.[50]

In September 2020, Governor Newsom signed Executive Order N-79-20 which establishes a goal that 100 percent of California sales of new passenger car and trucks be ZE by 2035.[51] In addition, the Governor's Order set a goal to transition all drayage trucks to ZEVs by 2035, all off-road equipment to ZE where feasible by 2035, and the remainder of medium- and heavy-duty vehicles to ZEVs where feasible by 2045. Under the Order, CARB is tasked to work with our State agency partners to develop regulations to achieve these goals considering technological feasibility and cost-effectiveness, which the proposed regulation seeks to fulfill.

In April 2021, CARB released the Revised Draft 2020 Mobile Source Strategy.[52] The strategy document looks at existing and emerging technologies to reduce emissions from California's transportation sector, including cars, trucks, trains, ships, and other on-road and off-road sources. These strategies illustrate the technology mixes needed for the State to meet its various clean air goals, including national ambient air quality standards, community risk reductions, and ambitious mid- and long-term climate change targets. To meet these goals, the Mobile Source Strategy found it is necessary for California's transportation sector to rapidly increase use of ZE technologies everywhere feasible.

In January 2022, CARB released the Draft 2022 State SIP Strategy for public comment. It will be considered by the Board in mid-2022. Given that the document indicates California will be short of needed tons of emissions reductions needed for attainment, there is a need to push for more ZEV deployments and avoid scaling back regulatory pressure on the market.

1.3.5 Supporting Incentive Programs

CARB's incentive and regulatory programs work together to accelerate the market for ZEVs. Incentives primarily support early commercialization and market development prior to regulatory requirements, early adopter purchase decisions by reducing incremental costs, and vehicle cost reductions over time by building manufacturer economies of scale. Historically, as regulatory requirements approach, the incentive strategy has shifted toward a focus on financial assistance for fleets that are challenged to qualify for traditional financing programs. Limited incentives may continue to be available for purchases that are made in advance of applicable regulatory schedules, or in addition to minimum purchase requirements. Incentive programs produce emissions reductions, and CARB is developing improved analyses of emissions benefits that result from incentive funding. SB 1403 (Lara, Chapter 370, Statutes of 2018) guides CARB's heavy-duty vehicle investments funded with Cap-and-Trade auction proceeds, and extended the California Clean Truck, Bus, and Off-

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[50] Washington, Oregon, New York, New Jersey, and Massachusetts have all adopted the ACT regulation.

[51] State of California Executive Order signed by Governor Gavin Newsom, *Executive Order N-79-20*, 2020 (web link: https://www.gov.ca.gov/wp-content/uploads/2020/09/9.23.20-EO-N-79-20-Climate.pdf, last accessed January 2022).

[52] California Air Resources Board, *Revised Draft 2020 Mobile Source Strategy*, April 23, 2021. (web link: https://ww2.arb.ca.gov/sites/default/files/2021-04/Revised_Draft_2020_Mobile_Source_Strategy.pdf, last accessed January 2022)

Road Vehicle and Equipment Technology Program created under SB 1204 (Lara, Chapter 524, Statutes of 2014). Funding allocations are subject to annual appropriations by the Legislature, and Board approval of the annual Funding Plan for Clean Transportation Incentives. Historically, most funding for medium- and heavy-duty ZEVs has been provided through the Hybrid and Zero-Emission Truck and Bus Voucher Incentive Project (HVIP), which began in 2009. Subject to funding availability, HVIP provides base vouchers of up to $120,000 for Class 8 battery-electric vehicle (BEV) trucks, with additional funding for trucks based in disadvantaged communities, and for drayage trucks purchased prior to January 1, 2022. In addition, the Volkswagen Environmental Mitigation Trust includes $90 million for ZE Class 8 freight and port drayage trucks with a maximum incentive of up to $200,000 per truck. The first statewide installment of $27 million has been allocated, and the remaining $63 million will be available beginning in 2022. Other incentive programs include the Carl Moyer Program, AB 617 Community Air Protection Program, the Air Quality Improvement Program, as well as infrastructure funding from utilities and the California Energy Commission (CEC). Financing assistance for small fleets is available through the Truck Loan Assistance Program.

1.4 Major Regulation Determination

Per Department of Finance (DOF) regulations (title 1, California Code of Regulations, Sections 2000-2004)[53], the proposed regulation has been determined to be a major regulation because the economic impact of the regulation in California is estimated to exceed $50 million in multiple years of the regulatory timeline extending from 2024 to 2050. The economic impact is estimated because of direct cost and cost-savings to the proposed regulated entities providing transportation services.

1.5 Baseline Information

The economic and emissions impacts of the proposed regulation are evaluated against the business as usual (BAU) scenario each year for the analysis period from 2024 to 2050. The BAU case for the economic and emissions analysis for the proposal is also referred to as the "Legal Baseline" and uses the same vehicle inventory for all analyses. The Legal Baseline reflects the implementation of all existing State and federal laws and regulations on the vehicles the proposed regulation would affect. The Heavy-Duty Inspection and Maintenance (HDIM) regulation was heard by the Board in December 2021 but was not included in the Legal Baseline because it was not approved by Office of Administrative Law (OAL) at the time this analysis was prepared.

[53] California Code of Regulations § 2000-2004, Division 3, *Standardized Regulatory Impact Assessment for Major Regulations*. (web link: https://govt.westlaw.com/calregs/Document/IAA1C7210595511E3BFC8D5B3615C797F?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)&bhcp=1#co_anchor_IA8F81D2F7A734A449389719B2F838650, last accessed January 2022).

A second baseline analysis was also done to show how the analysis differs if the HDIM regulation is approved. This analysis is in the Modified Baseline Analysis Appendix and presents a scenario that anticipates the HDIM regulation being finalized prior to implementation of the proposed regulation.

Staff used CARB's Emission Factor Inventory Model (EMFAC) to assess the Legal Baseline vehicle inventory, including vehicle sales and population growth assumptions, for Class 2b and larger vehicles for all fuel types.[54] EMFAC includes the effects of CARB's ASB, ICT, Truck and Bus, Heavy-Duty Omnibus, ACT regulation, and Low Carbon Fuel Standard (LCFS) program compliance. It is important to note that the benefits of low carbon fuels such as renewable diesel and renewable natural gas that are part of the LCFS are already included in the Legal Baseline and all scenarios. Therefore, the economic and environmental impacts attributable to the ACF regulation are solely attributable to new actions beyond those already expected. This means only ZEV deployments required by the proposal that exceed the ZEV sales already expected from the ACT regulation will result in new emissions benefits and costs. When compared to the Legal Baseline, the proposed regulation would increase the expected number of medium- and heavy-duty ZEVs (beyond existing regulations) from about 320,000 to about 520,000 by 2035 and from about 776,000 to about 1,200,000 ZEVs by 2045. This increase in ZEVs is expected to be from Class 4-8 vehicles. Based on recent announcements and market developments, a portion of the ZEV sales expected in the Legal Baseline for Class 2b-3 will include vehicles, such as pickup trucks to individuals and small business, that are not in the scope of the proposed regulation.[55] Further discussion of vehicle population estimates is in Chapter "Direct Costs", Section "Vehicle Population." For the costs and emissions analysis, if the estimated ZEV sale can be attributed to the ACT regulation in the Legal Baseline, it will not be counted toward the proposed regulation.

Staff anticipates significant sales of medium- and heavy-duty ZEVs based on the number of preorders which have already been placed by customers. As shown in Table 3, these near-term commercial ZEV pre-orders number over 300,000 in the United States, indicating a clear demand for the vehicles such that individuals and entities that are not subject to the proposed regulation are expected to purchase them.[56] These early model sales are being counted towards compliance with the ACT regulation and would not be attributed to the proposed regulation.

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[54] California Air Resources Board, *EMFAC 2021 Database*, 2021 (web link: https://arb.ca.gov/emfac/, last accessed January 2022).
[55] M.J. Bradley & Associates, *Electric Vehicle Market Status Update, 2021* (https://www.mjbradley.com/sites/default/files/EDF_EV_Market_Report_January_2021_Update_0.pdf, last accessed January 2022)
[56] Electrek Co, *Tesla Cybertruck pre-orders rise to over 650,000, says new report* 2020 (https://electrek.co/2020/06/22/tesla-cybertruck-pre-orders-rose-over-650000-report/, last accessed January 2022)

Table 3. Existing Medium- and Heavy-Duty ZEV Orders in North America as of November 2021

Manufacturer	Order Status
Tesla	At least 252,000 on order (250,000 Cybertruck) [57,58]
Ford	At least 160,000 on order[59]
Rivian	At least 130,000 on order[60,61]
Lordstown	At least 100,000 on order[62]
Nikola	At least 16,500 on order[63,64]
Workhorse	At least 7,900 on order[65]
Arrival	At least 10,000 on order[66]
GMC	At least 10,000 on order[67]
Bollinger	At least 6,000 on order[68]

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[57] Trucks.com, *Everything We Know About the Tesla Semi Truck*, 2019 (https://www.trucks.com/2019/09/05/everything-we-know-about-the-tesla-semi-truck/, last accessed January 2022)
[58] CNBC, *Elon Musk suggests Tesla has received 250,000 pre-orders for its Cybertruck*, 2020 (https://www.cnbc.com/2019/11/27/elon-musk-suggests-tesla-received-250000-pre-orders-for-cybertruck.html, last accessed January 2022)
[59] Elektrek, *Ford F-150 Lightning reservations surpass 160,000 during pre-production*, 2021 (https://electrek.co/2021/11/03/ford-f-150-lightning-reservations-surpass160000-during-pre-production/, last accessed January 2022)
[60] The Verge, *Amazon will order 100,000 electric delivery vans from EV startup Rivian, Jeff Bezos says*, 2019 (https://www.theverge.com/2019/9/19/20873947/amazon-electric-delivery-van-rivian-jeff-bezos-order, last accessed January 2022).
[61] Inside EVs, *Reservation Numbers Reveal Rivian R1T Has 30,000 Buyers Waiting*, 2020 (https://insideevs.com/news/437341/rivian-r1t-30-thousand-reservations/, last accessed January 2022).
[62] Elektrek, *Lordstown claims more than 100,000 pre-orders for its electric pickup truck*, 2021 (https://electrek.co/2021/01/11/lordstown-over-100000-pre-orders-electric-pickup-truck/, last accessed January 2022)
[63] Bloomberg, *Nikola Founder Builds $7.4 Billion Fortune Off Free Truck Orders*, 2020 (https://www.bloomberg.com/news/articles/2020-06-12/nikola-founder-builds-7-4-billion-fortune-off-free-truck-orders, last accessed January 2022)
[64] Nikola, *Nikola Receives Landmark Order of 2500 Battery Electric Waste Trucks from Republic Services*, 2020 (https://nikolamotor.com/press_releases/nikola-receives-landmark-order-of-2500-battery-electric-waste-trucks-from-republic-services-91, last accessed January 2022)
[65] M.J. & Bradley, *EV Market Update January 2021*, 2021 (https://www.mjbradley.com/sites/default/files/EDF_EV_Market_Report_January_2021_Update_0.pdf, last accessed January 2022).
[66] Arrival, *UPS invests in Arrival and Orders 10,000 Generation 2 Electric Vehicles*, 2020 (https://arrival.com/news/ups-invests-in-arrival-and-orders-10000-generation-2-electric-vehicles, last accessed January 2022)
[67] Elektrek, *GMC Hummer EV receives surprising number of pre-orders, and GM is looking to increase production*, 2021 (https://electrek.co/2020/12/21/gmc-hummer-ev-surprising-number-pre-orders-increase-production/, last accessed January 2022)
[68] Biznes Alert, *Electric car for tough guys*, 2017 (https://translate.google.com/translate?sl=auto&tl=en&u=https://biznesalert.pl/bollinger-b1-samochod-elektryczny/, last accessed January 2022)

Manufacturer	Order Status
Lion	At least 300 delivered, 150 on order[69,70]
Motiv	At least 128 on order[71]
BYD	At least 100 delivered, 25 on order[72,73]
Lightning eMotors	At least 100 on order[74]
GreenPower	At least 100 on order[75]
Phoenix	At least 56 on order[76]
Volvo	At least 15 on order[77]

Although incentive funding is a key part of the overall State policy to develop and accelerate early markets, staff did not include assumptions about state, federal, or local grants, rebates, or other types of funding programs in the costs analysis. Part of the reasons for this are that annual funding appropriations for some existing programs are uncertain, and various approved funding allocations totaling more than a billion dollars in investments for medium- and heavy-duty ZEVs and infrastructure are expected to be used by a wide range of fleet owners that may not be within the scope of the proposed regulation. Clearly the significant vehicle and infrastructure incentives available would reduce costs for some impacted fleets. However, this approach shows the full cost of the proposed regulation and scenarios compared to the baseline without funding assistance.

1.6 Public Outreach and Input

In February 2020, CARB staff began informing the public of the proposed ACF regulation and development process. Staff offered engagement opportunities to receive feedback and solicit for alternatives from a variety of groups and stakeholders, including manufacturers, large fleet owners and single truck owners-operators, environmental advocacy organizations

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[69] Inside EVs. *Canadian National Railway Orders Lion Electric Trucks*, 2020 (https://insideevs.com/news/442185/canadian-national-railway-orders-lion-electric-trucks, last accessed January 2022)

[70] Inside EVs. *Lion Electric Scores Largest Truck Order to Date*, 2021 (https://insideevs.com/news/497182/lion-electric-largest-truck-order/, last accessed January 2022)

[71] Inside EVs, *Bimbo Orders More EV Trucks from Motiv After Successful Pilot*, 2020 (https://insideevs.com/news/453800/bimbo-orders-more-ev-trucks-motiv/, last accessed January 2022)

[72] BYD, *BYD Delivers 100th Battery Electric Truck in the United States,* 2020 (https://en.byd.com/news/byd-delivers-100th-battery-electric-truck-in-the-united-states/, last accessed January 2022)

[73] BYD, *Anheuser Busch Names BYD Sustainable Suppler of the Year*, 2020 (https://en.byd.com/news-posts/anheuser-busch-names-byd-sustainable-supplier-of-the-year, last accessed January 2022)

[74] Lightning eMotors, *Lightning eMotors Reports Financial Results for Second Quarter 2021*, 2021 (*https://lightningemotors.com/20120-2/*, last accessed January 2022)

[75] GreenPower, *GreenPower Receives Order for Additional 100 EV Stars from Green Commuter*, 2020 (https://greenpowermotor.com/10-100-ev-stars-green-commuter/, last accessed January 2022)

[76] Phoenix Motorcars, *Phoenix Motorcars Announces Order for 50 Zero-Emissions Utility Shuttles by LR Group of Companies*, 2016 (https://www.phoenixmotorcars.com/phoenix-motorcars-announces-order-for-50-zero-emissions-utility-shuttles-zeus-by-lr-group-of-companies/, last accessed January 2022)

[77] FleetOwner, *Volvo Trucks Lands Largest VNR Electric Order*, 2021 (https://www.fleetowner.com/running-green/press-release/21161426/volvo-trucks-lands-largest-vnr-electric-order, last accessed January 2022)

and the communities impacted most heavily by medium- and heavy-duty truck emissions. Numerous workshops, workgroup meetings, forums, and listening sessions were held via webcast and a full list of public meetings[78] related to this rulemaking is as follows:

- February 12, 2020: Workshop to Discuss a Potential Medium- and Heavy-Duty Zero-Emission Fleet Regulation
- September 18, 2020: Workshop to Discuss the Proposed Advanced Clean Fleets Regulation
- September 22, 2020: Workshop on Reporting Requirements for Large Entities and Fleets Under the Advanced Clean Truck Regulation
- December 9, 2020: Workgroup Meetings on Costs and Drayage Trucks
- March 2, 2021 and March 4, 2021: Workshop to Discuss the Proposed Advanced Clean Fleets Regulation
- June 2, 2021: Medium- and Heavy-Duty Zero-Emission Vehicle Fueling Infrastructure Forum
- June 8, 2021 and June 10, 2021: Freight Days Community Listening Session
- August 31, 2021: Truck Emissions Community Listening Session
- September 9, 2021: Workshop on Draft Regulatory Language and Updated Cost Assumptions for the Advanced Clean Fleets Regulation
- October 6, 2021: Workgroup to Discuss the Public Fleet Requirements of the Advanced Clean Fleets Regulation
- October 13, 2021: Workgroup to Discuss the High Priority Fleet Requirements of the Advanced Clean Fleets Regulation
- October 26, 2021: Workgroup to Discuss the Advanced Clean Fleets Regulation with Smaller Fleets
- November 17, 2021: Workgroup to Discuss the Emissions Inventory Associated with the Advanced Clean Fleets Regulation
- December 3, 2021: Medium- and Heavy-Duty Infrastructure Workgroup on Business Considerations
- December 16, 2021: Medium- and Heavy-Duty Infrastructure Workgroup on Hydrogen

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[78] California Air Resources Board, *Advanced Clean Fleets Meetings and Events*, 2021 (https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets/advanced-clean-fleets-meetings-events, last accessed January 2022)

- January 12, 2022: Medium- and Heavy-Duty Infrastructure Workgroup on Electricity and the Grid (Part 1)
- February 11, 2022: Medium- and Heavy-Duty Infrastructure Workgroup on Cost and Funding
- March 10, 2022: Medium- and Heavy-Duty Infrastructure Workgroup on Electricity and the Grid (Part 2)
- May 2, 2022: Workshop on Draft Regulatory Language for the Advanced Clean Fleets Regulation - High-Priority and Federal Fleets
- May 4, 2022: Workshop on Draft Regulatory Language for the Advanced Clean Fleets Regulation - State and Local Government Fleets
- May 6, 2022: Public Workshop on Draft Regulatory Language for the Advanced Clean Fleets Regulation - Drayage Trucks

Beginning in 2020, workshops were held to discuss a variety of strategies on the potential framework for a ZE truck regulation. In 2021, several comprehensive workshops were held on the proposed regulation as a whole and in September of 2021 a workshop was held in line with a draft of the regulation language being released to the public. Some workshops were recorded and posted for reference on the ACF website; others were not recorded to allow for frank discussions. Most were held remotely due to the Coronavirus pandemic.

Smaller workgroups were held to better capture stakeholder input from similarly affected fleets.[79] These meetings focused on different topics including drayage fleets and costs, public fleets, high priority and federal fleets, and smaller fleets. This provided a dedicated space for smaller fleets to ask questions and comment about the proposed regulatory requirements and express how those requirements might affect them.[80] The small fleet workgroup meetings included both day and evening sessions to reach and receive input from the largest possible audience. A separate channel for live interpretation was provided once for Punjabi and twice for Spanish with one Spanish session recorded and posted on the ACF website. A workgroup was also held to discuss the emissions reductions associated with the proposed regulation. Staff were available throughout the meetings to answer questions. All workgroups were recorded and posted for reference on the ACF website.

Separate from the workgroups focused on the regulation proposal, CARB staff also hosted a four-part series of workgroup meetings in collaboration with the CEC, CPUC, and the California Governor's Office of Business Administrations and Economic Development (GO-Biz). Spanning from late 2021 to March 2022, these meetings focused on activities,

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[79] California Air Resources Board, Notice of Public Workshop Meeting to Discuss the Proposed Advanced Clean Fleets Regulation, 2021 (Notice of Public Workshop Meeting to Discuss the Proposed Advanced Clean Fleets Regulation, 2021 (https://ww2.arb.ca.gov/resources/documents/mailout-msc-21-2103, last accessed January 2022).

[80] California Air Resources Board, *Notice of Public Workshop to Discuss the Proposed Advanced Clean Fleets Regulation*, 2021 (https://content.govdelivery.com/accounts/CARB/bulletins/2f6a894)

challenges, and solutions surrounding the build-out of fueling infrastructure needed to support the fleet of ZE trucks and buses that the ACF regulation would bring about. The primary objective was to gain a collective understanding of the status in each topic area, the initiatives underway at each State agency, and the opportunities presented in meeting the demands of infrastructure scale-up. Workgroup meetings were held on four topics including Business Considerations, Hydrogen, Electricity and the Grid, and Costs and Funding.

Staff used notices to announce meeting events, documents, a public comment docket, translation resources, and other associated regulatory materials to encourage participation and attendance at the workgroups and workshops. This information was distributed to 10 public email distribution lists containing 80,372 recipients as well as 84,597 fleet contacts from the TRUCRS reporting database system. The program webpage housed all available information and documents that were made available for public comment.[81] These documents include staff presentations, the December 2020 Preliminary Draft Cost Data and Methodology Discussion updated and reposted with new September 2021 data, and the Draft ACF Regulation Language.[82] [83] Regulation text was written and organized in sections including requirements for high priority and federal fleets, public fleets, drayage truck fleets, and vehicle manufacturers and was posted publicly 2 weeks prior to the September 2021 workshop. Furthermore, the 30-day informal comment period following this posting was extended to allow ample and additional time for input, feedback, and alternatives to the proposed ACF regulation. Alternatives were also solicited at the March 2 and March 4, 2021 workshops. Table 4 list the number of recipients for each email list used by staff to announce public events.

Table 4. Distribution to CARB Email Lists

Public Email List	Number of Recipients
actruck	7,909
zevfleet	3,529
porttruck	6,244
onrdiesel	33,288
publicfleets	5,581
swcv	4,084
sfti	2,879
aqip	8,864
hvip	2,723
hdlownox	5,271

[81] California Air Resources Board, *Advanced Clean Fleets*, 2021 (https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets, last accessed January 2022)
[82] California Air Resources Board, *Cost Data and Methodology Discussion Document, 2020 (https://ww2.arb.ca.gov/sites/default/files/2020-12/201207costdisc_ADA.pdf, last accessed January 2022).*
[83] California Air Resources Board, *Advanced Clean Fleets Draft Regulation and Comments*, 2021 (https://ww2.arb.ca.gov/our-work/programs/advanced-clean-fleets/advanced-clean-fleets-draft-regulation-and-comments, last accessed January 2022)

Public Email List	Number of Recipients
TRUCRS	84,597
Total	164,969

In addition to public workgroups and workshops, CARB staff reached out to many proposed regulatory parties throughout the regulatory development and conducted more than 273 group and individual meetings with more than 130 stakeholders including, but not limited to, the Truck and Engine Manufacturers Association, California Trucking Association, California Electric Transportation Coalition, Community Steering Committees, Amazon, UPS, Pepsi, Southern California Edison (SCE), Pacific Gas and Electric (PG&E), Ikea, Waste Management, LA Metro, Ports of Los Angeles, Long Beach, Oakland, and San Diego, American Trucking Association, South Coast Air Quality Management District, California Chamber of Commerce, California Environmental Associates, CALSTART, Harbor Trucking Association, California Cleaner Freight Coalition, Better World Group, Coalition for Clean Air, BlueGreen Alliance, Earth Justice, Warehouse Worker Resource Center, California Workforce Development Board, CEC, CPUC, California Department of Transportation, GO-Biz, Sierra Club, Union of Concerned Scientists, Center for Community Action and Environmental Justice, Port of Oakland Trucker Workgroup, Natural Resources Defense Council, California Association of Port Authorities, Los Angeles Business Council, and Owner-Operator Independent Driver Association amongst many other fleet representatives and nonprofit organizations.

Staff also worked to include input from the community beyond directly regulated stakeholders and environmental advocacy organizations. To do this, CARB hosted a community listening session focused on truck activities as well as a two-day listening session focused on freight activities. These events gave attendees a brief overview of CARB's work to reduce air pollution from California trucks and allowed interested community members the opportunity to provide their input and vision for what CARB's priorities should be going forward. In addition, staff directly reached out to over 50 environmental justice groups to offer information and time to discuss the proposed ACF regulation. This work resulted in several informational meetings and 3 webinar presentations for AB617 Community Steering Committees. Staff also published an article in the CARB Environmental Justice blog spot to reach a wider and more diverse audience of affected parties.[84] This post was highlighted in the November 2021 Environmental Justice newsletter.

Staff also explored several other avenues to inform and engage fleets who may not be tuned into CARB's workgroups or email lists. An informational postcard mailer was sent to over 273,000 fleets identified to be either directly or indirectly affected by the proposed ACF regulation. Staff has also reached out to 14 trade associations and 18 metropolitan planning organizations. Several rural areas were also engaged through our outreach efforts and meetings were held with the Otay Mesa Chamber of Commerce and the Imperial County Environmental Justice IVAN committee. Staff also reached out by email to the Rural Counties Representatives Council. To reach public fleets, staff reached out directly by email to the Metropolitan Planning Organizations, the SANDAG Freight Stakeholders Working Group,

[84] California Air Resources Board, *CARB Environmental Justice Blog*, 2021 (web link: http://carbej.blogspot.com/2021/10/new-zero-emission-truck-regulation-will.html, last accessed January 2022).

Clean Cities Coalitions and the Institute of Local Governments, who in turn included an overview in several affiliated newsletters and listservs. An overview of the rulemaking has also been incorporated into a new CARB training course that has hosted over 883 attendees in 5 separate sessions in addition to 586 attendees who received an ACF overview when CARB staff hosted the One-Stop Truck events that occurred October 2021 and January 2022.

Staff will continue to meet with stakeholders and explore ways to inform the public about the proposed regulation including utilizing radio broadcast partnerships to offer information to an even wider audience in the coming months. Beyond these plans, the program webpage and CARB's TruckStop website will be continually updated to offer information on opportunities to engage, existing and future regulations, and the resources that would aid fleets in their transition to ZE technologies.[85]

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[85] California Air Resources Board, *CARB TruckStop Zero-Emission Vehicles*, 2021 (web link: http://ww2.arb.ca.gov/sites/default/files/truckstop/zev/zevinfo.html, last accessed January 2022).

2 Benefits

The proposed regulation supports the goals of the State SIP Strategy and reduces pollutants linked to multiple adverse health effects identified by California and federal ambient air quality standards.[86,87] These pollutants are NOx, key ingredients in the formation of several airborne toxic substances, and $PM_{2.5}$, which may deposit deep inside the lungs.[88] NOx is a precursor to both ozone and $PM_{2.5}$. Long-term exposure to $PM_{2.5}$ has been linked to premature death, particularly in people who have chronic heart or lung diseases, and reduced lung function and growth in children.[89] The proposed regulation would reduce GHG emissions, petroleum use, and ensure community health benefits in areas that need them most. The proposed ACF fleet purchase and turnover requirements would effectively accelerate benefits for all Californians.

The 2016 Mobile Source Strategy identified ZEVs as urgently important to address the localized risk of cancer and other adverse effects from combustion engine emissions at major freight hubs, and that fleet electrification must also play a growing role in reducing GHG emissions and petroleum use.[90] The 2020 Mobile Source Strategy continues to build upon the 2016 Mobile Source Strategy's plan for increasing medium- and heavy-duty ZEVs and the reduction of health impacts.[91] In January 2022, CARB released the Draft 2022 State SIP Strategy for public comment. It will be considered by the Board in mid-2022. Given that the document indicates California will be short of needed tons of emissions reductions needed for attainment, there is a need to push for more ZEV deployments and avoid scaling back regulatory pressure on the market. The proposed ACF regulation will significantly expand the number of ZEVs deployed statewide beyond existing measures, and more will be needed.

2.1 Emissions Benefits

2.1.1 Inventory Methodology

Staff used the EMFAC2021 model[92] to assess the emissions reductions that would be associated with the proposed regulation. EMFAC is California's official on-road (e.g., cars, trucks, and buses) mobile source inventory model that CARB uses for various clean air

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[86] California Air Resources Board, *2016 State Strategy for the State Implementation Plan*, 2017 (web link: https://ww3.arb.ca.gov/planning/sip/2016sip/rev2016statesip.pdf, last accessed January 2022).
[87] California Air Resources Board, *California Ambient Air Quality Standards* (web link: https://ww2.arb.ca.gov/resources/california-ambient-air-quality-standards, last accessed January 2022).
[88] California Air Resources Board, *Nitrogen Dioxide and Health* (web link: https://ww2.arb.ca.gov/resources/nitrogen-dioxide-and-health, last accessed January 2022).
[89] California Air Resources Board, *Inhalable Particulate Matter (PM 2.5 and PM10)* (web link: https://ww3.arb.ca.gov/research/aaqs/common-pollutants/pm/pm.htm, last accessed January 2022).
[90] California Air Resources Board, *2016 Mobile Source Strategy*, 2016 (web link: https://www.arb.ca.gov/planning/sip/2016sip/2016mobsrc.pdf, last accessed January 2022).
[91] California Air Resources Board, *Draft 2020 Mobile Source Strategy*, 2020 (web link: https://ww2.arb.ca.gov/sites/default/files/2020-11/Draft_2020_Mobile_Source_Strategy.pdf, last accessed January 2022).
[92] California Air Resources Board, *EMFAC*, 2021 (web link: *https://arb.ca.gov/emfac/*, last accessed April 2022).

planning, policy development, and regulatory efforts. EMFAC2021 incorporates CARB's latest understanding of statewide and regional vehicle activity and emissions and reflects the Legal Baseline of adopted medium- and heavy-duty vehicle regulations including the ACT regulation. An alternative baseline is also presented in the "Baseline Information" Section to show how emissions compare if the HDIM regulation recently adopted by the Board is approved and finalized by OAL. The proposed regulation would require affected entities to upgrade their fleets to ZEVs, thereby eliminating NOx, PM, and GHG tailpipe emissions resulting from vehicle operations.

PM, NOx, and GHG emissions benefits are projected by assuming zero tailpipe emissions for the forecasted number of medium- and heavy-duty ZEVs operating in California with the proposed ACF requirements in place and assuming no change in total VMT, compared to the Legal Baseline. The PM emissions analysis also includes an estimated 50 percent reduction in PM associated with brake-wear for electric vehicles due to regenerative braking when compared to conventional vehicles.[93] Projections, including inventory assumptions, are further discussed in the Direct Costs Section of this SRIA. Staff used the latest available data on population, activity, and in-use emissions from medium- and heavy-duty truck fleets operating in California to estimate the Legal Baseline emissions.

This assessment is focused on the vehicle emissions, also known as tank-to-wheel (TTW) emissions, and does not include upstream emissions associated with producing and delivering the fuel or energy source to the vehicle that are addressed by other measures and policies to reduce those emissions. However, upstream emissions from medium and heavy-duty ZEVs are expected to show greater cumulative PM, NOx, and GHG reductions due to the much lower total energy use and the upstream emissions associated with electricity and hydrogen production compared to gasoline, diesel, natural gas, and other fuels.[94]

2.1.2 Anticipated Emissions Benefits

2.1.2.1 Criteria Pollutant Emissions Benefits

Medium- and heavy-duty trucks are the predominant means of distributing freight and services. These trucks can be seen along distribution centers, seaports, railyards, warehouses, and major roadways, which are commonly located around more densely populated urban areas, including in low-income and disadvantaged communities. ZEV deployment in low-income and disadvantaged communities will be an important part of the solution, not only for maximizing NOx and PM reductions needed to meet SIP requirements, but also for achieving

[93] National Renewable Energy Laboratory, *BAE/Orion Hybrid Electric Buses at New York City Transit* (web link: https://afdc.energy.gov/files/pdfs/42217.pdf, last accessed January 2022).
[94] California Air Resources Board, *Advanced Clean Cars II SRIA*, 2022 (web link: https://www.dof.ca.gov/forecasting/economics/major_regulations/major_regulations_table/documents/ACCII-SRIA.pdf, last accessed January 2022).

GHG emissions goals established in many statutes, or complementary to existing statutes including AB 32, SB 32, SB 350, and SB 375.[95]

The projected statewide emissions benefits of the proposed regulation from 2024 through 2050 are identified in Table 5 with respect to NOx, $PM_{2.5}$, and GHGs. The calendar years displayed in the table below represent targets for California to meet air quality standards and GHG goals. Years 2031 and 2037 are mid-term attainment deadlines for national ambient air quality standards, whereas years 2045 and 2050 are longer-term climate goals to achieve carbon neutrality and 80 percent GHG emissions reductions below 1990 levels, respectively.

Table 5. Statewide TTW NOx, $PM_{2.5}$, and GHG Benefits of the Proposed Regulation Relative to Legal Baseline

Calendar Year	NOx (tpd)	$PM_{2.5}$ (tpd)	CO_2 (MMT/year)
2024	0.29	0.01	0.11
2025	0.89	0.02	0.28
2026	2.73	0.05	0.70
2027	5.36	0.08	1.24
2028	7.53	0.12	1.72
2029	11.50	0.20	2.65
2030	15.69	0.28	3.62
2031	20.45	0.37	4.66
2032	25.21	0.46	5.71
2033	29.43	0.54	6.59
2034	35.62	0.65	7.83
2035	42.09	0.78	9.12
2036	48.01	0.90	10.18
2037	54.36	1.03	11.32
2038	61.08	1.16	12.53
2039	67.52	1.30	13.73

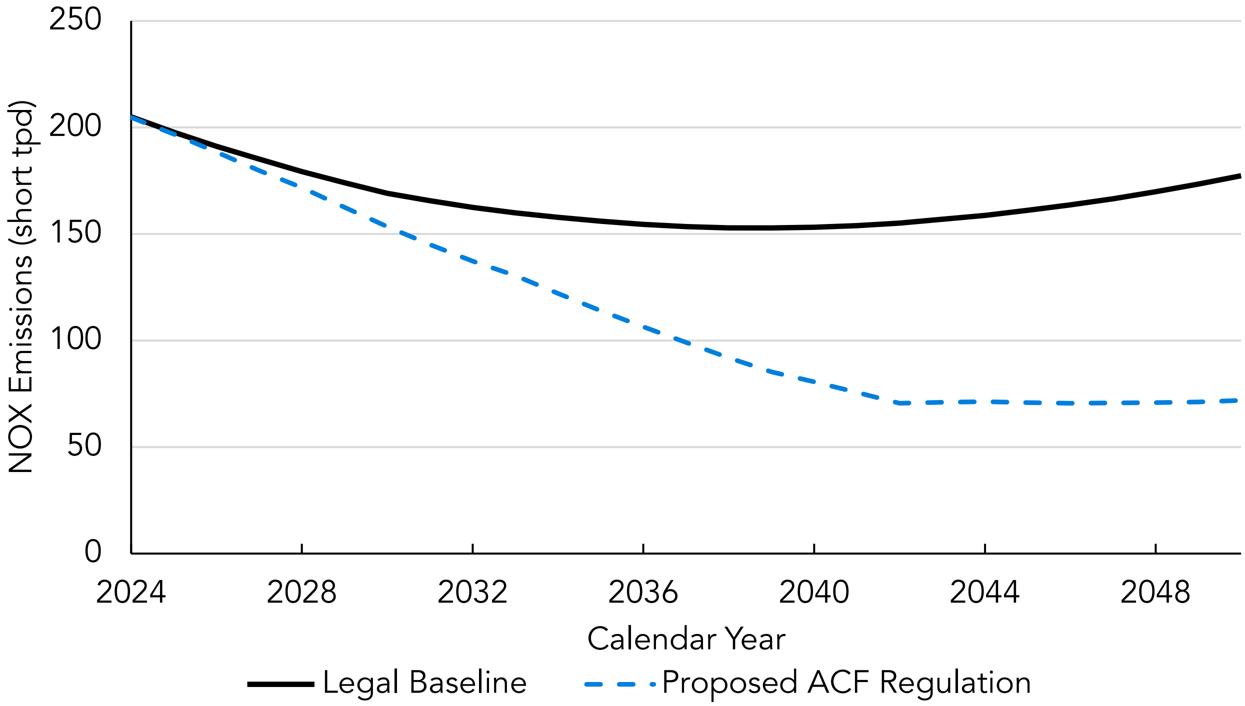
[95] The Sustainable Communities and Climate Protection Act of 2008 (SB 375) requires CARB to develop and set regional targets for GHG emissions reductions from passenger vehicles. CARB has set regional targets, indexed to years 2020 and 2035, to help achieve significant additional GHG emissions reductions from changed land use patterns and improved transportation in support of the State's climate goals, as well as in support of statewide public health and air quality objectives.

Calendar Year	NOx (tpd)	$PM_{2.5}$ (tpd)	CO_2 (MMT/year)
2040	72.59	1.45	15.06
2041	78.32	1.61	16.61
2042	84.59	1.77	18.20
2043	85.90	1.84	18.88
2044	87.47	1.91	19.58
2045	90.16	2.00	20.44
2046	93.01	2.09	21.32
2047	95.94	2.18	22.19
2048	99.07	2.27	23.07
2049	102.23	2.36	23.95
2050	105.40	2.45	24.81

Emissions benefits increase as the ZEV fleet requirements phase in and the population of medium- and heavy-duty ZEVs increases. The cumulative total emissions reductions from 2024 to 2050 is estimated to result in 443,799 tons reduction in NOx, 9,313 tons reduction in $PM_{2.5}$ and 316 million metric tons (MMT) reduction of GHG, relative to the Legal Baseline. Note that the emissions reductions presented are TTW and the conversion of NOx and $PM_{2.5}$ from tons per day into years assumes 312 operational days per year.

The statewide NOx and $PM_{2.5}$ emissions impacts of the proposed regulation are presented relative to the Legal Baseline in the following two figures and are shown in short tons per day (tpd). In the Legal Baseline, projected NOx emissions decrease significantly until 2023 when the Truck and Bus regulation achieves its goal of upgrading most diesel vehicles to 2010 MY and newer engines. Beginning in 2024, the Legal Baseline for NOx emissions continues to decline as cleaner engines and ZEVs are phased in, even as VMT continues to grow, due to the normal replacement of existing vehicles with cleaner vehicles and existing regulations. However, in later years, the Legal Baseline NOx emissions begin to increase with projected VMT growth.

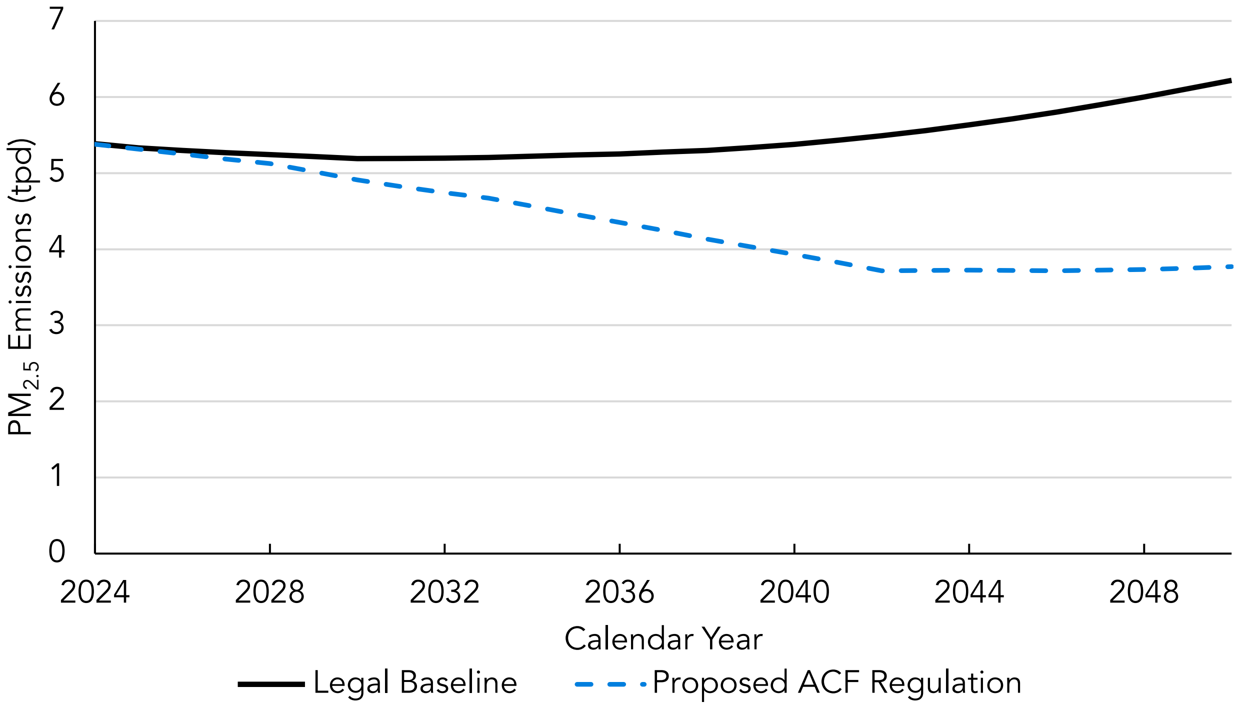
Figure 2. Projected Statewide NOx TTW Emissions, Legal Baseline and Proposed Regulation



In the Legal Baseline, NOx emissions are expected to decline from 205.0 tpd in 2024 to 177.3 tpd in 2050. With the proposed regulation, NOx emissions decline from 205.0 tpd in 2024 to 71.9 tpd in 2050. Although the regulated fleets will have fully converted to ZEVs by 2042, the new ZEV sales requirement will keep bringing extra emissions benefits despite the predicted VMT growth and emissions deterioration from remaining combustion vehicles.

For $PM_{2.5}$ emissions shown in Figure 3, the Legal Baseline is initially expected to remain relatively flat as most diesel trucks already have PM filters and only limited additional reductions are expected from newer engines. Then $PM_{2.5}$ emissions are expected to increase as projected VMT grows. With the proposed regulation, $PM_{2.5}$ emissions are expected to decline rapidly until about 2042 and then slow as more regulated fleets make a full conversion to ZEVs. Under the Legal Baseline, $PM_{2.5}$ emissions are expected to increase from 5.4 tpd in 2024 to 6.2 tpd in 2050. With the proposed regulation, $PM_{2.5}$ emissions are expected to decrease from 5.4 tpd in 2024 to 3.8 tpd in 2050. Remaining emissions are largely due to vehicles not covered by the rule and other non-exhaust sources such as brake or tire wear.

Figure 3. Projected Statewide $PM_{2.5}$ TTW Emissions, Legal Baseline and Proposed Regulation



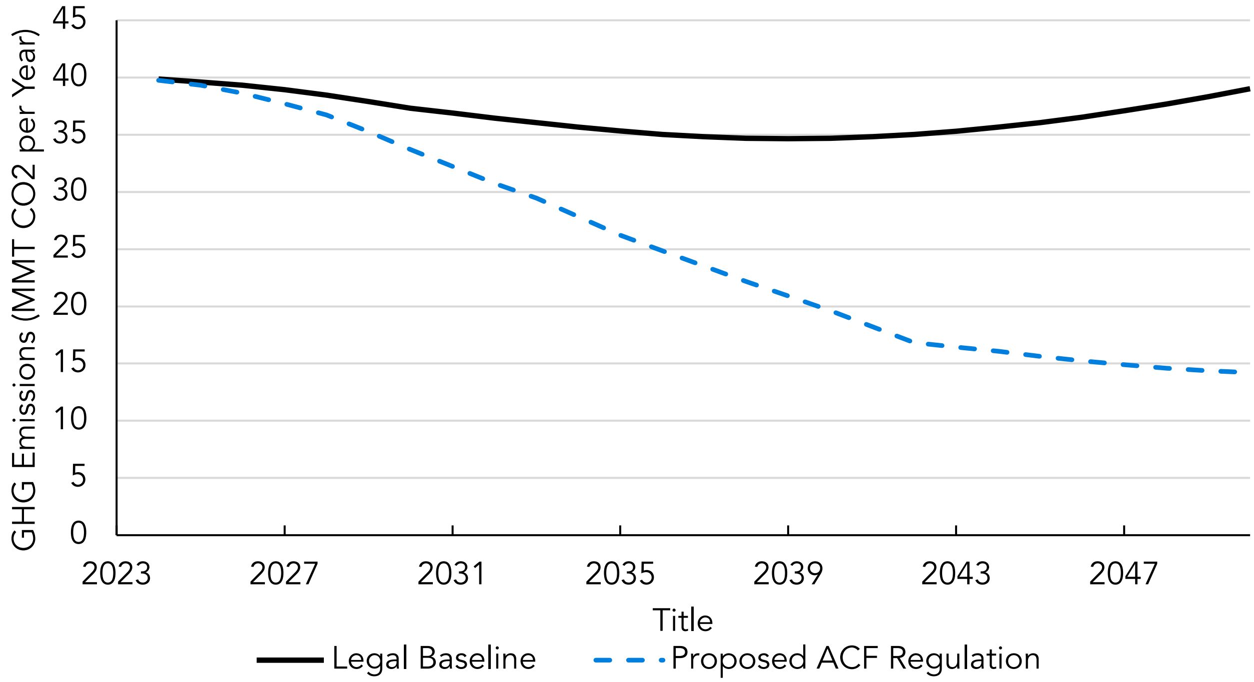
2.1.2.2 GHG Emissions Benefits

ZEV adoptions in low-income and disadvantaged communities will be an important part of the solution for improvement of air quality in these areas that are so heavily impacted by truck traffic, not only for maximizing NOx and PM reductions needed to meet SIP requirements, but also for achieving the State's GHG emissions reduction goals. Reducing GHG emissions will help stabilize the climate, which benefits all communities, including low-income and disadvantaged communities.

The proposed regulation would be expected to result in significant GHG emissions reductions, due to replacing ICE vehicles with ZEV technologies. ZEVs produce no tailpipe emissions and have lower upstream emissions. These emissions reductions contribute to keeping California on the GHG emissions reductions path set in the Climate Change Scoping Plan.

Figure 4 summarizes the estimated TTW GHG emissions from both the proposed regulation and the Legal Baseline, in units of MMT of CO_2 per year. The proposed regulation would be expected to reduce cumulative TTW GHG emissions by an estimated 316 MMT of CO_2 relative to the Legal Baseline from 2024 to 2050.

Figure 4. Projected Statewide TTW GHG Emissions of the Proposed Regulation



In the Legal Baseline, GHG emissions display a gradual overall decline from 2024 to 2039. The decline is the result of engine manufacturers meeting stricter emissions standards resulting in older models being replaced with more efficient models when normal replacements are made, the ACT regulation requiring manufacturers to build and sell a percentage of medium- and heavy-duty ZE trucks and buses. However, emissions begin to increase in about 2040, and by 2050, reach about the same annual emissions level as 2024. The GHG emissions increase is primarily due to the projected growth in medium- and heavy-duty truck VMT.

With the proposed regulation, GHG emissions demonstrate a rapid decline from 2024 to 2042, reducing the annual emissions by roughly half of the 2024 estimate. The decrease in GHG emissions in comparison to the Legal Baseline is attributed to an increase in the number of ZEVs and some early retirement of medium- and heavy-duty ICE vehicles that reach the end of their useful life. The benefits are from the fact ZEVs have no tailpipe emissions. From 2043 to 2050, GHG emissions continue to decline but at a much slower rate than in prior years.

The oil and gas and refining sector account for half of the industrial sector emissions in the State's annual GHG inventory, roughly 10 percent of the State's total GHGs.[96] The electricity sector currently accounts for approximately 14 percent of the State's total GHGs. As the

[96] California Air Resources Board, *California Greenhouse Gas Emissions for 2000 to 2019,* 2021 (web link: https://ww2.arb.ca.gov/sites/default/files/classic/cc/ca_ghg_inventory_trends_2000-2019.pdf, last accessed January 2022).

State moves away from fossil fuel combustion technology, there will be less dependence on petroleum, this could potentially result in a reduction in petroleum industry related GHG emissions. During the COVID-19 pandemic and the stay-at-home orders, there was a drastic reduction in demand for petroleum fuels as residents stayed home. As a result of that reduced demand, several refineries shutdown or announced the repurposing of those facilities to produce low carbon fuels.[97,98] It is reasonable to expect that as fleets turnover and transition away from petroleum fuel and demand is reduced, we may see resulting upstream reductions in petroleum industry activities which could translate into additional GHG reductions.

Moreover, the transition to a cleaner fleet may also see demand increase for electricity. And, while the electricity sector is still a source of GHG emissions, there are multiple efforts to drastically decarbonize the grid even while load grows. The 2017 Scoping Plan Update, SB 350 Integrated Resource Plans, and SB 100 Report lay out the decarbonization targets and goals for 2030 and 2045.[99,100,101] The 2017 Scoping Plan estimated a 51 to 72 percent reduction in GHG emissions relative to 1990 levels in the electricity sector while SB 100 requires planning for 100 percent zero-carbon electricity retail sales by 2045. In addition to these sector specific upstream efforts to reduce GHG emissions, the 2022 Scoping Plan is currently evaluating four scenarios for achieving carbon neutrality no later than 2045 which either eliminates or drastically reduces the dependence on fossil fuel sourced energy.[102]

The benefit of these GHG emissions reductions can be estimated using the social cost of carbon (SC-CO_2), which provides a dollar valuation of the damages caused by one ton of carbon pollution and represents the monetary benefit today of reducing carbon emissions in the future.

In the analysis of the SC-CO_2 for the proposed regulation, CARB utilizes the current Interagency Working Group (IWG) supported SC-CO_2 values to consider the social costs of actions taken to reduce GHG emissions. This is consistent with the approach presented in the Revised 2017 Climate Change Scoping Plan, is in line with U.S. Government Executive Orders

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[97] Phillips 66, *Phillips 66 Plans to Transform San Francisco Refinery into World's Largest Renewable Fuels Plant, 2020* (web link: https://investor.phillips66.com/financial-information/news-releases/news-release-details/2020/Phillips-66-Plans-to-Transform-San-Francisco-Refinery-into-Worlds-Largest-Renewable-Fuels-Plant/default.aspx, last accessed January 2022).

[98] BiodieselMagazine.com, *Marathon proceeds with renewables conversion at Martinez refinery,* 2021 (web link: https://biodieselmagazine.com/articles/2517427/marathon-proceeds-with-renewables-conversion-at-martinez-refinery, last accessed January 2022)

[99] California Air Resources Board, *California's 2017 Climate Change Scoping Plan,* 2017 (web link: https://ww2.arb.ca.gov/sites/default/files/classic/cc/scopingplan/scoping_plan_2017.pdf, last accessed January 2022)

[100] California Air Resources Board, *SB 350 Electricity Sector Greenhouse Gas Planning Targets | California Air Resources Board,* (web link: https://ww2.arb.ca.gov/our-work/programs/sb350, last accessed January 2022)

[101] California Energy Commission, *SB 100 Joint Agency Report* (web link: https://www.energy.ca.gov/sb100, last accessed January 2022)

[102] California Air Resources Board, *Pathways Scenario Modeling 2022 Scoping Plan Update,* 2021 (web link: https://ww2.arb.ca.gov/sites/default/files/2021-12/Revised_2022SP_ScenarioAssumptions_15Dec.pdf, last accessed January 2022)

including 13990 and the Office of Management and Budget's Circular A-4 of September 17, 2003 and reflects the best available science in the estimation of the socio-economic impacts of carbon.[103,104]

IWG describes the social costs of carbon as follows:

> The SC-CO_2 for a given year is an estimate, in dollars, of the present discounted value of the future damage caused by a 1-metric ton increase in CO_2 emissions into the atmosphere in that year or, equivalently, the benefits of reducing CO_2 emissions by the same amount in that year. The SC-CO_2 is intended to provide a comprehensive measure of the net damages – that is, the monetized value of the net impacts from global climate change that result from an additional ton of CO_2.
>
> Those damages include, but are not limited to, changes in net agricultural productivity, energy use, human health, property damage from increased flood risk, as well as nonmarket damages, such as the services that natural ecosystems provide to society. Many of these damages from CO_2 emissions today will affect economic outcomes throughout the next several centuries.[105]

The SC-CO_2 is year-specific and is highly sensitive to the discount rate used to discount the value of the damages in the future due to CO_2. The SC-CO_2 increases over time as systems become more stressed from the aggregate impacts of climate change and as future emissions cause incrementally larger damages. This discount rate accounts for the preference for current benefits and future costs over future benefits and current costs. A higher discount rate decreases the value today of future environmental damages. While the proposed regulation cost analysis does not account for any discount rate, this social cost analysis uses the IWG standardized range of discount rates from 2.5 to 5 percent to represent varying valuation of future damages. Table 6 shows the range of SC-CO_2 discount rates developed by the IWG which reflect the societal value of reducing carbon emissions by one metric ton.[106]

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[103] California Air Resources Board, *California's 2017 Climate Change Scoping Plan*, 2017 (web link: https://ww2.arb.ca.gov/sites/default/files/classic//cc/scopingplan/scoping_plan_2017.pdf, last accessed January 2022).

[104] Office of Management and Budgets, *Circular A-4*, 2003 (web link: https://www.transportation.gov/sites/dot.gov/files/docs/OMB%20Circular%20No.%20A-4.pdf, last accessed January 2022).

[105] National Academies of Sciences, *Engineering, Medicine, Valuing Climate Damages: Updating Estimation of Carbon Dioxide*, 2017 (web link: http://www.nap.edu/24651, last accessed January 2022).

[106] Interagency Working Group on the Social Cost of Carbon, *Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 13990*, 2021 (web link: https://www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf, last accessed January 2022).

Table 6. SC-CO_2 Discount Rates (in 2021$ per Metric Ton of CO_2)

Year	5% Discount Rate	3% Discount Rate	2.5% Discount Rate
2020	$16	$57	$85
2025	$19	$63	$93
2030	$22	$68	$100
2035	$25	$75	$107
2040	$29	$82	$115
2045	$31	$88	$122
2050	$36	$94	$130

The avoided SC-CO_2 from 2024 to 2050 is the sum of the annual TTW GHG emissions reductions multiplied by the SC-CO_2 in each year. The cumulative TTW GHG emissions reductions along with the estimated benefits from the proposed regulation are shown in Table 5. These benefits range from about $9.5 billion to $37.4 billion through 2050, depending on the chosen discount rate. In Table 7, staff calculated the avoided SC-CO_2 values (Million 2021$) by applying values in Table 6 (Million 2021$ per Metric Ton of CO_2) that were adjusted with a California consumer price index inflation adjustment factor.

Table 7. Avoided SC-CO_2 (Million 2021$)

Year	GHG Emissions Reductions (MMT)	Avoided SC-CO_2 5% Discount Rate	Avoided SC-CO_2 3% Discount Rate	Avoided SC-CO_2 2.5% Discount Rate
2024	0.1	$1.8	$6.2	$9.0
2025	0.3	$5.7	$18.9	$27.9
2026	0.7	$13.4	$45.0	$66.1
2027	1.2	$24.6	$78.8	$114.9
2028	1.7	$34.9	$113.9	$165.1
2029	2.7	$55.4	$180.9	$265.9
2030	3.6	$78.8	$246.2	$359.4
2031	4.7	$102.9	$327.8	$475.7
2032	5.7	$132.5	$405.4	$584.7
2033	6.6	$153.5	$478.4	$686.0
2034	7.8	$192.0	$576.1	$821.4
2035	9.1	$224.0	$684.5	$970.8

Year	GHG Emissions Reductions (MMT)	Avoided SC-CO_2 5% Discount Rate	Avoided SC-CO_2 3% Discount Rate	Avoided SC-CO_2 2.5% Discount Rate
2036	10.2	$265.1	$781.2	$1,102.1
2037	11.3	$293.6	$880.9	$1,251.9
2038	12.5	$341.9	$991.6	$1,401.9
2039	13.7	$374.8	$1,105.5	$1,555.2
2040	15.1	$433.7	$1,239.1	$1,734.8
2041	16.6	$476.8	$1,384.9	$1,929.8
2042	18.2	$547.6	$1,518.4	$2,140.7
2043	18.9	$568.7	$1,602.7	$2,248.9
2044	19.6	$616.6	$1,688.8	$2,359.0
2045	20.4	$641.7	$1,785.7	$2,483.2
2046	21.3	$699.2	$1,893.6	$2,621.9
2047	22.2	$728.7	$2,004.0	$2,793.4
2048	23.1	$789.8	$2,116.8	$2,938.2
2049	24.0	$820.6	$2,232.1	$3,085.5
2050	24.8	$881.9	$2,340.4	$3,222.3
Total	**316.1**	$9,500.2	$26,727.9	$37,415.8

It is important to note that the SC-CO_2, while intended to be a comprehensive estimate of the damage caused by carbon globally, does not represent the cumulative cost of climate change and air pollution to society. There are additional costs to society outside of the SC-CO_2, including costs associated with changes in co-pollutants, the social cost of other GHGs including methane and nitrous oxide, and costs that cannot be included due to modeling and data limitations. The Intergovernmental Panel on Climate Change[107] has stated that the IWG SC-CO_2 estimates are likely underestimated due to the omission of significant impacts that cannot be accurately monetized including important physical, ecological, and economic impacts.[108]

[107] Intergovernmental Panel on Climate Change, *IPCC webpage*, (weblink: https://www.ipcc.ch/, last accessed January 2022)

[108] Environmental Protection Agency, *Social Cost of Carbon Fact Sheet*, 2016, (weblink: https://www.epa.gov/sites/default/files/2016-12/documents/social_cost_of_carbon_fact_sheet.pdf, last accessed January 2022)

2.2 Benefits to Typical Businesses

2.2.1 Truck and Bus Owners

Individual businesses may be able to lower their total cost of ownership by taking advantage of the operational cost-savings of ZEVs like battery-electric or hydrogen FCEVs. ZEV owners that also own their charging or hydrogen fueling stations can lower costs further by taking advantage of the LCFS program. Details can be found in the Direct Costs chapter of this SRIA in section 3.1.4.3.

Trucking companies and others that have ZEV fleets might choose to advertise themselves as being environmentally friendly and make partnerships or sign contracts with other companies that want to support the movement toward replacing fossil fuel-burning trucks and buses with those that produce no tailpipe emissions, resulting in better public health. Less vibration in the cab results in a reduced health impact to truck drivers, including a reduction in "driver's fatigue" which can lead to deadly accidents.[109, 110, 111] ZEVs reduce harmful emissions that contribute to air toxics hot spots at places such as truck mechanic shops, loading docks, and inside truck cabs, resulting in better quality air that truck drivers, including owner-operators, breathe.[112]

2.2.2 Electric Utility Providers

The proposed regulation would increase the number of medium- and heavy-duty ZEVs deployed which, in turn, would increase the amount of electricity supplied by electric utility providers, either directly or indirectly. In addition, since electric utilities also operate trucks, they would also see potential benefits like other truck owners.

The proposed regulation would also help the state's investor-owned utilities meet the goals of SB 350, which includes a requirement that the state's investor-owned utilities develop programs "to accelerate widespread transportation electrification." PG&E, SCE, and San Diego Gas and Electric (SDG&E) have active programs to install low-cost or free electric vehicle supply infrastructure on a customer's site, and they commonly offer a voucher for the charger itself.

All three of these investor-owned utilities have established new electricity rates for commercial ZEV deployments to better align with fleet needs and to ensure affordability, which includes a variety of approaches such as demand charge holidays or a subscription-based approach. Research and development of new rate strategies is ongoing. By ensuring that vehicles would be available to make use of these utility investments and rates, the

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[109] Institute of Transport Economics, *Experiences from Battery-Electric Truck Users in Norway* , 2020 (web link: https://www.mdpi.com/601754, last accessed January 2022).
[110] Bose Corporation, *The impact of different seats and whole-body vibration exposures on truck driver vigilance and discomfort*, 2017 (web link: https://doi.org/10.1080/00140139.2017.1372638, last accessed January 2022).
[111] RAND Corporation, *Evaluating the Impact of Whole-Body Vibration (WBV) on Fatigue and the Implications for Driver Safety*, 2015 (web link: www.rand.org/t/rr1057, last accessed January 2022).
[112] National Library of Medicine, *Potential air toxics hot spots in truck terminals and cabs*, 2012 (web link: https://pubmed.ncbi.nlm.nih.gov/23409510/, last accessed January 2022).

proposed regulation supports the utilities' programs, the goals of SB 350, and an increase in electricity demand. In addition, other electric service providers, such as publicly owned utilities and community choice aggregators, continue to develop and deploy new programs and policies and would similarly benefit from increased electricity deliveries.

2.2.3 Other California Businesses

The proposed regulation may result in benefits to ZEV manufacturers and component suppliers, electric vehicle supply equipment (EVSE) suppliers and installers, and hydrogen fuel station suppliers. Due to higher demand for medium- or heavy-duty ZEVs from the proposed regulation, production of ZEVs in California would be expected to rise, leading to increases in manufacturing and related jobs throughout the state. The increase in the production and usage of ZEVs would be expected to also benefit various businesses related to the ZEV component supply chain, including those involved with batteries, fuel cells, and electric drivetrains.

The proposed regulation may also benefit EVSE suppliers who would see an increase in charging equipment installation because of increased medium- and heavy-duty ZEV purchases. Most of these installations are expected to be in central depots or yards where trucks are parked overnight. Increased installation of charging infrastructure would benefit the EVSE suppliers, equipment installers, and electricians. EVSE installations would primarily in California (though, conceivably, some businesses might also choose to operate their ZEVs in other states, resulting in additional EVSE in those states), and some of the EVSE equipment may be manufactured in California. Increased purchase of medium- and heavy-duty ZEVs under the proposed regulation would also benefit various California businesses related to installing hydrogen fueling stations, supplying hydrogen, and providing associated maintenance.

Companies that contract with or use ZEV fleets would be able tout that they are either moving towards or currently operating with a carbon neutral or carbon optimal supply chain.[113] Choosing to focus on a more environmentally friendly shipping method and supply chain may help some companies in their move towards carbon neutrality by compensating for other aspects of their businesses from which it is more difficult to reduce GHG emissions.

2.3 Benefits to Small Businesses

The proposed regulation may result in benefits to small business due to higher demand for medium- and heavy-duty ZEVs, and associated infrastructure, which would likely lead to increases in manufacturing, distribution, infrastructure installation and maintenance, and other related jobs for small businesses throughout the state. Electricians, construction companies (including infrastructure installers), existing ZEV manufacturers, and fuel cell and electric drivetrain parts and components businesses may fall into the small business category and may see an increase in new sales or other business opportunities. Increased installation

[113] University of California at Los Angeles, *Carbon-Optimal and Carbon-Neutral Supply Chains*, 2011 (web link: https://escholarship.org/uc/item/3s01b6pg, last accessed January 2022).

of charging infrastructure would benefit EVSE suppliers, equipment installers, and electricians that could be small businesses. EVSE installations would be primarily in California (though, conceivably, some businesses might also choose to operate their ZEVs in other states, resulting in additional EVSE in those states), and some of the EVSE equipment may be manufactured in California. Increased purchase of medium- and heavy-duty ZEVs under the proposed regulation could also benefit various California small businesses related to installing hydrogen fueling stations, supplying hydrogen, and providing associated maintenance.

A shift in environmental conscientiousness and ZEV range availability may influence businesses to seek to fulfill their medium- and heavy-duty ZEV purchase and service needs with local companies, which may be small businesses, rather than ordering from businesses more distant from their communities. There may also be a decrease in shipping costs, due to the significantly lower fuel prices associated with purchasing from local businesses, which can be passed on to the customer or reinvested into the small business.

2.4 Benefits to Individuals

2.4.1 Health Benefits

The proposed regulation would reduce NOx and $PM_{2.5}$ emissions, resulting in health benefits for individuals in California. The value of health benefits calculated for this regulation is due to fewer instances of premature mortality and fewer hospital and ER visits. The evaluation method used in this analysis is the same as the one used for CARB's LCFS 2018 Amendments, Heavy-Duty Vehicle Inspection Program, and Periodic Smoke Inspection Program.

CARB analyzed the value associated with four health outcomes in the Legal Baseline, proposed regulation, and alternatives: cardiopulmonary mortality, hospitalizations for cardiovascular illness, hospitalizations for respiratory illness, and ER visits for asthma. These health outcomes and others have been identified by U.S. EPA as having a causal or likely causal relationship with exposure to $PM_{2.5}$ based on a substantial body of scientific evidence.[114] U.S. EPA has determined that both long-term and short-term exposure to $PM_{2.5}$ plays a causal role in premature mortality, meaning that a substantial body of scientific evidence shows a relationship between $PM_{2.5}$ exposure and increased risk of death. This relationship persists when other risk factors such as smoking rates, poverty, and other factors are taken into account. U.S. EPA has also determined a causal relationship between non-mortality cardiovascular effects and short- and long-term exposure to $PM_{2.5}$, and a likely causal relationship between non-mortality respiratory effects (including worsening asthma) and short- and long-term $PM_{2.5}$ exposure. These outcomes lead to hospitalizations and ER visits and are included in this analysis.

[114] U.S. EPA, *Integrated Science Assessment for Particulate Matter (Issue EPA/600/R-19/188)*, 2019 (web link: https://cfpub.epa.gov/ncea/isa/recordisplay.cfm?deid=347534, last accessed January 2022).

CARB staff evaluated a limited number of statewide non-cancer health impacts associated with exposure to $PM_{2.5}$ and NOx emissions from medium- and heavy-duty vehicles. NOx includes nitrogen dioxide, a potent lung irritant, which can aggravate lung diseases such as asthma when inhaled.[115] However, the most serious quantifiable impacts of NOx emissions occur through the conversion of NOx to fine particles of ammonium nitrate aerosols through chemical processes in the atmosphere. $PM_{2.5}$ formed in this manner is termed secondary $PM_{2.5}$. Both directly emitted $PM_{2.5}$ and secondary $PM_{2.5}$ from medium- and heavy-duty vehicles are associated with adverse health outcomes, such as cardiopulmonary mortality, hospitalizations for cardiovascular illness and respiratory illness, and ER visits for asthma. As a result, reductions in $PM_{2.5}$ and NOx emissions are associated with reductions in these health outcomes.

2.4.1.1 Incidence-Per-Ton Methodology

CARB uses the incidence-per-ton (IPT) methodology to quantify the health benefits of emissions reductions in cases where dispersion modeling results are not available. A description of this method is included on CARB's webpage.[116] CARB's IPT methodology is based on a methodology developed by U.S. EPA.[117,118,119]

Under the IPT methodology, changes in emissions are approximately proportional to changes in health outcomes. IPT factors are derived by calculating the number of health outcomes associated with exposure to $PM_{2.5}$ for a baseline scenario using measured ambient concentrations and dividing by the emissions of $PM_{2.5}$ or a precursor. The calculation is performed separately for each air basin using the following equation:

$$IPT = \frac{number\ of\ health\ outcomes\ in\ air\ basin}{annual\ emissions\ in\ air\ basin}$$

Multiplying the emissions reductions from the proposed regulation in an air basin by the IPT factor then yields an estimate of the reduction in health outcomes achieved by the proposed regulation. For future years, the number of outcomes is adjusted to account for population

[115] United States Environmental Protection Agency, *Integrated Science Assessment for Oxides of Nitrogen – Health Criteria, EPA/600/R-15/068*, 2016 (web link: http://ofmpub.epa.gov/eims/eimscomm.getfile?p_download_id=526855, last accessed January 2022).
[116] California Air Resources Board, *CARB's Methodology for Estimating the Health Effects of Air Pollution* (web link: https://ww2.arb.ca.gov/resources/documents/carbs-methodology-estimating-health-effects-air-pollution, last accessed January 2022).
[117] Fann N, Fulcher CM, Hubbell BJ., *The influence of location, source, and emission type in estimates of the human health benefits of reducing a ton of air pollution*, Air Quality, Atmosphere & Health, 2:169-176, 2009 (web link: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2770129/, last accessed January 2022).
[118] Fann N, Baker KR, Fulcher CM., *Characterizing the PM2.5-related health benefits of emission reductions for 17 industrial, area and mobile emission sectors across the U.S.*, Environ Int.; 49:141-51, 2012 (web link: https://www.sciencedirect.com/science/article/pii/S0160412012001985118 , last accessed January 2022).
[119] Fann N, Baker K, Chan E, Eyth A, Macpherson A, Miller E, Snyder J., *Assessing Human Health PM2.5 and Ozone Impacts from U.S. Oil and Natural Gas Sector Emissions in 2025, Environ. Sci. Technol. 52 (15), pp 8095–8103*, 2018 (web link: https://pubs.acs.org/doi/abs/10.1021/acs.est.8b02050, last accessed January 2022).

growth. CARB's current IPT factors are based on a 2014-2016 baseline scenario, which represents the most recent data available at the time the current IPT factors were computed. IPT factors are computed for the two types of $PM_{2.5}$: primary $PM_{2.5}$ and secondary $PM_{2.5}$ of ammonium nitrate aerosol formed from precursors.

2.4.1.2 Reduction in Adverse Health Impacts

CARB staff evaluated the reduction in adverse health impacts including cardiopulmonary mortality, hospitalizations for cardiovascular and respiratory illness, and ER visits for asthma. The scale of emissions from short term construction of infrastructure is expected to be trivial in the context of the total emissions reductions expected from the regulation in the next two decades. For context, staff reviewed a sample of more than 20 CEQA notices for recent medium- and heavy-duty ZEV infrastructure projects funded by CARB and sister agencies and found all of the notices reviewed identified the projects as not having significant impacts on the environment. These ZEV deployments are expected to result in substantial emissions reductions. For instance, the Volvo Low Impact Green Highway Transportation Solutions pilot project description identified the project will deploy 23 Class 8 battery-electric tractors and was expected to result in 3.57 tons of criteria emission reductions and 3,020 metric tons of GHG reductions.[120] Staff estimates that the total number of cases statewide that would be reduced (from 2024 to 2050) from implementation of the proposed regulation are as follows:

- 5,888 cardiopulmonary deaths reduced (4,605 to 7,195, 95 percent confidence interval (CI));
- 932 hospital admissions for cardiovascular illness reduced (0 to 1,828, 95 percent CI);
- 1,113 hospital admissions for respiratory illness reduced (261 to 1,964, 95 percent CI); and
- 2,707 ER visits for asthma reduced (1,713 to 3,702, 95 percent CI).

Table 8 shows the estimated avoided cardiopulmonary mortality, hospitalizations, and ER visits because of the proposed regulation for 2024 through 2050 by California air basin, relative to the Legal Baseline. Note, the proposed regulation will result in additional health benefits beyond what CARB staff has quantified. CARB's current $PM_{2.5}$ mortality and illness evaluation focuses on select air pollutants and health outcomes, and therefore captures only a portion of the health benefits of the proposed regulation. For example, while the current analysis considers the impact of NOx on the formation of secondary $PM_{2.5}$ particles, NOx can also react with other compounds to form ozone, which can cause respiratory problems. The proposed regulation would also result in a decrease of toxic air contaminants emitted from diesel engines, which can cause cancer and other adverse health effects. In addition to the health benefits that are quantified, the proposed regulation would reduce additional cardio and respiratory illnesses, nonfatal and fatal cancers, and lost workdays. Expanding CARB's health evaluation to include any of the above additional health outcomes would allow the

[120] California Air Resources Board, *Fiscal Year 2017-18 Zero- and Near Zero-Emission Freight Facilities Project Solicitation - List of Applications Received and Project Summaries*, 2018 (web link: https://ww2.arb.ca.gov/our-work/programs/low-carbon-transportation-investments-and-air-quality-improvement-program/low, last accessed April 2022)

public to reach a better understanding of the benefits from reducing air pollution by moving toward zero-emission technologies and Staff are updating methodologies that will allow these additional benefits to be quantified in the future.

While this analysis does not further quantify upstream emissions benefits of criteria pollutant reductions, to the degree reduced fuel demand from this rule results in reduced liquid fuel production at California refineries, further benefits would result from criteria pollutant reductions.[121] As noted above, during the COVID-19 pandemic and the stay-at-home orders, there was a drastic reduction in demand for petroleum fuels as residents stayed home. As a result of that reduced demand, several refineries shutdown or announced the repurposing of those facilities to produce low carbon fuels.[122,123] Just as GHG reductions from these sources might be expected to result from corresponding fuel demand reductions from this regulation, criteria and toxic pollution reduction from these sources could similarly occur, further expanding the benefits of these regulations. To be conservative, and in light of the many factors affecting upstream sector behavior, CARB has opted not to include specific reductions here – and even without them very significant health benefits are expected.

The results presented in Table 8 are estimated at a regional scale, at the air basin level. However, it is important to consider that the proposed regulation may decrease the occupational exposure to air pollution of California truck operators and other employees who work around truck traffic. These individuals are likely at higher risks of developing cardiovascular and respiratory issues as a result of medium- and heavy-duty vehicle PM emissions. Although CARB staff cannot quantify the potential effect on occupational exposure, the proposed regulation is expected to provide large health benefits for these types of workers.

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[121] CARB conducted a similar analysis, incorporated here by reference, in a recent SRIA document for the large fuel demand reductions associated with the proposed Advanced Clean Cars 2 Regulation. *See* California Air Resources Board, *Advanced Clean Cars II SRIA*, 2022 (web link: https://www.dof.ca.gov/forecasting/economics/major_regulations/major_regulations_table/documents/ACCII-SRIA.pdf, last accessed January 2022).

[122] Phillips 66, *Phillips 66 Plans to Transform San Francisco Refinery into World's Largest Renewable Fuels Plant, 2020* (web link: https://investor.phillips66.com/financial-information/news-releases/news-release-details/2020/Phillips-66-Plans-to-Transform-San-Francisco-Refinery-into-Worlds-Largest-Renewable-Fuels-Plant/default.aspx, last accessed January 2022).

[123] BiodieselMagazine.com, *Marathon proceeds with renewables conversion at Martinez refinery,* 2021 (web link: https://biodieselmagazine.com/articles/2517427/marathon-proceeds-with-renewables-conversion-at-martinez-refinery, last accessed January 2022)

Table 8. Regional and Statewide Avoided Mortality and Morbidity Incidents from 2024 to 2050 under the Proposed Regulation

Air Basin	**Cardiopulmonary mortality**	**Hospitalizations for cardiovascular illness**	**Hospitalizations for respiratory illness**	**ER visits**
Great Basin Valleys	3 (2 - 4)‡	0 (0 - 1)	0 (0 - 1)	1 (1 - 2)
Lake County	2 (2 - 3)	0 (0 - 0)	0 (0 - 0)	1 (1 - 1)
Lake Tahoe	1 (0 - 1)	0 (0 - 0)	0 (0 - 0)	0 (0 - 0)
Mojave Desert	100 (78 - 122)	15 (0 - 29)	18 (4 - 31)	38 (24 - 52)
Mountain Counties	49 (38 - 60)	5 (0 - 9)	6 (1 - 10)	16 (10 - 22)
North Central Coast	24 (19 - 30)	4 (0 - 8)	5 (1 - 9)	14 (9 - 19)
North Coast	9 (7 - 11)	1 (0 - 2)	1 (0 - 2)	3 (2 - 4)
Northeast Plateau	3 (2 - 3)	0 (0 - 1)	0 (0 - 1)	1 (1 - 2)
Sacramento Valley	258 (202 - 317)	33 (0 - 65)	40 (9 - 70)	96 (61 - 132)
Salton Sea	75 (59 - 92)	11 (0 - 22)	14 (3 - 24)	35 (22 - 48)
San Diego County	241 (188 - 295)	36 (0 - 71)	43 (10 - 77)	95 (60 - 130)
San Francisco Bay	447 (349 - 547)	72 (0 - 142)	86 (20 - 152)	240 (152 - 329)
San Joaquin Valley	1,180 (924 – 1,440)	150 (0 - 295)	180 (42 - 317)	418 (265 - 571)
South Central Coast	66 (52 - 81)	11 (0 - 21)	13 (3 - 22)	28 (18 - 39)
South Coast	3,429 (2,682 – 4,189)	592 (0 – 1,161)	707 (166 – 1,248)	1,721 (1,089 – 2,353)
Statewide*	5,888 (4,605 – 7,195)	932 (0 – 1,828)	1,113 (261 – 1,964)	2,707 (1,713 – 3,702)

*Note: Totals may differ due to rounding

‡ Numbers in parentheses throughout this table represent the 95 percent CI.

2.4.1.3 Monetization of Health Impacts

In accordance with U.S. EPA practice, health outcomes are monetized by multiplying each incident by a standard value derived from economic studies.[124] The value per incident is shown in Table 9. The value for avoided premature mortality is based on willingness to pay, which is a statistical construct based on the aggregated dollar amount that a large group of people would be willing to pay for a reduction in their individual risks of dying in a year.[125] While the cost-savings associated with premature mortality is important to account for in the analysis, the valuation of avoided premature mortality does not correspond to changes in expenditures, and is not included in the macroeconomic modeling. As avoided hospitalizations and ER visits correspond to reductions in household expenditures on health care, these values are included in the macroeconomic modeling.

Unlike mortality valuation, the cost-savings for avoided hospitalizations and ER visits are based on a combination of typical costs associated with hospitalization and the willingness of surveyed individuals to pay to avoid adverse outcomes that occur when hospitalized. These include hospital charges, post-hospitalization medical care, out-of-pocket expenses, lost earnings for both individuals and family members, lost recreation value, and lost household production (e.g., valuation of time-losses from inability to maintain the household or provide childcare).[126] These monetized benefits from avoided hospitalizations and ER visits are included in macroeconomic modeling.

Table 9. Valuation per Incident for Avoided Health Outcomes (2021$)

Outcome	Value per incident
Avoided Premature Mortality	$10,453,897
Avoided Cardiovascular Hospitalizations	$61,750
Avoided Acute Respiratory Hospitalizations	$53,862
Avoided ER Visits	$884

[124] U.S. EPA, *Appendix B: Mortality Risk Valuation Estimates, Guidelines for Preparing Economic Analyses (240-R-10-001)*, 2010 (web link: https://www.epa.gov/sites/default/files/2017-09/documents/ee-0568-22.pdf, last accessed January 2022).
[125] U.S. EPA, *An SAB Report on EPA's White Paper Valuing the Benefits of Fatal Cancer Risk Reduction (EPA-SAB-EEAC-00-013)*, 2000 (web link: https://nepis.epa.gov/Exe/ZyPDF.cgi/P100JOK2.PDF?Dockey=P100JOK2.PDF, last accessed January 2022).
[126] Chestnut, L. G., Thayer, M. A., Lazo, J. K. and Van Den Eeden, S. K., *The Economic Value Of Preventing Respiratory And Cardiovascular Hospitalizations*, Contemporary Economic Policy, 24: 127– 143, 2006 (web link: https://onlinelibrary.wiley.com/doi/abs/10.1093/cep/byj007, last accessed January 2022).

Statewide valuation of health benefits was calculated by multiplying the value per incident by the statewide total number of incidents for 2024-2050 as shown in Table 9. The total statewide health benefits derived from criteria emissions reductions is estimated to be $61.5 billion, with $61.4 billion resulting from reduced premature cardiopulmonary mortality and $0.1 billion resulting from reduced hospitalizations and ER visits. The spatial distribution of these benefits across the state follows the distribution of the health impacts by air basin as described in Table 10.

Table 10. Statewide Valuation from Avoided Health Outcomes (million 2021$)

Year	Avoided cardiopulmonary mortality valuation	Avoided hospitalizations for cardiovascular illness valuation	Avoided hospitalizations for respiratory illness valuation	Avoided ER visits valuation	Annual total valuation*
2024	1	0	0	1	$10.77
2025	3	0	0	2	$32.39
2026	9	1	1	5	$98.23
2027	18	3	3	9	$193.61
2028	26	4	4	13	$275.73
2029	41	6	7	20	$432.01
2030	57	8	10	28	$601.02
2031	76	11	13	36	$794.14
2032	94	14	17	45	$989.50
2033	112	17	20	53	$1,169.06
2034	137	21	25	65	$1,431.12
2035	163	25	30	77	$1,709.71
2036	188	29	35	88	$1,968.64
2037	215	33	40	100	$2,248.33
2038	243	38	45	113	$2,545.07
2039	271	43	51	126	$2,837.83
2040	295	47	56	136	$3,088.09
2041	322	51	61	148	$3,372.84
2042	351	56	67	161	$3,679.86
2043	360	57	68	165	$3,773.05
2044	370	59	70	169	$3,875.60
2045	384	62	73	175	$4,025.37
2046	399	64	77	181	$4,180.37
2047	414	67	80	188	$4,337.03
2048	430	70	83	195	$4,501.78
2049	446	73	87	202	$4,667.35
2050	461	75	90	208	$4,830.20
Total Benefit*	**$61,360.4**	**$57.6**	**$59.8**	**$2.4**	**$61,668.71**

*Note: Totals may differ due to rounding

2.4.2 Other Benefits

In addition to emissions reductions, ZEVs offer a number of other benefits to truck operators when compared to gasoline and diesel vehicles. ZEVs are quieter and have a smoother ride than ICE vehicles, and they reduce noise at the worksite as well as in the community where the vehicles operate.

3 Direct Costs

The proposed regulation would require fleets to replace their gasoline, diesel, natural gas, and other ICE vehicles with medium- and heavy-duty ZEVs. Staff assumes the costs to California includes the upfront capital costs for the ZEVs and their associated infrastructure, changes to operating expenses, and other cost elements associated with this technology transition. This approach shows the full estimated cost to California for deploying the number of ZEVs as required by the regulation.

3.1 Direct Cost Inputs

The estimated direct costs from the proposed regulation and the Legal Baseline scenario include upfront capital costs of the vehicles, infrastructure, and ongoing operating costs which include fueling, maintenance, and LCFS revenues where applicable. Compared to gasoline, diesel, or natural gas vehicles, ZEVs generally have higher upfront capital costs today but lower operating costs, which results in an overall savings in staff's analysis over the useful life of the vehicles.

Currently, there are a number of rebate and voucher programs in California that offset some or all of the incremental costs for ZEVs and supporting infrastructure; however, none of these incentives are included in the cost analysis due to uncertainty as to which fleets may utilize funding and uncertainty in ongoing funding. Separate from CARB's incentive programs, the LCFS regulation is a market-based regulatory program that allows some fleets that dispense low carbon fuels to generate credits and sell them on the open market to generate revenue. Because of the regulatory certainty associated with LCFS regulation, staff models credit revenue from the LCFS regulation for those who own and operate charging or hydrogen fueling stations. For retail stations, staff assumes a small portion of the LCFS credit value that reflects the difference in light-duty and heavy-duty credit value is passed through to the fleet. The assumptions underlying the direct costs are detailed in the following sections.

3.1.1 Vehicle Population

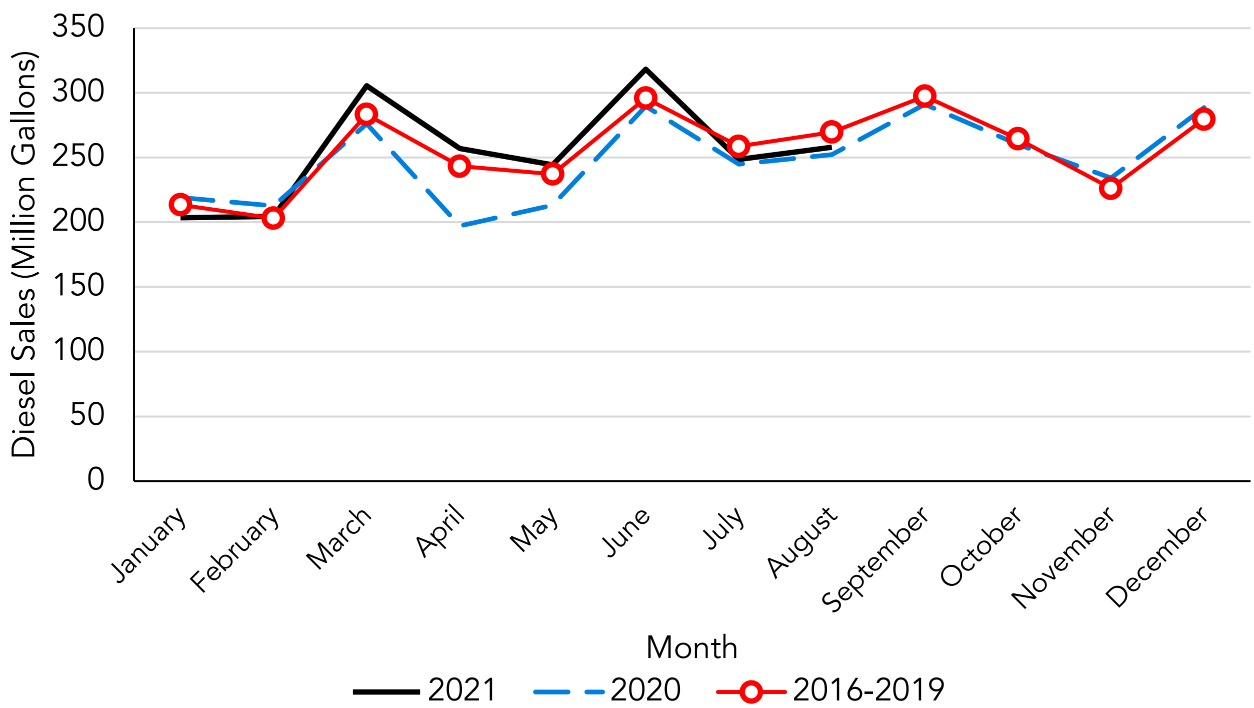
In this analysis, all estimates for annual California population and sales come from CARB's EMFAC 2021 inventory model.[127] The EMFAC model is developed and used by CARB to assess emissions from on-road vehicles including cars, trucks, and buses in California, and to support CARB's regulatory and air quality planning efforts to meet the Federal Highway Administration's transportation planning requirements. U.S. EPA approves EMFAC for use in SIP and transportation conformity analyses. It includes vehicle population growth, mileage accrual rates over time, vehicle fuel usage and associated emissions factors, and vehicle attrition over time.

Staff analyzed the impacts of COVID-19 on the trucking industry during development of EMFAC 2021 and as part of this analysis. Diesel fuel sales are a data surrogate to estimate

[127] California Air Resources Board, *EMFAC 2021 Web Database*, 2021 (web link: https://arb.ca.gov/emfac/emissions-inventory/, last accessed January 2022).

diesel VMT and illustrate the general trends present in the trucking market. Data from the California Department of Tax and Fee Administration is displayed in Figure 5.[128] It shows that diesel fuel sales dropped dramatically in April 2020 and remained depressed through the second quarter of 2020. Afterwards, diesel fuel sales rebounded and returned to normal trends by the end of the year. These trends indicate that diesel fuel sales and the trucking industry were not as impacted by the COVID-19 pandemic as other parts of the economy and the general trends forecasted within EMFAC 2021 remains appropriate for the purpose of this analysis.

Figure 5. Diesel Sales Data for 2021 and 2020 Versus 2016 Through 2019



The proposed regulation affects a subset of the total California Class 2b-8 vehicle population. Staff used data sources including CARB's EMFAC 2021 model, DMV registration data, the Drayage Truck Registry, and financial information from Dun and Bradstreet to determine which vehicles would be subject to the proposed regulation.

Public fleet population estimates are derived from DMV information. Vehicles registered in DMV with an exempt plate were assumed to be owned by public fleets. Staff estimates that roughly 128,000 trucks and buses would be subject to the proposed public fleet requirements by 2024.

To estimate the number of vehicles subject to the drayage truck requirements, staff used the data from the CARB Drayage Truck Registry and the seaports and railyards to estimate the

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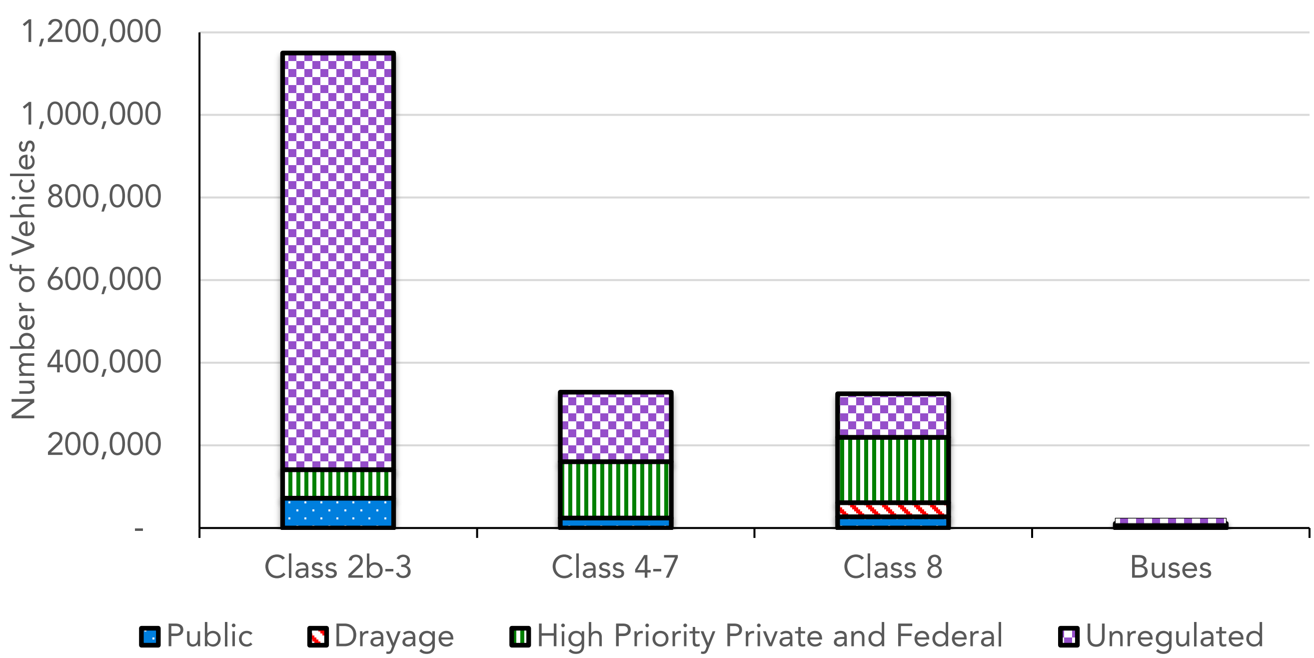
[128] California Department of Tax and Fee Administration, *Taxable Diesel Gallons 10 Year Report*, 2021 (web link: https://www.cdtfa.ca.gov/taxes-and-fees/Diesel-10-Year-Report.xlsx, last accessed December 2021).

number of drayage trucks actively operating in California. Staff assumed a truck to be a part of the active fleet if they visited an average of 2 times per week. Staff estimates that approximately 34,000 trucks would be subject to the proposed drayage truck requirements by 2024.

To identify vehicles subject to the high priority and federal fleet requirement, staff first used DMV and International Registration Plan data to identify fleets with 50 or more vehicles. Staff then used Dun and Bradstreet data to determine California locations owned by businesses with greater than $50 million in annual revenue and, then used this data to match up locations owned by these businesses with vehicles registered at these locations in DMV. The data received from the ACT Large Entity Reporting requirement aligns with the results derived from this methodology. Staff estimated the number of vehicles under common ownership and control based on data collected in the ACT One-Time Large Entity Reporting survey to be an additional 20 percent of the high priority fleet. This data was applied to EMFAC population numbers to create projections for this analysis. Figure 6 summarizes the projected proportion of vehicles subject to the proposed regulation in four groups versus the total vehicle population in each group. Generally, vehicles in the Class 2b-3 group include pickup truck and vans that are owned by individuals and small businesses who would not be subject to the proposed regulation. Although the Class 2b-3 category has the highest number of vehicles, the proposed regulation would include the majority of heavier vehicles operating in California. These heavier Class 4-8 vehicles make up only 36 percent of the total medium- and heavy-duty fleet but produce 74 percent of NOx emissions and 75 percent of GHG emissions. Buses shown in the figure exclude transit buses.

Figure 6. Regulated Vehicles Versus Total Population in 2024



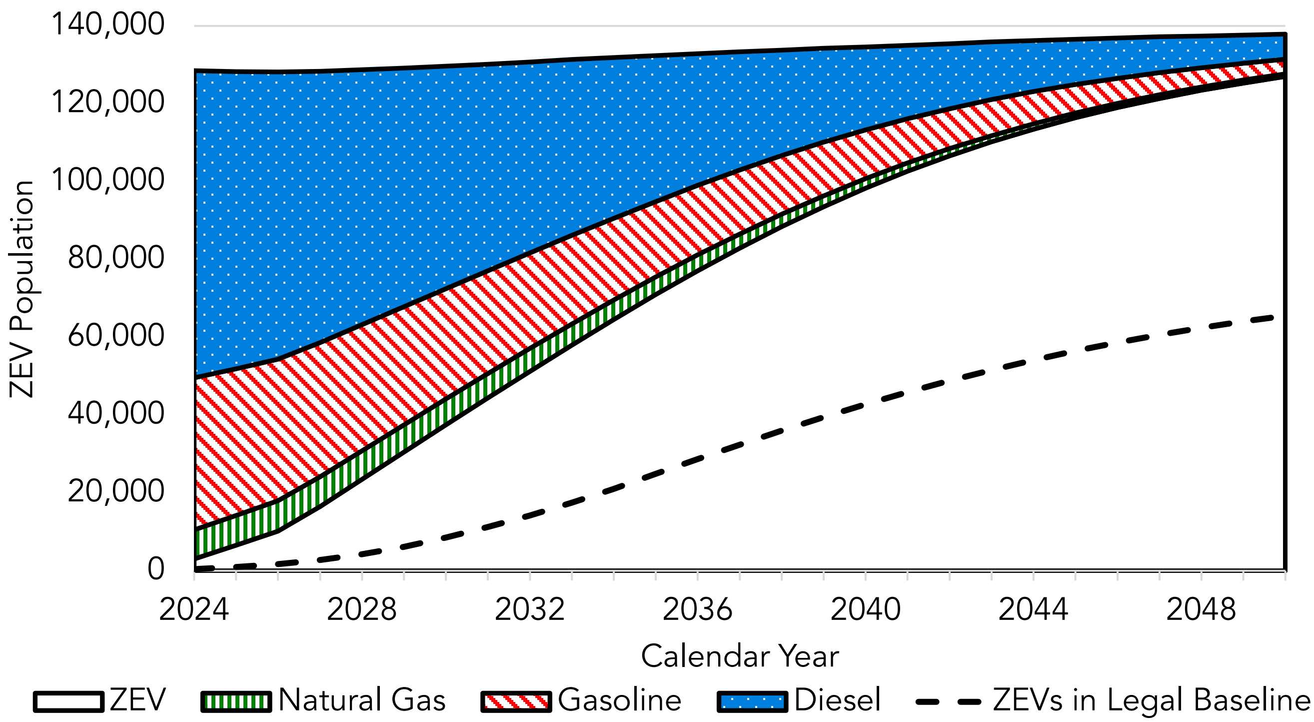
To calculate the public fleet technology mixture over time, the percentage schedules shown below in Table 11 are applied to the projected public fleet sales numbers to calculate the number of medium- and heavy-duty ZEVs purchased per year. Staff estimates that 3 percent of public fleets operate in the designated low population counties and 97 percent operate elsewhere.

Table 11. Public Fleets ZEV Purchase Schedule

Model Year	Designated Counties	All Other Counties
2024-2026	0	50%
2027+	100%	100%

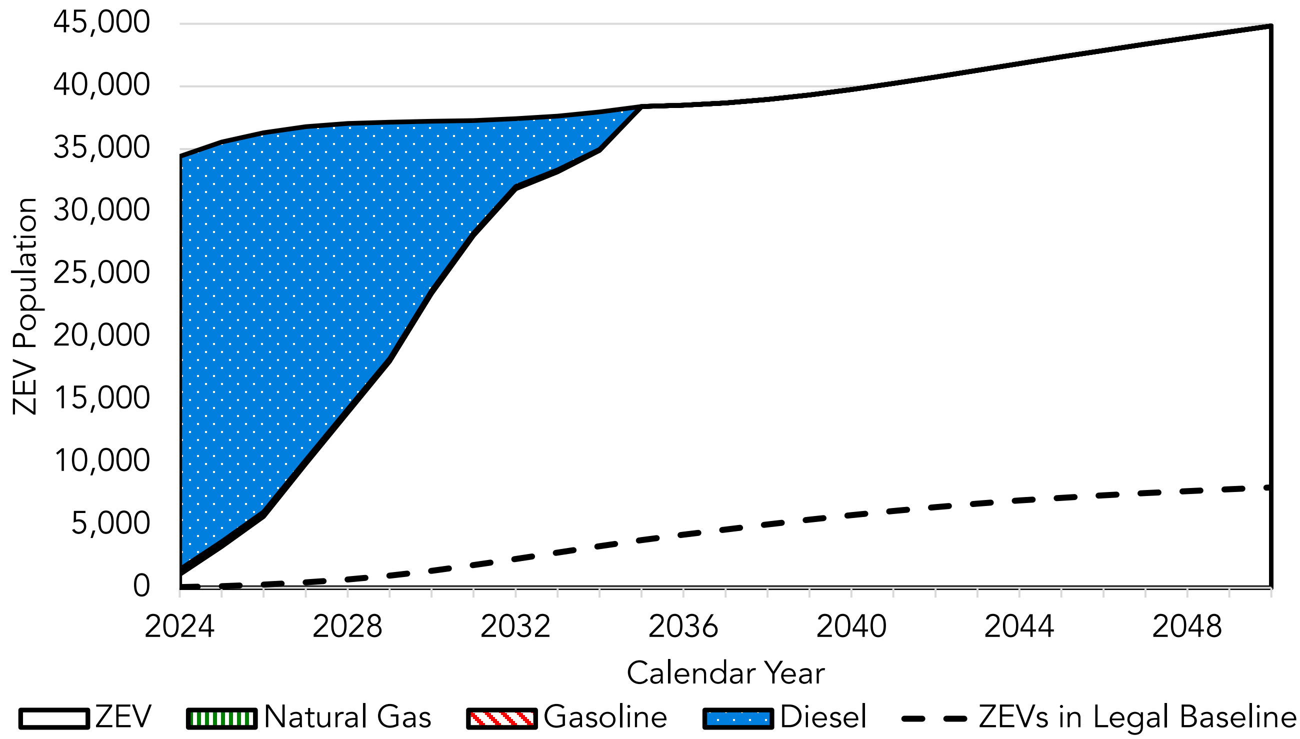
Figure 7 illustrates the projected public fleet population over time by technology type using these inputs versus the medium- and heavy-duty ZEV population in the Legal Baseline scenario.

Figure 7. Projected Public Fleet Population with the Proposed Regulation



To calculate the drayage truck technology mixture over time, staff assumed all additions to the drayage truck population beginning in 2024 would be ZEVs. Combustion-powered vehicles would leave the drayage truck inventory when they reach 800,000 miles which would typically be when the vehicle is 15-years-old based on mileage data. Figure 8 illustrates the projected drayage fleet population over time by technology type using these inputs versus the medium- and heavy-duty ZEV population in the Legal Baseline scenario. The natural gas population is under 300 vehicles in 2023 and is difficult to see on the figure. This figure includes drayage trucks operating at seaports as well as railyards.

Figure 8. Projected Drayage Truck Population with the Proposed Regulation



For the high priority and federal fleet requirements, vehicles would be subject to different phase-in schedules based on the vehicle body type. Table 12 outlines the medium- and heavy-duty ZEV percentage requirements for the three groups. Work trucks are single-unit trucks except for specialty vehicles and vehicles already included in Group 1. A specialty vehicle is a fairly uncommon Class 8 vocational vehicle that either: has a heavy front axle, has a unique custom-built chassis, or is designed to perform work while stationary with an auxiliary device which is integral to the vehicle's design (e.g. a boom truck or digger derrick). For the emissions and costs analysis, fleet ZEV percentages are interpolated in years between regulatory requirements. All high priority fleets are assumed to meet the phase-in schedule as the portion of fleets utilizing either the alternative compliance pathway or exemptions is expected to be negligible. Figure 9 illustrates the estimated 2023 population of vehicles in each vehicle category and vehicle group.

Table 12. High Priority and Federal Fleet Percentage Schedule

Group	**Vehicle Type**	**10%**	**25%**	**50%**	**75%**	**100%**
1	Box trucks, vans, two-axle buses, yard trucks	2025	2028	2031	2033	2035

Group	**Vehicle Type**	**10%**	**25%**	**50%**	**75%**	**100%**
2	Work trucks, day cab tractors, three-axle buses	2027	2030	2033	2036	2039
3	Sleeper cab tractors and specialty vehicles	2030	2033	2036	2039	2042

Figure 9. Estimated Number of Vehicles per Vehicle Category and High Priority and Federal Fleet Grouping in 2024

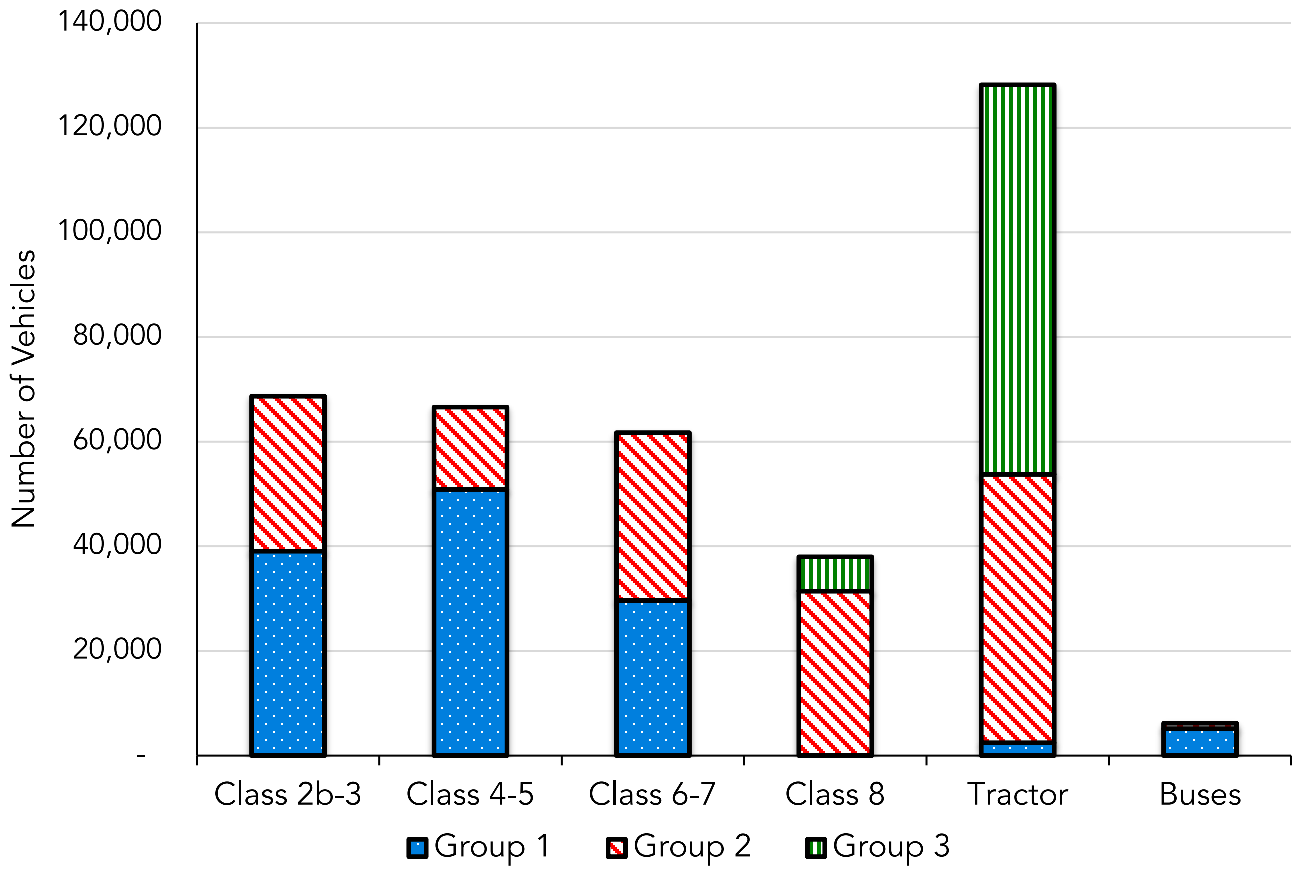
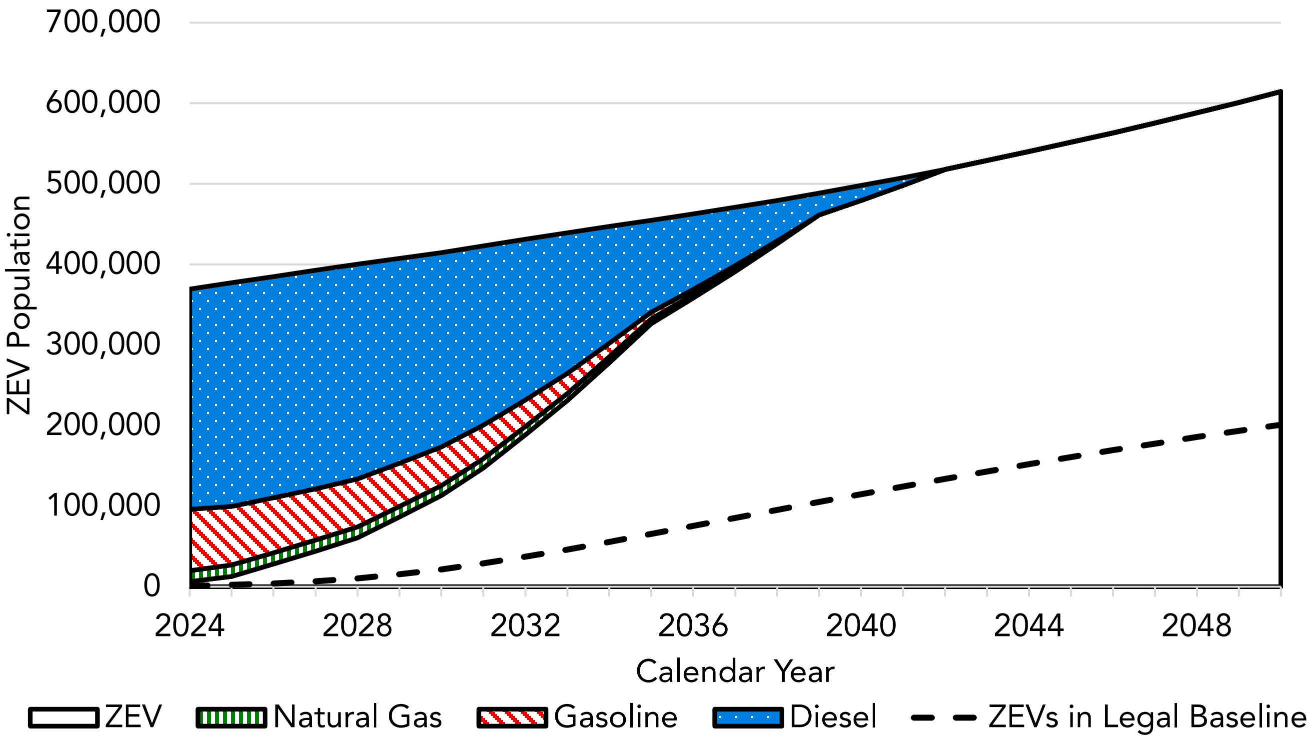


Figure 10 illustrates the projected high priority and federal fleet population over time by technology type using these inputs.

Figure 10. High Priority and Federal Fleet Population with the Proposed Regulation



All 2040 model year and newer vehicles are assumed to be ZEVs. Nearly all new vehicles operating within California are originally sold in California; however, staff modelled that more used vehicles originally sold outside California will begin entering the state and will be purchased by regulated fleets. Table 13 shows what portion of vehicles are assumed to be originally sold in California based on their age.[129] This data was gathered using first sold data from California DMV. Instate buses and Class 2b-3 vehicles are assumed to all be sold in California, while out-of-state tractors are assumed to have all been sold outside of California. Most other vehicles newly registered in California are assumed to be purchased in California, but this fraction drops over time showing that more used trucks are being newly registered in California. For example, in 2040, 89.0 percent of 2040 model year Class 8 tractors registered within California are assumed to have been sold in California. By 2045, this fraction drops to 45.87 percent of Class 8 tractors.

Table 13. Percentage of California Registered Vehicles Originally Sold in California

Age	Class 4-6 Vocational	Class 7 Vocational	Class 8 Vocational	Class 7 Tractor	Class 8 Tractor
-1 or 0	90.97%	85.01%	89.78%	84.31%	89.00%

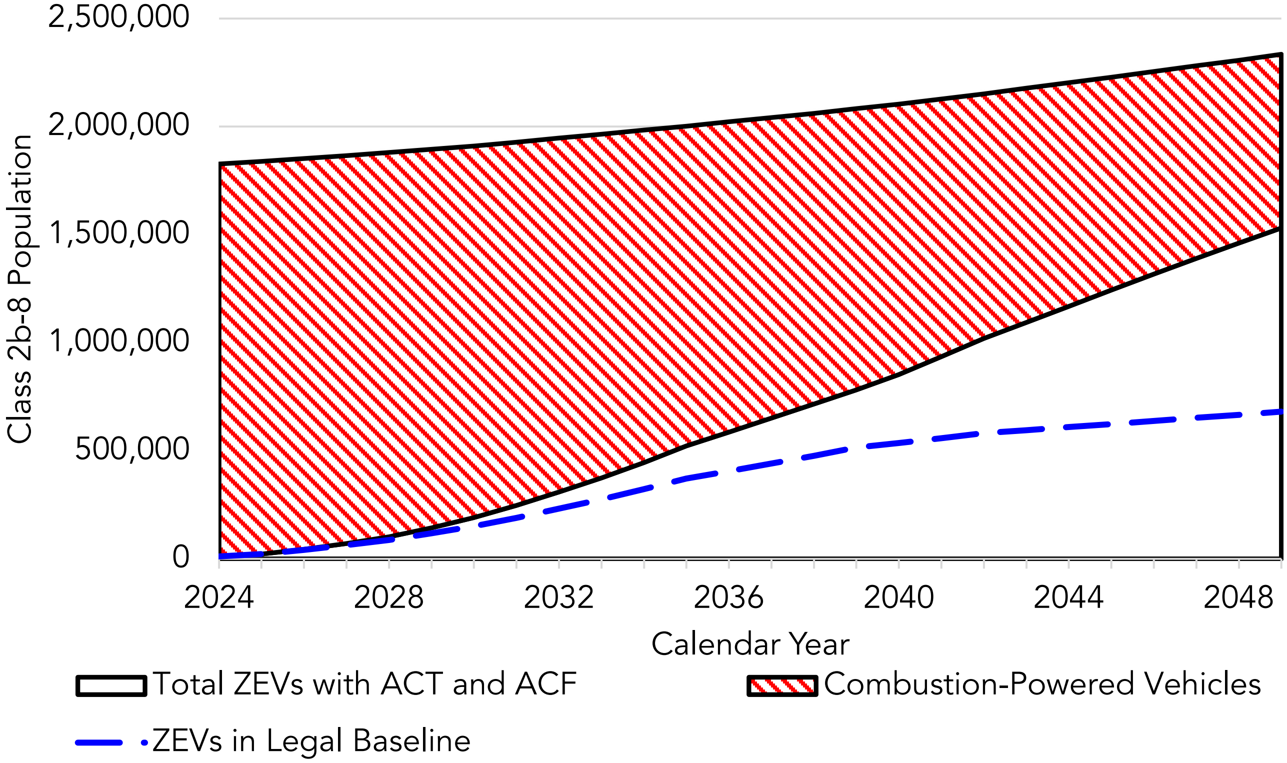
[129] California Air Resources Board, *Appendix F: Emissions Inventory Methods and Results for the Proposed Advanced Clean Trucks Regulation*, 2019 (web link: https://ww2.arb.ca.gov/sites/default/files/barcu/regact/2019/act2019/appf.pdf, last accessed January 2022).

Age	**Class 4-6 Vocational**	**Class 7 Vocational**	**Class 8 Vocational**	**Class 7 Tractor**	**Class 8 Tractor**
1	88.38%	80.35%	85.80%	82.10%	86.61%
2	85.68%	76.22%	81.86%	76.91%	79.17%
3	83.07%	72.74%	78.34%	69.92%	68.61%
4	80.74%	70.02%	75.59%	62.30%	56.87%
5	78.90%	68.18%	74.00%	55.25%	45.87%
6	77.76%	67.35%	73.92%	49.92%	37.55%
7+	77.50%	67.35%	73.92%	47.51%	33.85%

Staff are not anticipating a prebuy situation beyond what is already expected with the Truck and Bus regulation. Most fleets that would be subject to the proposed regulation are already subject to the Truck and Bus regulation. The Truck and Bus regulation requires significant turnover to 2010 or newer diesel engines prior to 2023 and accelerates vehicle purchases beyond what would be expected without that regulation. The accelerated purchases due to the Truck and Bus regulation is expected to reduce medium- and heavy-duty diesel vehicle purchases in the following years as trucks in the fleet will be newer than is typical for some fleets. This shift in fleet behavior is included in the baseline EMFAC modelling assumptions. In addition, staff are also aware of the current worldwide supply chain delays that would also dampen any short-term prebuy effects due to limited production capability from manufacturers in the immediate future.

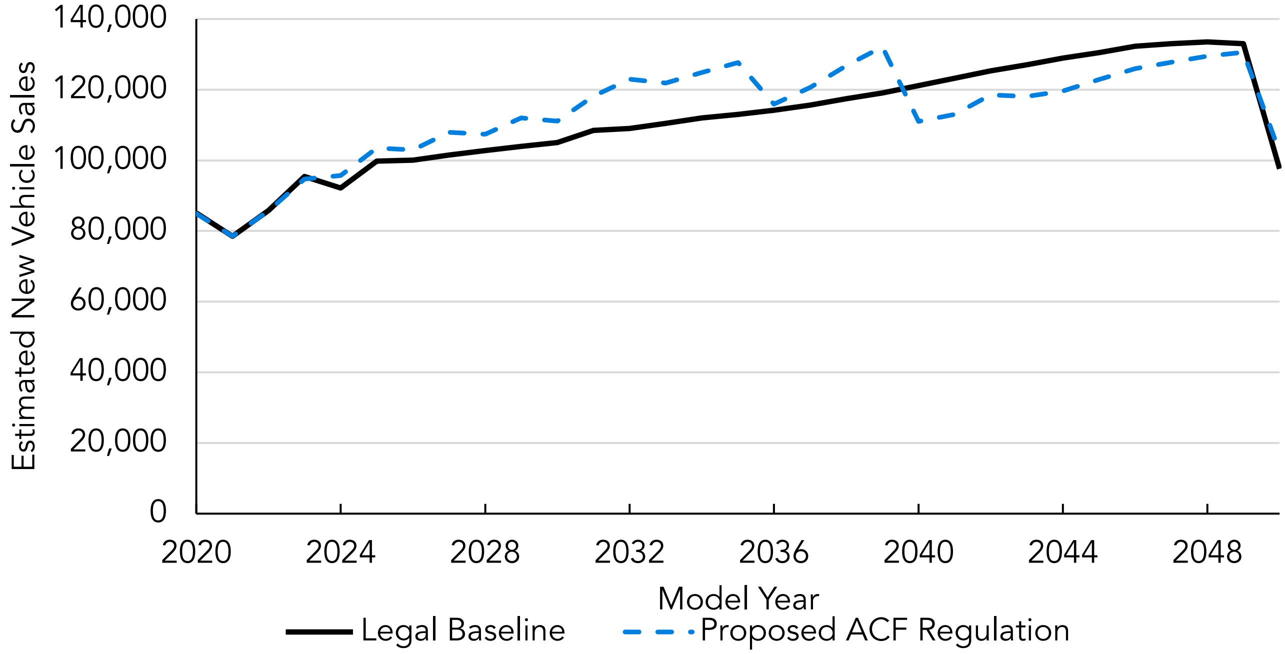
The proposed regulation is designed to complement the ACT regulation's requirement that manufacturers produce and sell increasing numbers of ZEVs in California. Figure 11 illustrates the net result of the 2 policies as well as the number of medium- and heavy-duty ZEVs each regulation would have achieved by itself. Generally, the proposed regulation by itself would be expected to result in more ZEVs deployed than the adopted ACT regulation. Because ZEV sales are not all expected to be purchased by the fleets regulated under the proposed regulation, the combination of the 2 would be expected to result in greater ZEV sales than each regulation achieves on its own. As a result, the proposed regulation would be expected to increase the number of medium- and heavy-duty ZEVs beyond existing regulations from about 320,000 to about 520,000 by 2035, from about 775,000 to about 1,250,000 ZEVs by 2045, and from about 950,000 to about 1,600,000 ZEVs by 2050.

Figure 11. Statewide Population Forecast with the Proposed Regulation



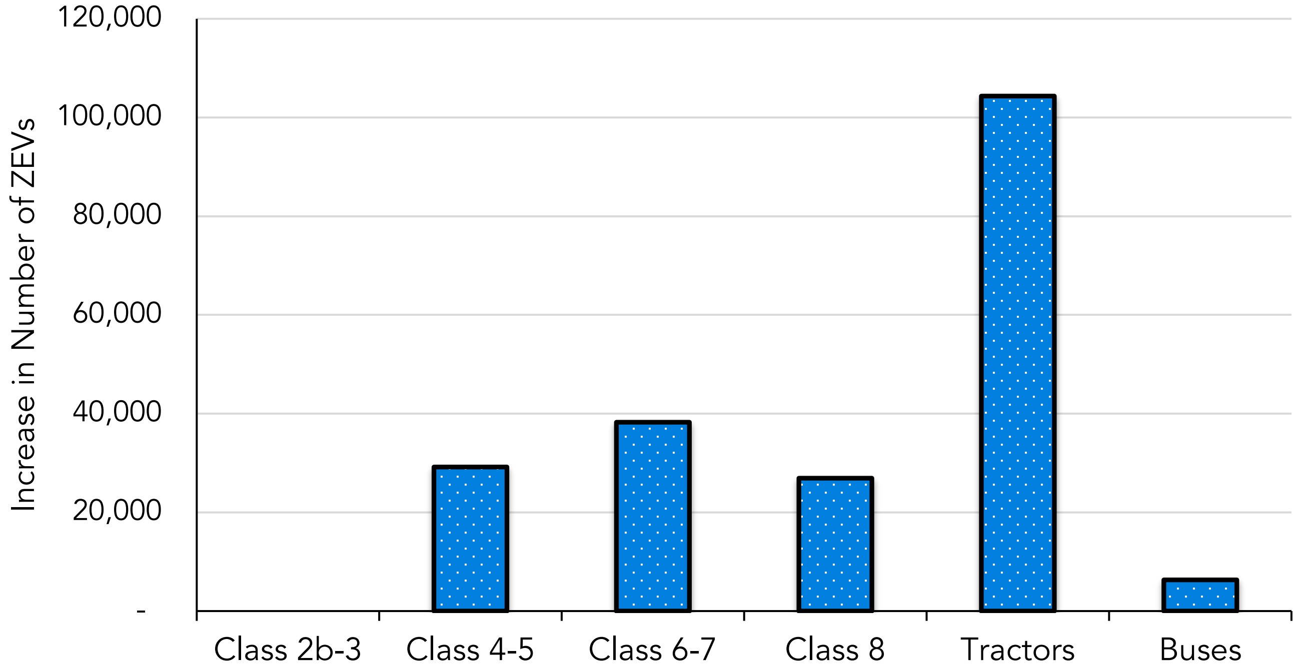
The proposed regulation will result in changes to vehicle purchasing behavior. Because ZEVs are a newly commercial technology, fleets will not be able to purchase used ZEVs for a significant period of time. The regulation will also require some fleets to purchase vehicles quicker than their baseline replacement rate to keep up with regulatory milestones. As a result, the proposed regulation is expected to increase new vehicle purchases by fleets. Figure 12 illustrates the projected sales per model year in the baseline and under the proposed regulation. The number of new vehicle sales increases from 2024 to 2039 due to implementation of the high priority and drayage requirements. New vehicle sales are projected decline after 2040 when the phase-in for Group 2 vehicles end before rebounding to their baseline value near 2050.

Figure 12. Estimated New Vehicle Sales per Model Year



The increase in ZEVs deployed varies depending on the type of vehicles. The ACT regulation is projected to result in the largest portion of ZEVs deployed in the Class 2b-3 vehicle group and relatively fewer tractors based on that regulation's requirements and estimated sales numbers. The proposed regulation generally places higher requirements on heavier vehicle classes, especially tractors, as noted previously in Figure 9. Figure 13 illustrates the expected increase in number of ZEVs by vehicle grouping in 2035.

Figure 13. Estimated Increase in ZEVs by Vehicle Category in 2035



Staff simplified the inventory analysis to use for cost modelling to better match inventory categories with cost information. The vehicle categories in EMFAC were grouped into the following vehicle categories:

- Class 2b-3 trucks (GVWR between 8,501 and 14,000 lbs.) representing heavy-duty pickup trucks, cargo vans, and passenger vans;
- Class 4-5 trucks (GVWR between 14,001 and 19,500 lbs.) representing lighter delivery vans and service trucks;
- Class 6-7 single-unit trucks (GVWR between 19,501 and 33,000 lbs.) representing heavier delivery vans, bucket trucks, and others;
- Class 8 single-unit trucks (GVWR above 33,001 lbs.) representing a wide variety of heavy-duty vehicles including dump trucks, construction equipment, and others;
- Solid waste collection vehicles (SWCV) refer to refuse trucks used for urban waste pickup and collection;
- Tractor-trailers representing day cab tractors typically used for drayage and short to regional haul operation as well as sleeper cab tractors used for long-haul trucking; and
- Buses representing primarily cutaway shuttles and motorcoaches.

For each component of the proposed regulation, staff assigned a representative vehicle for each vehicle category to calculate costs. Table 14, Table 15, and Table 16 display the different regulatory components and vehicle categories and what representative vehicle was used for that grouping.

Table 14. Public Fleet Vehicle Assumptions

Vehicle Category	Representative Vehicle
Class 2b-3	Class 3 Service Truck
Class 4-5	Class 5 Service Truck
Class 6-7	Class 6 Bucket Truck
Class 8	Class 8 Dump Truck
SWCV	Class 8 Refuse Packer
Buses	Class 5 Cutaway Shuttle

Table 15. Drayage Fleet Vehicle Assumptions

Vehicle Category	Representative Vehicle
Tractors	Class 8 Day Cab Tractor

Table 16. High Priority Fleet Vehicle Assumptions

Vehicle Category	Representative Vehicle
Group 1 - Class 2b-3	Class 2b Cargo Van
Group 1 - Class 4-5	Class 5 Walk-in Van
Group 1 - Class 6-7	Class 6 Box Truck
Group 1 - Buses	Class 5 Cutaway Shuttle
Group 1 – Yard Tractor	Class 8 Yard Tractor
Group 2 – Class 2b-3	Class 2b Pickup
Group 2 – Class 4-5	Class 5 Service Truck
Group 2 – Class 6-7	Class 6 Bucket Truck
Group 2 – Class 8	Class 8 Dump Truck
Group 2 – SWCV	Class 8 Refuse Packer
Group 2 – Buses	Class 8 Motorcoach
Group 2 – Tractors	Class 8 Day Cab Tractor
Group 3 – Tractors	Class 8 Sleeper Cab Tractor
Group 3 – Specialty	Class 8 Bucket Truck

Throughout the body of the document, staff will refer to the cost elements of sample vehicles from the list above rather than all vehicles for brevity. A list of all vehicle-specific cost elements used in this analysis is provided in Section 8 Vehicle Cost Attributes Appendix.

3.1.2 Technology Mix Projections

Fleets purchase trucks powered by a variety of fuels – most commonly gasoline or diesel, and relatively low volumes of compressed natural gas, liquid natural gas, propane, E85, and other fuels. In staff's assumed Legal Baseline conditions, for simplification, Class 2b-3 vehicles and buses are split between gasoline- and diesel-powered based on existing assumptions within the EMFAC database. Class 4-8 vehicles are generally treated as diesel-powered with the exception of refuse trucks and tractors where a small portion are modelled to be natural gas powered. Based on EMFAC data, roughly 10 percent of Class 4-8 vehicles use a fuel other than diesel, mainly gasoline.

Under the proposed regulation, fleets are anticipated to meet their medium- and heavy-duty ZEV requirements using a combination of BEVs and FCEVs. Additionally, the public fleet and high priority and federal fleet requirements can partly be met with NZEV technologies like PHEVs prior to 2035. It is somewhat challenging to predict which ZE technologies fleets would use for complying with the proposed regulation, especially as battery and fuel cell technologies have different characteristics and change as such technologies continue to advance, and costs continue to decline. Generally, FCEVs commonly have shorter refueling times and are expected to have less sensitivity to weight concerns in long range applications when compared to a battery-electric counterpart. BEVs can offer greater fuel cost-savings, especially for overnight charging, as electricity is generally a lower cost fuel compared to gasoline, diesel, natural gas, and hydrogen in a return to base duty cycle with sufficient dwell time to recharge the vehicles.

Based on expected manufacturer product availability and vehicle suitability analyses, staff assumes that fleets would comply with the proposed regulation with a combination of battery-electric and fuel cell technologies. Currently, a wide variety of battery-electric trucks in all weight classes and configurations are commercially available. There are several commercially available battery-electric tractors now and limited small-scale deployments of fuel cell electric tractors by several small and major truck manufacturers. Based on manufacturer announcements, the majority of tractors commercially launched within the immediate future will be battery-electric. Manufacturers are simultaneously making investments into fuel cell electric technologies leading to commercialization in the latter half of the decade. As a result, staff is assuming 10 percent of day cab tractors will be FCEV until 2027 and 25 percent afterwards.

For sleeper cab tractors, staff is assuming an even 50:50 split between BEVs and FCEVs as they are phased in to meet 2030 compliance requirements. Both technologies face similar issues where a network of publicly accessible infrastructure is necessary to enable long-distance transportation throughout California and outside the state. For all other vehicles, staff is assuming all purchases would be battery-electric until 2026, purchases starting in 2027 onward would be 90 percent BEV and 10 percent FCEV. Currently, there are a number of medium- and heavy-duty FCEVs being demonstrated but it remains somewhat uncertain on when manufacturers will commercially release FCEVs and in which market segments they would be preferred over other technologies. Staff foresees a portion would be fuel cell powered, but up to this point BEV technologies appear preferred for these segments which do not have high range or payload needs.

Although NZEVs are expected to have a lower upfront cost per vehicle than full ZEVs, they still require charging infrastructure and would not have as significant operational cost-savings as BEVs or FCEVs. They are not modeled in the analysis as they are expected to play a transitional role in limited use cases as existing BEVs already meet most fleet needs.

Table 17 outlines the technology assumptions for each vehicle group in the cost analysis. The Legal Baseline scenario and ACF Proposal scenario use the same technology distribution, but the number of ZEVs and combustion-powered vehicles will differ between the two scenarios.

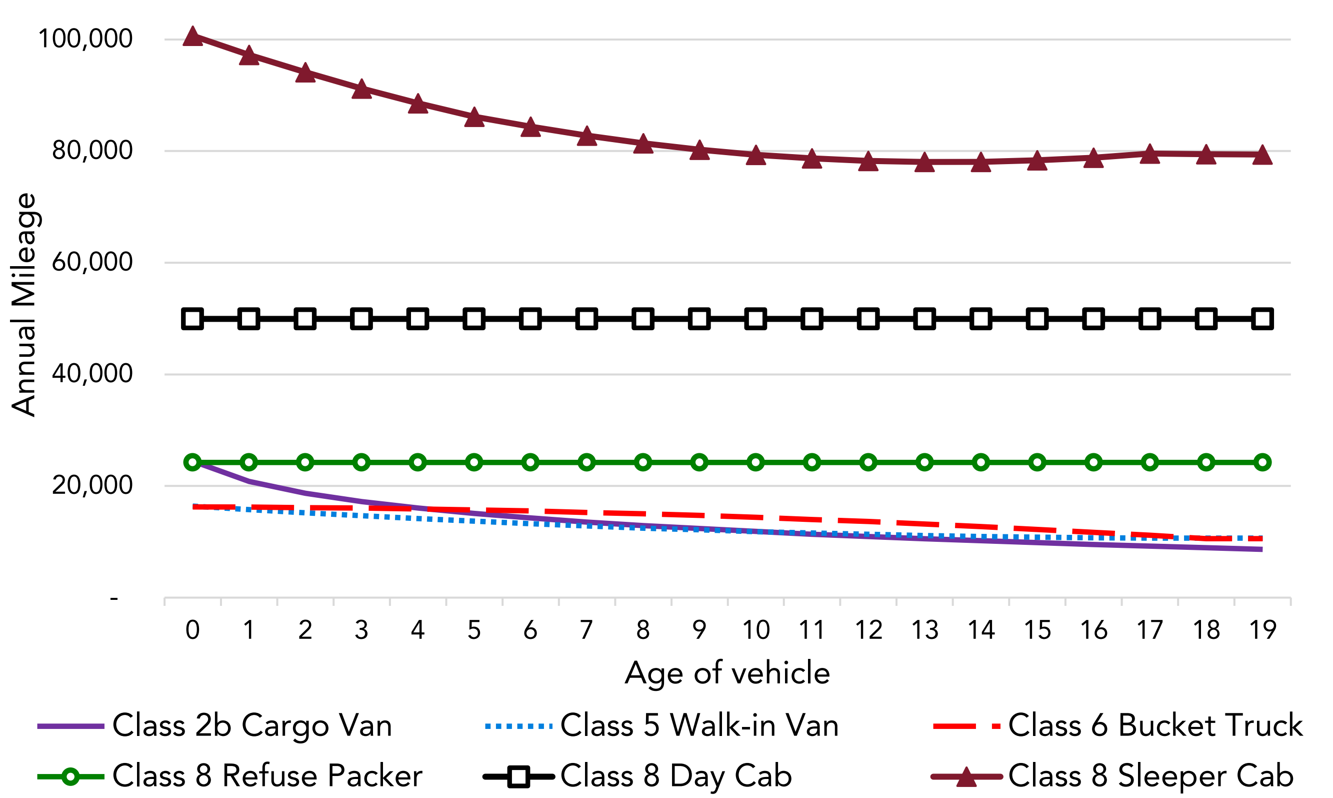
Table 17. Vehicle Groups and Technologies in the Cost Analysis

Vehicle Group	Technology Types
Class 2b-3	Diesel, Gasoline, BEV, FCEV
Class 4-5	Diesel, BEV, FCEV
Class 6-7	Diesel, BEV, FCEV
Class 8	Diesel, BEV, FCEV
SWCV	Diesel, Natural Gas, BEV, FCEV
Class 7-8 Tractor	Diesel, Natural Gas, BEV, FCEV
Buses	Diesel, Gasoline, BEV, FCEV

3.1.3 Annual Mileage

Annual mileage factors into a number of costs in this analysis including battery size, fuel costs, maintenance, and LCFS revenue. All annual mileage assumptions are based on EMFAC inventory estimates as representative of a typical vehicle within the category. For most vehicle categories, annual mileage is highest for newer vehicles and drops over time as the vehicle ages. EMFAC data was matched to the different representative vehicles. Figure 14 illustrates the accrual rates for a set of sample vehicles. Mileage accrual assumptions for all representative vehicles are listed in the Vehicle Attribute Appendix.

Figure 14. Sample Annual Mileage Accrual Rates by Vehicle and Age



Staff has modeled an additional power take off operation by the Class 8 specialty vehicles by assuming an effective 50 percent increase in annual mileage as a surrogate for fuel use during stationary operation. A corresponding increase in battery size is modeled and is discuss later.

Staff assumes ZEVs will travel the same distance as their combustion-powered counterparts. As shown in Figure 14, the majority of single-unit trucks such as walk-in vans and refuse trucks travel under 25,000 miles per year which represents 100 miles per day. Most medium- and heavy-duty ZEVs available today can achieve this threshold and future product launches advertise higher range options. For tractors, the majority of in-state tractors travel below 200 miles per day. Manufacturers including Freightliner, Volvo, Tesla, and others have announced ZE tractor launches in 2022-2023 which would be capable of meeting these needs. As technology improves and publicly available infrastructure is built, staff anticipates fleets would be able to manage their fleets and introduce ZEVs where they are suitable to meet their daily needs. This transition to ZEV technology would occur over the course of the next one to two decades which would provide sufficient time for all vehicle types to transition to ZEV technology and perform the same duty cycle.

3.1.4 Upfront Costs

Fleets are the regulated party in the proposed regulation and would need to make upfront investments in vehicles, infrastructure, and other costs in order to comply with the proposed regulation's requirements.

3.1.4.1 New and Used Vehicle Prices

This section covers the cost to the fleet of purchasing a vehicle. Today and for the foreseeable future, purchases of most BEVs and FCEVs will cost more than their combustion-powered counterparts. Declining battery and component costs in addition to economies of scale are expected to lower the incremental costs of ZEVs as the market expands.

Base gasoline and diesel new vehicle prices are based on averages of new 2020 model year prices from manufacturers' websites and online truck marketplaces collected in early 2021. [130] New natural gas vehicle prices are derived from sources which estimate the incremental cost of upfitting a gasoline or diesel-powered vehicle to run on natural gas. Table 18 displays sample new vehicle retail prices for a variety of applications and technology types.

Table 18. Sample New Combustion-Powered Vehicle Prices

Vehicle Group	Vehicle Price
Class 2b Cargo Van – Gasoline	$35,000
Class 2b Cargo Van – Diesel	$39,000
Class 5 Walk-in Van – Diesel	$87,000
Class 6 Bucket Truck – Diesel	$126,000
Class 8 Refuse Packer – Diesel	$226,000
Class 8 Refuse Packer – Natural Gas	$256,295
Class 8 Day Cab – Diesel	$130,000
Class 8 Day Cab – Natural Gas	$180,000
Class 8 Sleeper Cab – Diesel	$140,000
Class 8 Sleeper Cab – Natural Gas	$230,000

[130] California Air Resources Board, New Vehicle Cost Analysis, 2021.

The Federal and California Phase 2 GHG regulations require manufacturers to build trucks that have lower GHG emissions than existing models. These requirements start in 2021 MY and ramp up through the 2027 MY. U.S. EPA estimated the cost per vehicle to comply with the federal Phase 2 GHG regulation shown in Table 19.[131] These costs are added to the base cost of combustion-powered vehicles. Because ZEVs produce zero tailpipe emissions, they do not incur increased costs due to the Phase 2 GHG regulation.

Table 19. U.S. EPA Phase 2 GHG Incremental Compliance Costs

Phase 2 Category	2021-2023 MY	2024-2026 MY	2027+ MY
Class 2b-3 Pickup/Van	$524	$963	$1,364
Vocational Vehicles	$1,110	$2,022	$2,662
Tractors	$6,484	$10,101	$12,442

The Heavy-Duty Omnibus rulemaking is a multi-pronged, holistic approach to decrease emissions of new heavy-duty engines sold in California beginning in the 2024 MY. The regulation lowers NOx emissions by lowering tailpipe NOx standards, establishing a new low-load test cycle to ensure emissions reductions are occurring in all modes of operation, strengthening durability, lengthening warranty and useful life, and in-use testing provisions, along with other measures. The costs to a typical fleet purchasing combustion-powered vehicles based on the certification type and the MY is shown in Table 20.[132] These costs are added to the base cost of combustion-powered vehicles, but do not change the cost for ZEVs because they do not have combustion engines and have zero tailpipe emissions. The costs associated with the Heavy-Duty Omnibus regulation are included in the Legal Baseline.

Table 20. Heavy-Duty Omnibus Estimated Increase in Purchase Price

Vehicle Category	Corresponding Weight Class	2024-2026 MY	2027-2030 MY	2031+ MY
Medium-Duty Diesel	Class 3	$1,554	$3,916	$4,354
Medium-Duty Otto	Class 3	$412	$412	$412

[131] United States Environmental Protection Agency, *Final Rule for Greenhouse Gas Emissions and Fuel Efficiency Standards for Medium- and Heavy-Duty Engines and Vehicles - Phase 2*, 2016 (web link: https://www.govinfo.gov/content/pkg/FR-2016-10-25/pdf/2016-21203.pdf, last accessed January 2022).
[132] California Air Resources Board, *Public Hearing to Consider the Proposed Heavy-Duty Engine and Vehicle Omnibus Regulation and Associated Amendments – Staff Report: Initial Statement of Reasons*, 2020 (web link: https://ww3.arb.ca.gov/regact/2020/hdomnibuslownox/isor.pdf, , last accessed January 2022).

Vehicle Category	Corresponding Weight Class	2024-2026 MY	2027-2030 MY	2031+ MY
Heavy-Duty Otto	Class 4-8	$506	$821	$1,015
Light-Heavy-Duty Diesel	Class 4-5	$1,687	$4,741	$6,041
Medium-Heavy-Duty Diesel	Class 6-7	$2,469	$6,063	$6,923
Heavy-Heavy-Duty Diesel	Class 8/Tractors	$3,761	$7,423	$8,478

Staff estimated the cost of medium- and heavy-duty ZEVs for battery-electric and fuel cell powered vehicles by adding electric components costs, fuel cell component costs, energy storage costs, and body costs to a conventional glider vehicle, similar to CARB's approach used in the ACT regulation. Component costs are adjusted to account for the indirect costs associated with production volume and early market complexity. The indirect cost multipliers are derived from the 2019 Argonne National Laboratory Report "Fuel Economy and Cost Estimates for Medium- and Heavy-Duty Vehicles" and are displayed in Table 21 and are applied to the individual component costs. These multipliers are the highest in earliest years when volumes are lowest and new engineering is needed to launch electrified products. Over time, these multipliers decline as economies of scale emerge and ZEV production becomes normalized within the industry. Values for years in between are interpolated.[133] The final retail price of the ZEV is the sum of these individual total component costs. The calculated prices for BEVs are comparable to battery-electric trucks and vans that are available through the HVIP program today.

Table 21. Indirect Cost Multipliers Applied to ZEV Component Costs

Vehicle Category	2020 and Earlier	2025	2030	2035 and Later
Electric machine	1.95	1.55	1.29	1.20
Battery Packs	2.18	1.76	1.48	1.20
Fuel Cell System	2.18	1.76	1.48	1.20

[133] Argonne National Laboratory, *Fuel Economy and Cost Estimates for Medium- and Heavy-Duty Vehicles*, 2019 (web link: https://publications.anl.gov/anlpubs/2021/02/165815.pdf, last accessed December 2021).

Vehicle Category	2020 and Earlier	2025	2030	2035 and Later
Hydrogen Storage	2.18	1.76	1.48	1.20

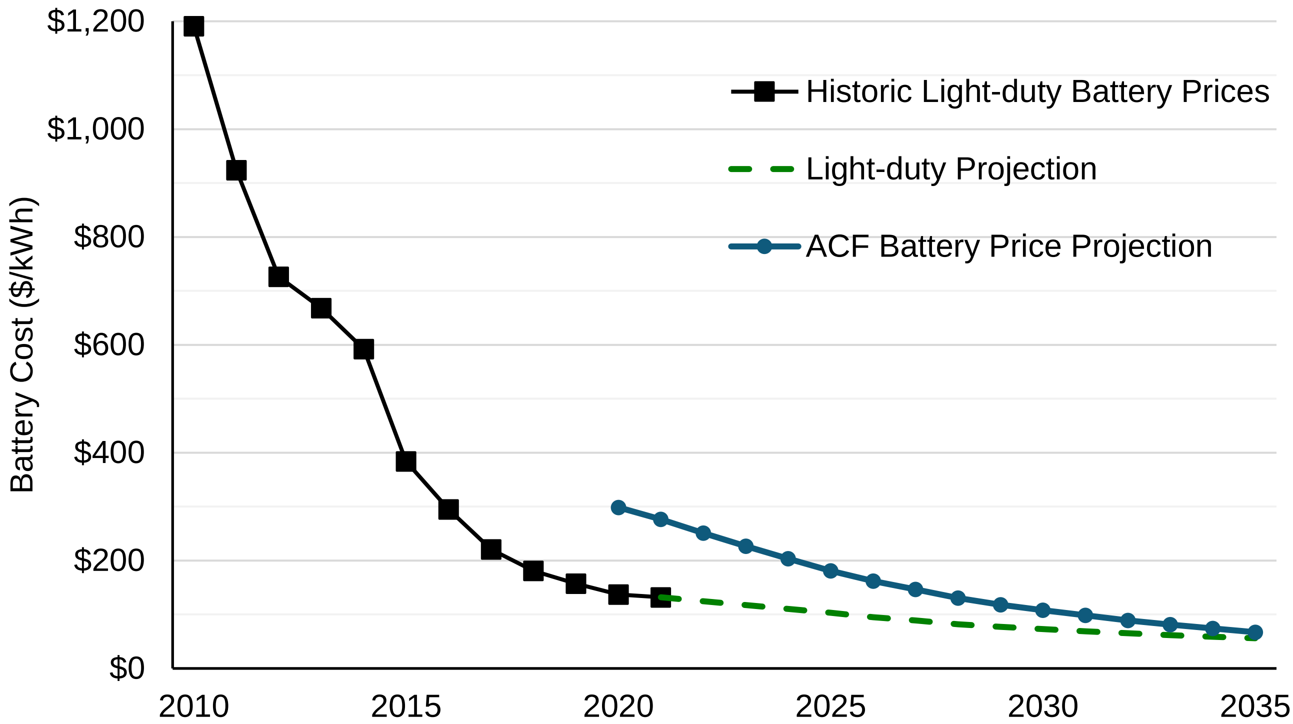
Electric component costs including motors and electronic controllers are derived using assumptions from Argonne National Laboratory's 2021 Vehicle Technology Benefit Analysis for medium- and heavy-duty vehicles by averaging the low and high cases.[134] Hydrogen system component costs for the fuel cell stack and hydrogen storage are calculated using data from two Strategic Analysis reports prepared for the Department of Energy which estimated hydrogen fuel cell system costs for medium- and heavy-duty trucks.[135,136]

Generally, heavy-duty vehicles are manufactured in stages. A chassis manufacturer such as Ford or Freightliner installs a powertrain built by themselves or an outside supplier to produce a cab-and-chassis. This is then sent to a body manufacturer to install a body on the vehicle such as a box or bucket truck body. These body costs are modeled separately for ZEVs. The cost of a body can be estimated by measuring the difference between the price of a cab-and-chassis and the finished vehicle with a body. For this analysis, staff assumes bodies requiring power takeoff such as a bucket truck or refuse truck will cost 10 percent extra up until 2030 to account for additional costs of electrifying the power takeoff. No increased costs are modeled for bodies without power takeoff.

The cost of battery storage is the largest contributing factor associated with the price of BEVs. Battery pack costs have dropped nearly 90 percent since 2010 and are projected to continue declining. Battery pack cost for medium- and heavy-duty applications are currently higher than for light-duty cars due to smaller volumes and differing packaging requirements even though many use the same cells. For this analysis, staff estimate battery costs using a recent 2021 analysis from the National Academies of Sciences, Engineering, and Medicine and the indirect cost modifiers displayed in Table 21.[137] Figure 15 shows the historic battery price trend and the battery price projections used in this analysis. The projections used in this analysis are shown in bold.

[134] Argonne National Laboratory, *2021 Vehicle Technology Benefit Analysis – Medium- and Heavy-Duty Vehicles - Assumptions*, 2021 (web link: https://anl.app.box.com/s/ml0vlag8merv5xb2jjt5f901cl6rbu38, last accessed December 2021).
[135] Strategic Analysis, *Fuel Cell Systems Analysis*, 2021 (web link: https://www.hydrogen.energy.gov/pdfs/review21/fc163_james_2021_o.pdf, last accessed December 2021).
[136] Strategic Analysis, *Hydrogen Storage Cost Analysis*, 2021 (web link: https://www.hydrogen.energy.gov/pdfs/review21/st100_james_2021_o.pdf, last accessed December 2021).
[137] National Academies of Sciences, Engineering, and Medicine, *Assessment of Technologies for Improving Light-Duty Vehicle Fuel Economy 2025-2035*, 2021 (web link: https://www.nap.edu/read/26092/chapter/1, last accessed December 2021).

Figure 15. Historic Battery Price Trends and Battery Price Projections



Staff is not forecasting that this proposed regulation would affect commercial battery prices and ZEV technology significantly. The proposed regulation would affect a portion of California's medium- and heavy-duty trucking fleet, which is very small compared to the worldwide market for batteries in consumer electronics, light-duty vehicles, battery-storage, and other applications. To the extent that this rule increases economies of scale for general ZEV components, infrastructure, and battery production, there may be an accelerated reduction in component and vehicle prices as a result of the rule, but these effects are less certain and are not modelled. The proposed regulation, along with the ACT rule and similar efforts outside California, may cause the cost for battery packs and components specifically designed for medium- and heavy-duty ZEVs to decrease as economies of scale start to emerge in this new market.

The costs for BEVs are modelled using motors and electrical components in line with an existing diesel counterpart's power needs. Battery storage is estimated using the vehicle's average daily mileage based on EMFAC data and the energy efficiency of the electric vehicle in 2020. For vehicles which EMFAC models as driving below 100 miles per day, staff assumed the battery will have a minimum capability of driving 100 miles daily. Staff then modeled a 35 percent buffer to account for battery degradation and some operational variability. For Class 2b pickups, staff modeled they will require an additional 50 percent larger battery than would otherwise be calculated to account for the towing needs of these vehicles as well as their operational variability. Similarly, staff modeled that the Class 8 specialty vehicle will require a 50 percent larger battery to accommodate expanded power take off operation as discussed previously. Table 22 lists the specifications of sample BEV.

Table 22. Battery Size Calculation

Representative Vehicle	Daily Mileage	2020 Efficiency (kWh/mi)	Battery Size (kWh)
Class 2b Cargo Van	100	0.6	80
Class 5 Walk-in Van	100	1	135
Class 6 Bucket Truck	100	1.5	205
Class 8 Refuse Packer	100	3.0	405
Class 8 Day Cab	160	2.1	455
Class 8 Sleeper Cab	320	2.1	920

The costs for FCEVs are modeled using motors and electrical components in line with an existing diesel counterpart's power needs. The battery is assumed to be 10 kilowatt-hours (kWh). The fuel cell stack power output is assumed to be one half the vehicle's peak power needs. The amount of hydrogen storage depends on vehicles size with larger vehicles requiring more storage: 10 kg for Class 2b-3 vehicles, 20 kg for Class 4-7 vehicles, 40 kg for most Class 8 vehicles and 80 kg for Class 8 sleeper cab tractors.

The assumed vehicle prices for sample vehicles of all fuel types are shown Table 23. Based on these projections, ZEV costs are expected to be higher than diesel vehicle costs until at least 2030. After that point, some vocations may see lower cost for ZEVs versus their diesel-powered counterparts as costs for ZEVs continue declining while combustion-powered costs increase over time. All costs for all MYs are available in the Vehicle Cost Attributes Appendix.

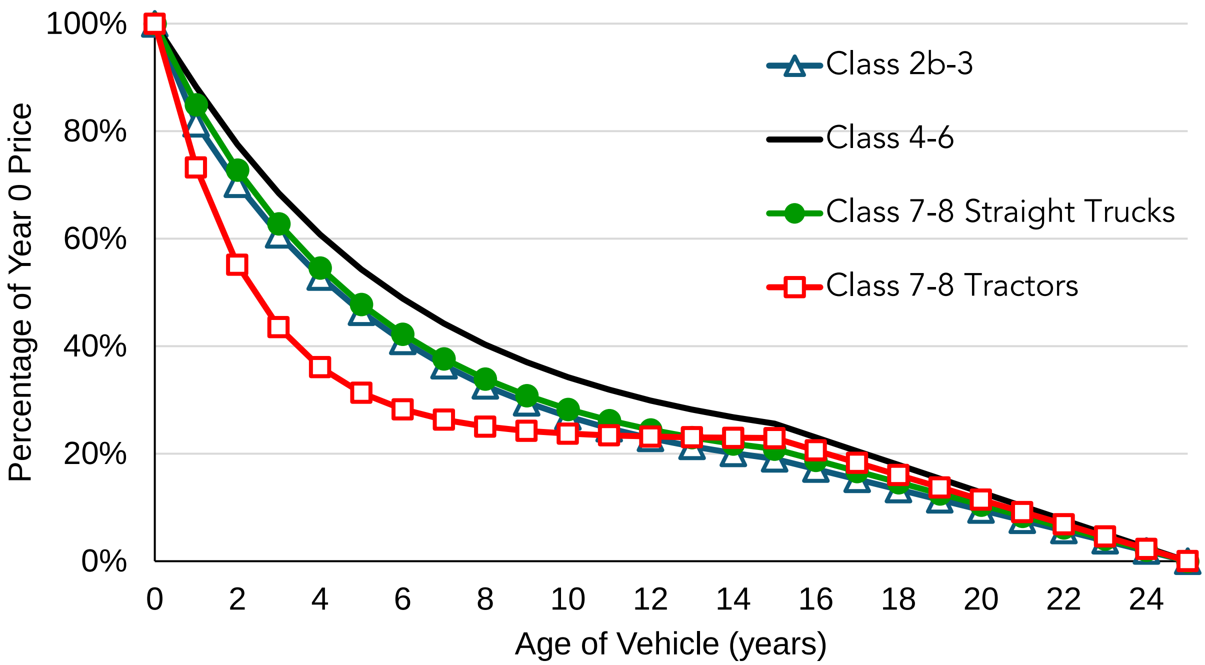
Table 23. New Vehicle Price Forecast

Vehicle Group	2025 MY	2030MY	2035 MY
Class 2b Cargo Van – Diesel	$40,137	$40,611	$40,611
Class 2b Cargo Van – Gasoline	$36,137	$36,611	$36,611
Class 2b Cargo Van – Battery-Electric	$54,835	$45,167	$40,361
Class 2b Cargo Van – Fuel Cell Electric	$89,469	$63,567	$48,115
Class 5 Walk-in Van – Diesel	$91,075	$94,884	$96,184

Vehicle Group	2025 MY	2030MY	2035 MY
Class 5 Walk-in Van – Battery-Electric	$107,074	$94,260	$87,552
Class 5 Walk-in Van – Fuel Cell Electric	$127,842	$106,944	$92,056
Class 6 Bucket Truck – Diesel	$130,857	$135,206	$136,066
Class 6 Bucket Truck – Battery-Electric	$165,527	$145,791	$142,076
Class 6 Bucket Truck – Fuel Cell Electric	$194,304	$161,337	$146,756
Class 8 Refuse Packer – Diesel	$232,149	$236,566	$237,621
Class 8 Refuse Packer – Natural Gas	$259,189	$260,259	$260,453
Class 8 Refuse Packer – Battery-Electric	$293,965	$257,685	$238,496
Class 8 Refuse Packer – Fuel Cell Electric	$319,852	$272,754	$240,265
Class 8 Day Cab – Diesel	$145,689	$152,115	$153,170
Class 8 Day Cab – Natural Gas	$192,434	$195,513	$195,707
Class 8 Day Cab – Battery-Electric	$204,579	$164,611	$143,371
Class 8 Day Cab – Fuel Cell Electric	$221,352	$174,254	$141,765
Class 8 Sleeper Cab – Diesel	$155,689	$162,115	$163,170
Class 8 Sleeper Cab – Natural Gas	$242,434	$245,513	$245,707
Class 8 Sleeper Cab – Battery-Electric	$295,597	$221,901	$181,883
Class 8 Sleeper Cab – Fuel Cell Electric	$254,774	$203,552	$160,833

The used vehicle prices for combustion-powered trucks are calculated using major online truck marketplaces such as TruckPaper and Commercial Truck Trader by measuring the price of a given body type over several MYs and weight classes. This analysis provided up to 2,000 data points per model year to calculate the long-term residual values for medium- and heavy-duty vehicles. The trend is calculated by grouping similar trucks, performing a weighted average, then calculating an exponential curve fit for the different groups. The residual value is assumed to linearly decline from its value at 15-years-old to a value of 0 at 25-years-old to reflect that most vehicles are out-of-service or scrapped at that point. Figure 16 displays the 4 residual value curves calculated for combustion-powered vehicles over a 25-year period. The residual value of ZEVs is assumed to decline at the same rate as combustion-powered trucks.

Figure 16. Residual Values by Vehicle Type and Age



For the purpose of this analysis, vehicles purchased by private fleets are assumed to be financed over a 5-year period while vehicles purchased by public fleets are assumed to be purchased outright. Staff assumes most fleets would be able to finance at a lower interest rate while some would have to finance for higher rates. Staff assumed that 80 percent of fleets finance at a 5 percent annual percentage rate and 20 percent of fleets finance at 15 percent to reflect costs on marginal operators affected by the regulation. These assumptions apply to both new and used vehicles.

3.1.4.2 Fueling Infrastructure Installation and Maintenance

Infrastructure is necessary to refuel or recharge vehicles. All vehicles need either dedicated refueling infrastructure onsite or publicly available retail stations in order to operate. There are numerous ways infrastructure expenses can be accounted for which would affect the cost to California businesses in different ways. Infrastructure expenses are generally an upfront capital investment needed prior to vehicles being deployed, but infrastructure can last multiple vehicle lifetimes and generally is amortized over its life.

For gasoline, diesel, and natural gas vehicles, staff assumes the fleet is either using existing infrastructure or publicly accessible stations and the infrastructure cost is already incorporated into the fuel cost. As a result, these infrastructure costs are not separately modeled.

For this analysis, staff assumes the BEVs would utilize both depot charging and recharging at publicly accessible medium- and heavy-duty retail stations and that it will vary by fleet. Staff estimated the portion of BEVs that would use depot charging versus retail refueling using data from the ACT Large Entity Reporting requirement.[138] Vehicles that travel under 200 miles per day and either fuel at base, park at their home base 8 or more hours per day, or return to base daily are assumed to be able to depot charge. Vehicles that cannot meet these criteria are assumed to require retail recharging, such as vehicles parked away from company grounds or owned by smaller operators without sufficient access to capital. Non-tractor trucks are assumed to solely depot charge until 2030 as the vast majority of these vehicles have ample opportunity to refuel at a home base during downtime. After 2030 as more vehicles transition to ZE, a portion of the non-tractor fleet is assumed to use retail charging to address more variable operations. Retail refueling assumptions are listed in Table 24. Staff acknowledges there are myriad ways fleets can choose to charge their vehicles and these assumptions are intended to be representative cost scenarios.

Table 24. Percentage of Retail Refueling for BEVs by Weight Class and Year

Vehicle Group	2023-2029	2030+
Class 2b-3	0%	15%
Class 4-5 Straight Truck	0%	15%
Class 6-7 Straight Truck	0%	15%
Class 8 Straight Truck	0%	15%
Class 7-8 Day Cab Tractor	25%	25%
Class 7-8 Sleeper Cab Tractor	75%	75%

Fleets owning BEVs that do not use retail charging would set up private, behind-the-fence facility-side infrastructure to recharge their vehicles. There are two main cost components of installing charging infrastructure: the cost of the charger itself and the cost of upgrading the site to deliver power to the charger.

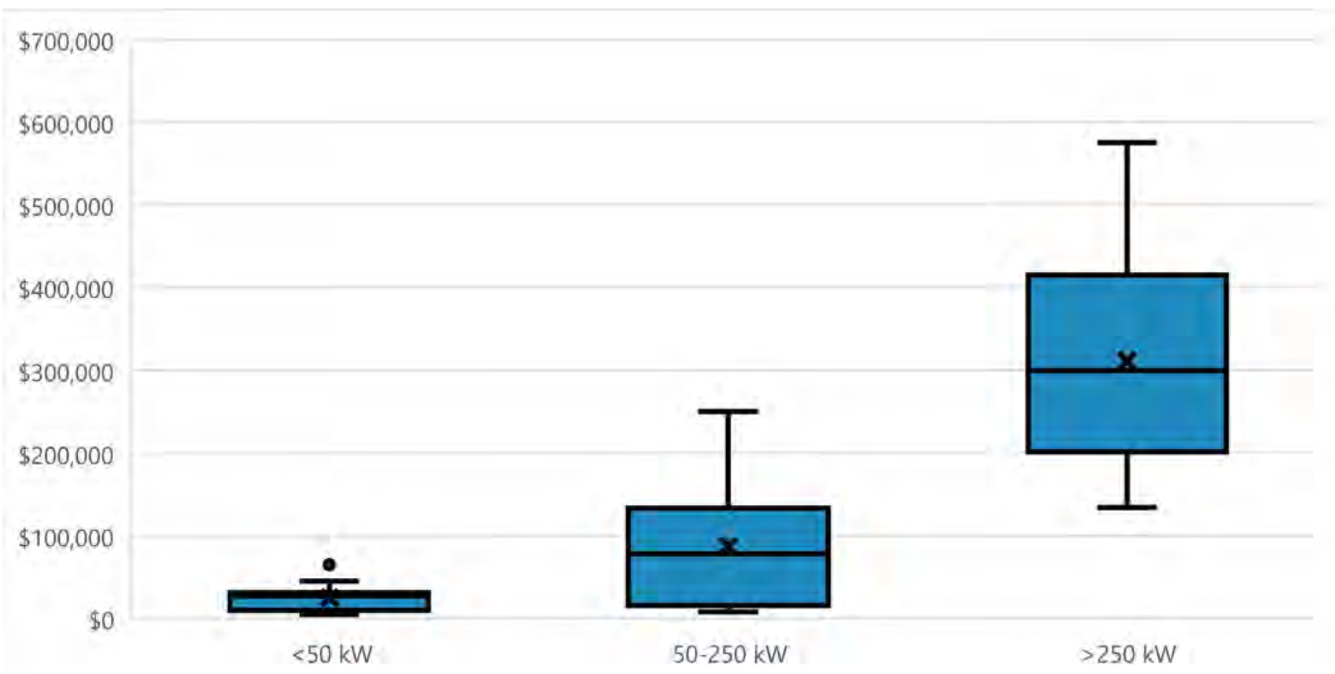
Charger costs are derived from the International Council on Clean Transportation working paper, "Estimating Electric Vehicle Charging Infrastructure Costs Across Major U.S. Metropolitan Areas".[139] Generally, smaller trucks can use similar Level 2 chargers to what

[138] Advance Clean Trucks, *Large Entity Reporting Results* (web: https://ww2.arb.ca.gov/our-work/programs/advanced-clean-trucks/large-entity-reporting, last accessed January 2022)
139 ge

light-duty vehicles use. Class 6 and heavier vehicles are assumed to require higher power direct current chargers. Class 8 vehicles and Class 7-8 tractors are to use a 150 kW charger with 2 ports for each pair of BEVs.

Infrastructure upgrade costs represent costs on the customer side of the meter associated with setting up charging infrastructure at a facility and may include trenching, cabling, conduit, and panels as well as associated infrastructure costs. Staff anticipate that nearly all costs associated with utility-side upgrades are the responsibility of the utility as per requirements of AB 841. Soft costs including additional training costs and short-term implementation challenges, such as staff cycling vehicles between chargers, are captured within subsection "Transitional Costs and Workforce Development". Infrastructure costs are derived from an analysis of BEV deployments conducted by CARB. The data was analyzed to calculate the cost per port and results were broken into 3 groups: below 50 kW, between 50 and 250 kW, and above 250 kW. The results are shown in Figure 17 in a box-and-whisker plot. As depicted, infrastructure costs for fleets can be highly variable based on the layout of the site and the type of upgrades. The average cost is appropriate for a statewide analysis but the infrastructure cost to a given fleet may be higher or lower.

Figure 17. Infrastructure Upgrade Cost per Port and Power Level



International Council on Clean Transportation, *Estimating Electric Vehicle Charging Infrastructure Costs Across Major U.S. Metropolitan Areas*, 2019. (web link: https://theicct.org/sites/default/files/publications/ICCT_EV_Charging_Cost_20190813.pdf, last accessed January 2022).

Table 25 outlines the assumptions for charger power, charger cost, and infrastructure upgrade costs.

Table 25. Charger Power Ratings and Infrastructure Costs Per Vehicle

Vehicle Group	Charger Power (kW)	Charger Cost ($/vehicle)	Infrastructure Upgrade Cost ($/vehicle)
Class 2b-3	19	$5,000	$25,000
Class 4-5	19	$5,000	$25,000
Class 6-7	50	$25,000	$44,000
Class 8	150 kW for 2 vehicles	$37,500	$44,000
Class 7-8 Tractor	150 kW	$75,000	$88,000

Fleets are assumed to amortize their infrastructure costs over a 20-year period with an interest rate of 5 percent. The number of charger installations and infrastructure upgrades each year is based on the increase in ZEV population per year to avoid double-counting infrastructure costs in situations in later years where a ZEV is replacing another ZEV in the fleet. Fleets may be able to offset significant upgrade costs by participating in utility electrification incentives, however due to uncertain long-term availability and qualification criteria, we do not assume so in our analysis. Hydrogen infrastructure costs are incorporated into the hydrogen fuel costs and are not included here.

Depot and retail chargers for ZEVs require regular maintenance. The maintenance costs of depot chargers are estimated by considering costs for replacing charger heads, connectors, and other components, as well as labor costs for regular inspections. Charger maintenance costs are estimated at $400/year/charger.[140] Staff assume that the maintenance costs for other fueling infrastructures are reflected in the fuel price.

Backup power generation is not included in this analysis. Although some fleets may want backup generation on site, staff does not assume infrastructure costs for the use of on-site backup generation for a number of reasons. First, ZEVs would gradually enter the fleet over time and only a small portion of the fleet would be zero-emission. Second, power outages affect all fuel types as fuel pumps cannot work without electricity, so similar issues already exist today. Third, mobile fueling and other solutions are currently being developed and

[140] Alternative Fuels Data Center, *Charging Infrastructure Operation and Maintenance*, 2021 (web link: https://afdc.energy.gov/fuels/electricity_infrastructure_maintenance_and_operation.html, last accessed January 2022).

present a solution for fleets seeking additional reliability.[141] Some backup generation options such as onsite power storage, present the opportunity to offset some or all of the costs to store energy during off-peak periods to reduce peak demand charges, or by reselling the electricity onto the grid during peak times using vehicle-to-grid technology. [142]

3.1.4.3 Sales Tax and Federal Excise Tax

Taxes are additional costs levied on the purchase of a vehicle. Because they are based on the purchase price of the vehicle, they are higher for ZEVs due to their higher upfront costs.

Vehicles purchased in California must pay a sales tax on top of the vehicle's purchase price. The sales tax varies across the state from a minimum of 7.25 percent up to 10.50 percent in some municipalities; a value of 8.6 percent was used for staff's analysis based on a statewide average weighted by economic output.[143] This results in higher costs for fleets and higher revenue for State and local governments. Class 8 vehicles are subject to an additional federal excise tax which adds 12 percent to their purchase price.

3.1.4.4 Maintenance Bay Upgrades

Maintenance bays are facilities used to service vehicles. Services performed include inspections, routine maintenance, preventative maintenance, repairs, overhauls and more. Servicing electric vehicles requires separate safety equipment, diagnostic tools, and equipment which would incur costs to the facility.

Based on transit agency data, upgrading a 15 bus maintenance bay to handle battery-electric buses would cost $25,000, and upgrading to handle fuel cell electric buses would cost $750,000. For this analysis, staff assume the cost per maintenance bay is the same and a 15 bus maintenance bay could accommodate 25 trucks. Per vehicle, this works out to be $1,000 per battery-electric vehicle and $30,000 per fuel cell electric vehicle. The amount of maintenance bay upgrades each year is based on the increase in ZEV population per year to avoid double-counting in situations where a ZEV is replaced by a ZEV.

3.1.5 Operating and Maintenance Costs

The proposed regulation would require fleets to purchase medium- and heavy-duty ZEVs to meet the compliance requirements. The cost of ZEVs includes the cost of operating these vehicles in California for their lifetime. These operating costs include fueling, maintenance, and LCFS revenue where other costs are assumed to be the direct costs of the proposed regulation.

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[141] GM, *GM Plans to Broaden Electrification, Expanding Fuel Cells Beyond Vehicles*, 2022 (web link: https://media.gm.com/media/us/en/gm/home.detail.html/content/Pages/news/us/en/2022/jan/0119-hydrotec.html, last accessed January 2022)

[142] EDF, *California Heavy-Duty Fleet Electrification Summary Report* , 2021 (web link: http://blogs.edf.org/energyexchange/files/2021/03/EDF-GNA-Final-March-2021.pdf, last accessed January 2022)

[143] Based on the *tax rate data* from California Department of Tax and Fee Administration: (https://cdtfa.ca.gov/taxes-and-fees/sales-use-tax-rates.htm)

3.1.5.1 Gasoline, Diesel, Natural Gas, Electricity, and Hydrogen Fuel Cost

Fuel costs are calculated using total fuel consumed per year, and the cost of fuel per unit. The total fuel consumed per year is based on the vehicle population per calendar year, the annual mileage traveled by those vehicles, and the fuel economy/fuel efficiency of the vehicles. Population and mileage assumptions are discussed on Vehicle Population subsection on page 44. In general, ZEVs are two to five times as efficient as similar vehicles with ICE technologies. and significantly reduce petroleum and other fossil fuel consumption.

Fuel economy is measured in miles per gallon for gasoline and diesel, and miles per diesel gallon equivalent for natural gas. The energy efficiency of BEVs and FCEVs is measured in miles per kWh and miles per kg, respectively.[144] Gasoline, diesel, and natural gas fuel economy is derived from EMFAC inventory projections for each group. Generally, combustion-powered fuel economy is expected to increase until the 2027 MY and remain relatively constant afterwards.

BEV energy efficiency is derived from in-use data collected from a variety of vehicles.[145,146,147] For fuel cell vehicle efficiency, staff applied the LCFS program's Energy Efficiency Ratio (EER) of 1.9 to the diesel fuel economy to estimate the fuel cell fuel economy as there is limited information which measures the energy efficiency of medium- and heavy-duty FCEVs.

Staff modeled that for both BEVs and FCEVs, the efficiency will improve at the same rate the Phase 2 GHG regulation would require for combustion-powered vehicles until 2027 MY, then remain constant afterwards. This may be a conservative estimate as both technologies are less developed than ICE powertrains and reports have shown recent improvements in the technology.

Table 26 outlines the fuel economy and energy efficiency assumptions for a sample of vehicle groups and technology types over the course of the regulation. Full assumptions are in the Vehicle Attribute Appendix.

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[144] tiFuel economy, as defined in the Energy Policy and Conservation Act of 1975 (EPCA), does not apply to BEVs. *See* 49 U.S.C. §§ 32901(10 & 11) (defining "fuel" as gasoline, diesel oil, or other "liquid or gaseous fuel" that needs conserving and defining "fuel economy" as the average number of miles traveled by an automobile per gallon of gasoline or its equivalent). Moreover, note that medium- and heavy-duty on-highway vehicles are not ''automobiles'' as defined in 49 U.S.C. 32901(a)(3) (4-wheeled vehicles rated under 10,000 lb. GVWR, excluding work trucks (vehicles rated between 8,500 to 10,000 lb. GVWR and not medium-duty passenger vehicles as defined in 40 CFR section 86.1803-01).

[145] California Air Resources Board, *Battery Electric Truck and Bus Efficiency Compared to Diesel Vehicles* (web link: https://ww2.arb.ca.gov/sites/default/files/2018-11/180124hdbevefficiency.pdf, last accessed January 2022).

[146] Penn State LTI Bus Research and Testing Center, *Motor Coach Industries D45 CRTeLE*, 2020 (web link: http://apps.altoonabustest.psu.edu/buses/reports/522.pdf?1608733416, last accessed January 2022).

[147] Penn State LTI Bus Research and Testing Center, *GreenPower Motor Company EV Star*, 2020 (web link: http://apps.altoonabustest.psu.edu/buses/reports/515.pdf?1603821665, last accessed January 2022).

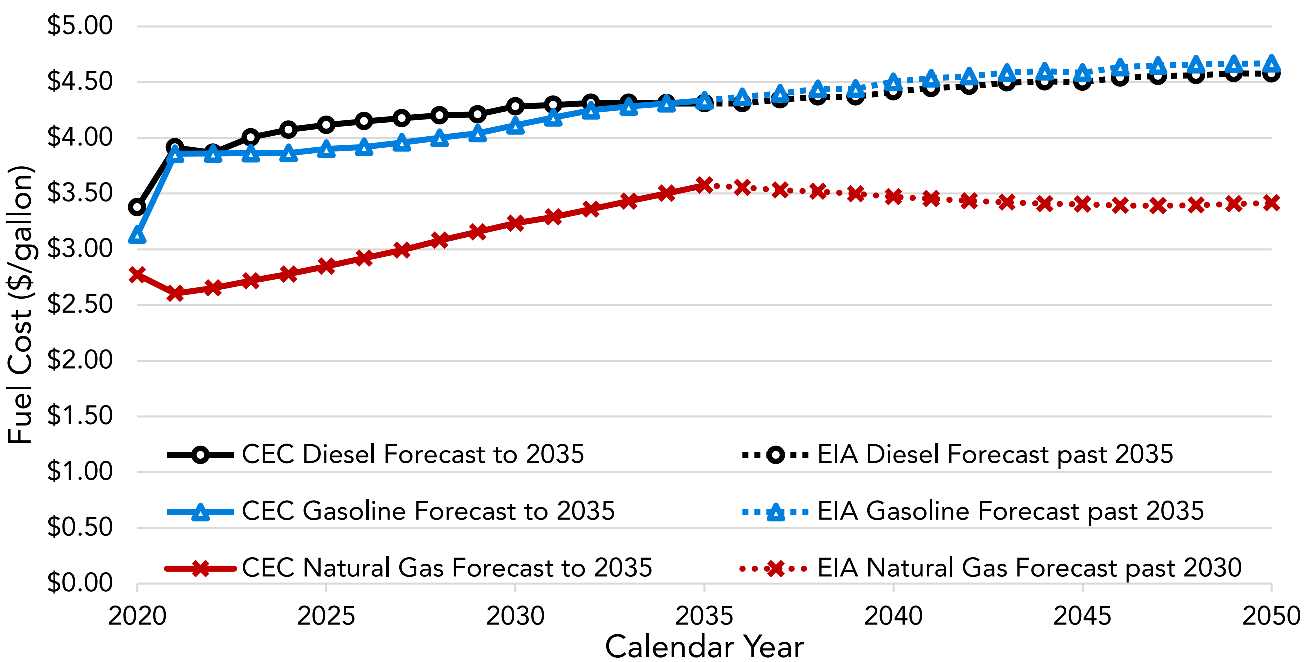
Table 26. Sample Vehicle Fuel Economy and Energy Efficiency

Vehicle Group	2024 MY	2027 MY	2031 MY	Unit
Class 2b Cargo Van – Diesel	19.4	19.4	19.3	mpg
Class 2b Cargo Van – Gasoline	14.1	14.1	14.0	mpg
Class 2b Cargo Van – Battery-Electric	1.9	2.0	2.0	mi./kWh
Class 2b Cargo Van – Fuel Cell Electric	42.5	42.4	42.4	mi./kg
Class 5 Walk-in Van – Diesel	9.4	9.5	9.6	mpg
Class 5 Walk-in Van – Battery-Electric	1.1	1.2	1.2	mi./kWh
Class 5 Walk-in Van – Fuel Cell Electric	16.1	17.0	17.0	mi./kg
Class 6 Bucket Truck – Diesel	8.9	9.0	9.1	mpg
Class 6 Bucket Truck – Battery-Electric	0.8	0.8	0.8	mi./kWh
Class 6 Bucket Truck – Fuel Cell Electric	15.1	15.9	15.9	mi./kg
Class 8 Refuse Packer – Diesel	3.2	3.2	3.3	mpg
Class 8 Refuse Packer – Natural Gas	6.5	6.5	6.6	mpg
Class 8 Refuse Packer – Battery-Electric	0.4	0.4	0.4	mi./kWh
Class 8 Refuse Packer – Fuel Cell Electric	5.2	5.5	5.5	mi./kg
Class 8 Day Cab – Diesel	6.9	7.0	7.0	mpg
Class 8 Day Cab – Natural Gas	6.7	6.8	6.9	mpg
Class 8 Day Cab – Battery-Electric	0.5	0.6	0.6	mi./kWh
Class 8 Day Cab – Fuel Cell Electric	10.9	11.6	11.6	mi./kg
Class 8 Sleeper Cab – Diesel	7.1	7.2	7.2	mpg

Vehicle Group	2024 MY	2027 MY	2031 MY	Unit
Class 8 Sleeper Cab – Natural Gas	6.5	6.5	6.5	mpg
Class 8 Sleeper Cab – Battery-Electric	0.5	0.6	0.6	mi./kWh
Class 8 Sleeper Cab – Fuel Cell Electric	11.0	11.6	11.6	mi./kg

Gasoline and diesel fuel prices to 2035 are taken from the "mid-demand" scenario from the CEC "Transportation Energy Demand Forecast."[148] Fuel prices past 2035 are calculated using the Energy Information Administration's (EIA) 2021 Annual Energy Outlook for the Pacific region.[149] The annual percentage change in EIA fuel prices past 2035 is applied to the 2035 CEC gasoline and diesel prices to estimate price changes past 2035. Figure 18 shows the projected prices of gasoline, diesel, and natural gas out to 2050.

Figure 18. Gasoline, Diesel, and Natural Gas Price Forecasts



Electricity costs for BEVs depend on the rate and on how they are charged and include energy costs, fixed fees, and demand fees. Vehicles charged at high power or during peak periods have higher electricity costs than if charging overnight or over an extended period.

[148] California Energy Commission, *Transportation Energy Demand Forecast*, 2021 (web link: https://efiling.energy.ca.gov/GetDocument.aspx?tn=240934, last accessed January 2022).
[149] Energy Information Administration, *Annual Energy Outlook 2021*, 2021 (web link: https://www.eia.gov/outlooks/aeo/data/browser/#/?id=3-AEO2021&region=1-9 , last accessed December 2021).

For this analysis, staff assumes the BEVs utilize both depot charging and recharging at publicly accessible medium- and heavy-duty retail stations using the same methodology as discussed previously in Section “ Fueling Infrastructure Installation and Maintenance”.

Electricity prices for depot charging are calculated using CARB’s Battery-Electric Truck and Bus Charging Calculator and assumes a fleet of 20 vehicles using a managed charging strategy with the applicable rate schedule.[150] Tractors are assumed to be charged in a 4 hour shift at night with midday opportunity charging. All other trucks are assumed to charge overnight. Energy costs, monthly fees, demand rates, charger efficiency losses and local electricity taxes are incorporated into these numbers. The cost per kWh is calculated separately for each utility and a weighted average is used to determine the cost per kWh per vehicle in 2021.

Table 27 shows the depot charging electricity price per kWh for each vehicle group and major utility region as well as the weighted statewide average. In general, electricity costs are lower for larger vehicles because they tend to use more electricity which decreases the fixed costs per kWh and allows the use of lower cost rate schedules for larger utility customers. Note that SCE’s newly introduced electric vehicle rates, EV-8 and EV-9, have no demand fees from 2019 to 2023 and phase them back over the following five years, with demand fees being fully reintroduced in 2029. However, to simplify the analysis, staff used the full cost of the SCE electricity rate including all demand charges from the beginning of the analysis period rather than discounting the price to reflect the transition period until the demand charges are fully reintroduced.[151]

Table 27. Depot Charging Electricity Cost Calculation for 2021 (2021$/kWh)

Utility Area	Class 2b-3	Class 4-5	Class 6-7	Class 8	Class 7-8 Tractor
Los Angeles Department of Water and Power	$0.11	$0.11	$0.13	$0.11	$0.17
Pacific Gas and Electric	$0.15	$0.15	$0.16	$0.15	$0.14
Sacramento Municipal Utility District	$0.17	$0.16	$0.16	$0.14	$0.14
San Diego Gas and Electric	$0.21	$0.20	$0.22	$0.20	$0.15
Southern California Edison*	$0.19	$0.15	$0.15	$0.14	$0.15

[150] California Air Resources Board, *Battery-Electric Truck and Bus Charging Calculator*, 2021 (web link: https://ww2.arb.ca.gov/resources/documents/battery-electric-truck-and-bus-charging-cost-calculator, last accessed December 2021).
[151] Southern California Edison, Communication via email with Alexander Echele in April 2019.

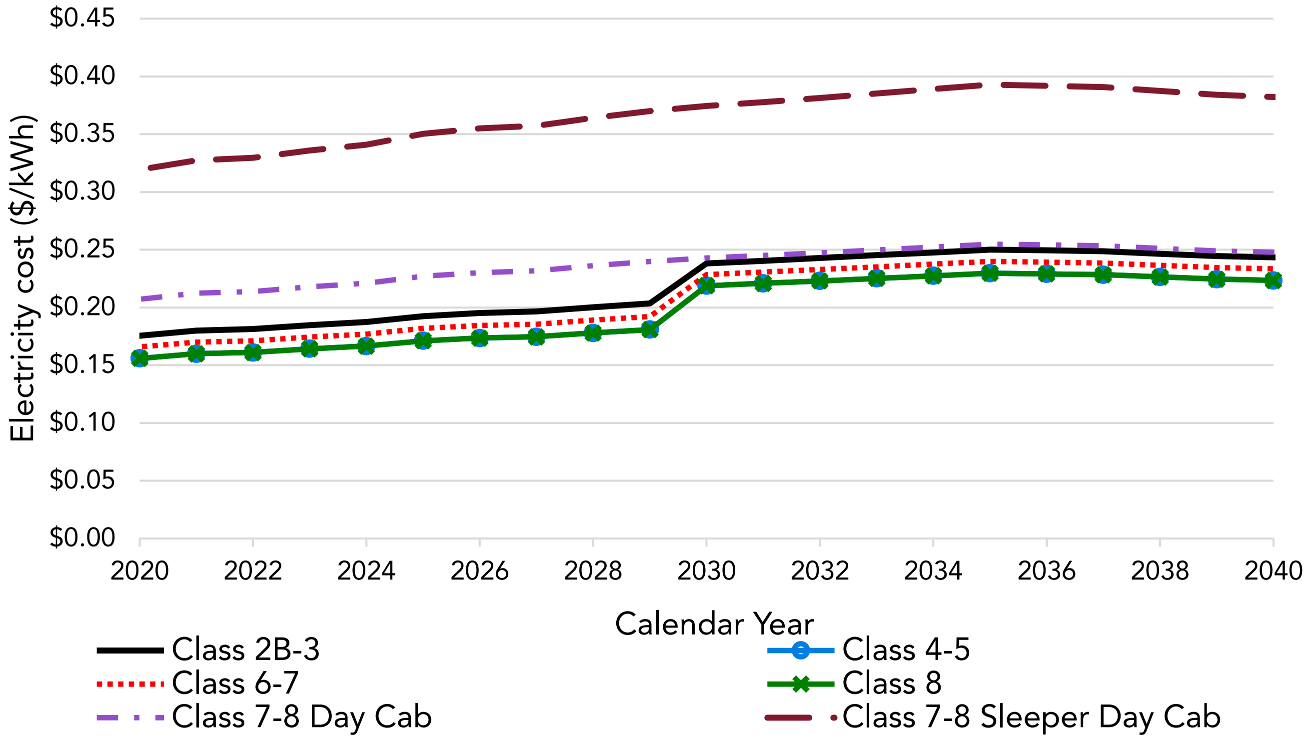
Utility Area	Class 2b-3	Class 4-5	Class 6-7	Class 8	Class 7-8 Tractor
Weighted Statewide Average	**$0.18**	**$0.16**	**$0.17**	**$0.16**	**$0.16**

For retail charging, staff assume the price for medium- and heavy-duty retail charging will be similar to current direct current fast charging costs for light-duty. Staff have used an average of charging costs offered today by Electrify America and EVgo to calculate a rate of $0.36/kWh in 2021.[152] The retail electricity charging prices have been adjusted to account for the higher LCFS credit value for heavy-duty vehicles as compared to light-duty vehicles. This adjustment is discussed further in the "Low Carbon Fuel Standard" Section.

Electricity rate changes over time are modelled using the CEC's "Transportation Energy Demand Forecast."[153] CEC's rate forecast includes current and escalating revenue requirements to support ongoing investments in transmission and distribution infrastructure. Fuel prices past 2035 are calculated using the EIA 2021 Annual Energy Outlook for the Pacific region.[154] The annual percentage change in EIA electricity prices past 2035 is applied to the 2035 CEC electricity to estimate future price changes. Results per vehicle type are shown in Figure 19.

[152] Electrify America, *Pricing and Plans for EV Charging*, 2021 (web link: https://www.electrifyamerica.com/pricing/, last accessed January 2022).
[153] California Energy Commission, *Transportation Energy Demand Forecast*, 2021 (web link: https://efiling.energy.ca.gov/GetDocument.aspx?tn=240934, last accessed January 2022).
[154] Energy Information Administration, *Annual Energy Outlook 2021*, 2021 (web link: https://www.eia.gov/outlooks/aeo/data/browser/#/?id=3-AEO2021&region=1-9 , last accessed December 2021).

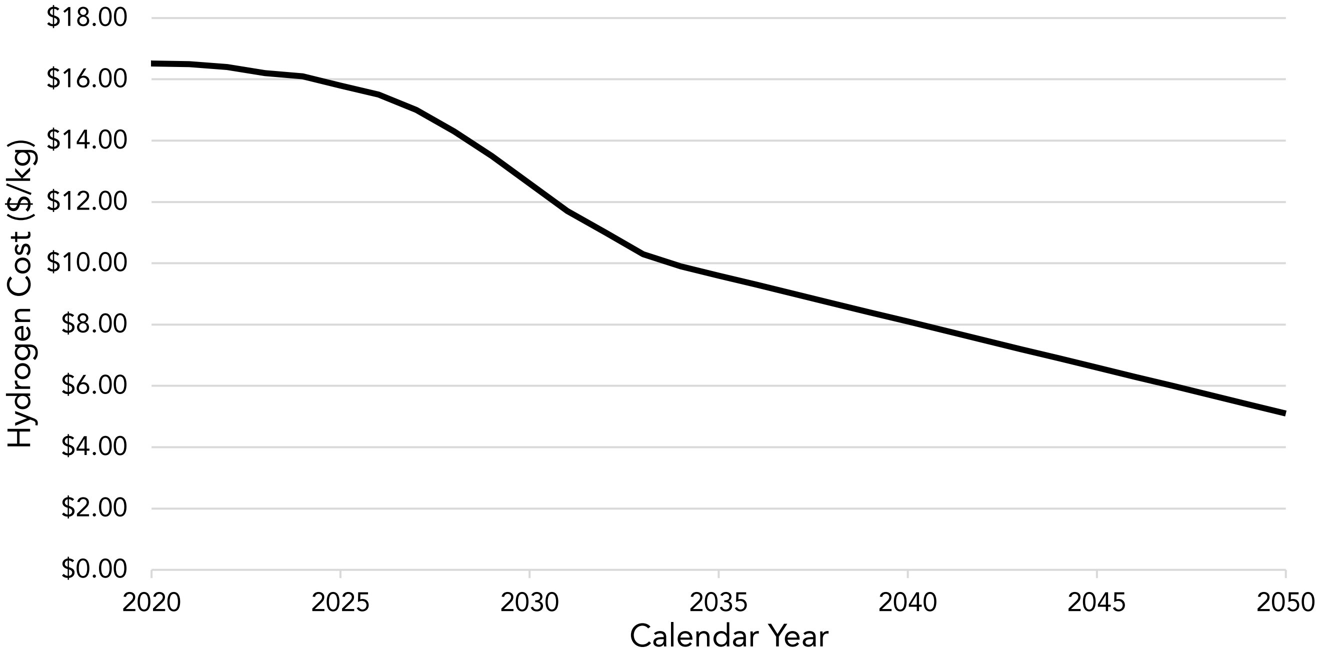
Figure 19. Electricity Price Forecasts



For this analysis, hydrogen stations are assumed to be available at strategic locations around seaports or major distribution hubs where the infrastructure costs are included in the hydrogen fuel price rather than reflecting costs for stations installed in a depot. This model is currently used for light-duty hydrogen stations and medium- and heavy-duty diesel sales and appears most appropriate for medium- and heavy-duty hydrogen fueling. Hydrogen fuel costs are modeled using the CEC's "Transportation Energy Demand Forecast".[155] Past 2035, the price of hydrogen continues to decline linearly. Hydrogen costs over time are shown in Figure 20.

[155] California Energy Commission, *Transportation Energy Demand Forecast*, 2021 (web link: https://efiling.energy.ca.gov/GetDocument.aspx?tn=240934, last accessed January 2022).

Figure 20. Hydrogen Price Forecasts



The cost of fuel displayed above includes fuel taxes. State and local taxes on fuel are listed below in Table 28.

Table 28. Local and State Taxes on Fuel

Fuel Type	Local Tax	State Tax
Gasoline	3.70% sales tax	$0.51/gal excise tax*
Diesel	4.5% sales tax	8.6% sales tax + $0.38/gal excise tax
Natural Gas	0	$0.887/gasoline gallon equivalent use tax
Electricity	3.53% utility user tax**	$0.0003/kWh
Hydrogen	0	0

*Local government portion is $0.22/gal and State government portion is $0.29/gal.
**Statewide population-weighted average

Staff acknowledge that both short-term and long-term forecasts for fuel and energy prices can change over time due to unexpected shocks in the economy. For example, The U.S. EIA's Short-Term Energy Outlook forecasts for Brent crude oil spot prices in 2022 have varied between $70 to $105 per barrel from the December 2021 to March 2022 forecast releases.[156,157] In the 2019, 2020, 2021, and 2022 releases of the U.S. EIA's Annual Energy Outlook, the predicted average annual real growth rate from 2021 through 2050 of transportation diesel fuel price varies from 1.0 percent, 1.5 percent, 1.5 percent, and 0.8 percent.[158] Similar patterns hold for the long-run projections on transportation gasoline prices and electricity prices, with relatively smaller adjustments for electricity prices. These different forecasts could result in changes in the cost and savings estimates for the proposed regulation and the alternatives. If the realized fuel prices differ from what is forecasted, there will be proportional changes in the fuel costs and cost savings.

3.1.5.2 Diesel Exhaust Fluid Consumption

Diesel-powered vehicles equipped with modern emissions control devices require diesel exhaust fluid (DEF) to break down NOx in the exhaust stream. Argonne National Laboratory estimates DEF consumption as being 2 percent of total fuel usage in their online 2020 AFLEET tool.[159] This assumption will be applied to the fuel economy discussed previously to estimate the DEF consumption per mile. DEF is assumed to cost $2.80 per gallon per Argonne.

3.1.5.3 Low Carbon Fuel Standard Revenue

The LCFS is a California regulation that creates a market mechanism incentivizing low carbon fuels and was recently amended in 2018 and 2019. These amendments 1) increased the EER for Class 4-8 trucks from 2.7 to 5.0, 2) reduced the carbon intensity target to 20 percent reduction by 2030, and 3) clarified how hydrogen station operators can receive credits. The regulation now requires the carbon intensity of California's transportation fuels to decrease by 20 percent through the 2030 timeframe and maintains the standard afterwards. Electricity and hydrogen are eligible to earn LCFS credits which can be sold and used to offset the costs of these fuels. Fossil gasoline and diesel are generally not eligible for LCFS credits.

Fleets who own and operate their infrastructure generate credits based on the amount of fuel or energy they dispense. Credit values for different fuel types are calculated using the LCFS Credit Price Calculator.[160] For this analysis, staff is projecting an LCFS credit price of $200 until 2030, then declining linearly to $25 in 2045 and remaining constant thereafter. An electric Class 2b-3 vehicle would earn $0.147/kWh in 2024 using grid electricity while an electric Class 4-8 vehicle would earn roughly $0.249/kWh in 2024 at this credit price. Staff

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[156] U.S Energy Information Administration, *Short-Term Energy Outlook December 2021*, 2021 (web link: https://www.eia.gov/outlooks/steo/archives/Dec21.pdf, last accessed April 2022).
[157] U.S. Energy Information Administration, *Short-Term Energy Outlook March 2022*, 2022 (web link: https://www.eia.gov/outlooks/steo/archives/Mar22.pdf, last accessed April 2022).
[158] U.S. Energy Information Administration, *Annual Energy Outlook 2019-2022, Table 3 Energy Prices by Sector and Sources, Pacific Region*, 2022 (web link: https://www.eia.gov/outlooks/aeo/, last accessed April 2022).
[159] Argonne National Laboratory, *Alternative Fuel Life-Cycle Environmental and Economic Transportation (AFLEET) Tool*. (https://greet.es.anl.gov/afleet, last accessed January 2022)
[160] California Air Resources Board, *LCFS Credit Price Calculator*, 2021(web link: https://ww2.arb.ca.gov/sites/default/files/classic/fuels/lcfs/dashboard/creditvaluecalculator.xlsx, last accessed January 2022).

assume hydrogen is produced from 33 percent renewable feedstock as required by SB 1505 (2006). This results in Class 4-8 vehicles earning $1.422/kg in 2024 at this credit price. LCFS credit revenue for a given fuel drops slightly over time as the program standards tighten and maintains upward pressure on the credit price.

For retail electricity refueling, staff conservatively assume that most LCFS credit revenue is not be passed on to fleets directly as the credit value is already incorporated into the retail price. As described previously, retail charging station costs are based off of what light-duty retail stations are charging today, which includes revenue they receive from the LCFS program. One key difference between light-duty and heavy-duty BEVs is that heavy-duty vehicles earn substantially more LCFS credits due to their higher EER value. To reflect this, staff applied this higher EER value to the retail electricity price by calculating the difference between light-duty and heavy-duty LCFS revenue and scaling the revenue by the credit value over time. This adjustment reduces the price of heavy-duty retail charging by $0.12/kWh by 2024 declining to $0.01/kWh by 2045. This adjustment is applied to the retail charging electricity cost.

This analysis reflects that the LCFS value associated with natural gas is already included in the retail price to the fleet owner. Fossil natural gas is expected to be a deficit generator in the LCFS program for the majority of this analysis and not generate revenue. While renewable natural gas does generate LCFS credits, the credits are typically claimed by the fuel producer and used to offset the higher cost of renewable natural gas. Therefore, the net cost to the fleet owner using renewable natural gas is essentially the same as fossil-based natural gas.

3.1.5.4 Maintenance Costs

Maintenance costs reflect the cost of labor and parts for routine maintenance, preventative maintenance, and repairing broken components, and does not include costs reflected in the next Section "Midlife Costs" where engine rebuilds, battery replacements, or fuel cell stack refurbishments are described. Maintenance costs for electric vehicles are generally assumed to be lower than for diesel in part due to their simpler design and fewer moving components.

Maintenance costs for combustion-powered vehicles are based on numerous studies published assessing maintenance costs for vehicles over a representative timeframe. The maintenance cost for the selected representative vehicles was calculated by identifying all sources where the maintenance cost appeared for the representative vehicles and averaging the values. All maintenance cost sources are listed in the Vehicle Attribute Appendix.

BEVs and FCEVs are assumed to have 40 percent lower vehicle maintenance costs compared to gasoline and diesel based on an aggregation of sources and data.[161] While numerous reports assume ZEVs can achieve maintenance costs of 50 percent or greater compared to

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[161] Argonne National Laboratory, *Comprehensive Total Cost of Ownership Quantification for Vehicles with Different Size Classes and Powertrains* (web link: https://www.arb.ca.gov/regact/2018/ict2018/appg.pdfhttps://www.arb.ca.gov/msprog/bus/maintenance_cost.pdf, last accessed January 2022)

gasoline or diesel, the lack of long-term data on maintenance costs presents uncertainty for modelling purposes; therefore the staff analysis uses the more conservative estimate.

Table 29 illustrates the maintenance for a set of sample vehicles. Maintenance cost assumptions for all representative vehicles are listed in the Vehicle Attribute Appendix. All prices have been adjusted to 2021 dollars using a consumer price index.

Table 29. Sample Vehicle Maintenance Costs per Mile

Vehicle Group	Maintenance Cost ($/mi.)
Class 2b Cargo Van – Diesel	$0.337
Class 2b Cargo Van – Gasoline	$0.337
Class 2b Cargo Van – Battery-Electric	$0.202
Class 2b Cargo Van – Fuel Cell Electric	$0.202
Class 5 Walk-in Van – Diesel	$0.210
Class 5 Walk-in Van – Battery-Electric	$0.126
Class 5 Walk-in Van – Fuel Cell Electric	$0.126
Class 6 Bucket Truck – Diesel	$0.199
Class 6 Bucket Truck – Battery-Electric	$0.119
Class 6 Bucket Truck – Fuel Cell Electric	$0.119
Class 8 Refuse Packer – Diesel	$0.943
Class 8 Refuse Packer – Natural Gas	$0.943
Class 8 Refuse Packer – Battery-Electric	$0.566
Class 8 Refuse Packer – Fuel Cell Electric	$0.566
Class 8 Day Cab – Diesel	$0.198
Class 8 Day Cab – Natural Gas	$0.198
Class 8 Day Cab – Battery-Electric	$0.119
Class 8 Day Cab – Fuel Cell Electric	$0.119
Class 8 Sleeper Cab – Diesel	$0.159
Class 8 Sleeper Cab – Natural Gas	$0.159
Class 8 Sleeper Cab – Battery-Electric	$0.095
Class 8 Sleeper Cab – Fuel Cell Electric	$0.095

3.1.5.5 Midlife Costs

Midlife costs are the cost of rebuilding or replacing major propulsion components due to wear or deterioration. These costs do not include general maintenance on vehicles – these are included in the "Maintenance Costs" Section. The frequency and cost of a midlife rebuild varies across the different technologies. For combustion-powered vehicles, this would be a midlife rebuild, for BEVs this would be a battery replacement, and for a hydrogen FCEV this would be a fuel cell stack refurbishment.

The frequency of a diesel engine rebuild varies based on the vehicle's weight class. Table 30 shows the anticipated diesel engine useful life based on years or miles. The cost of an engine rebuild is estimated to be one quarter of the total price without a body.

Table 30. Useful Life of Diesel Engines

Vehicle/Engine Category	Useful Life (Years/Miles)
Class 4-5 (Light-Heavy-Duty)	15/270,000
Class 6-7 (Medium-Heavy-Duty)	12/350,000
Class 8 (Heavy-Heavy-Duty)	12/800,000

Data is limited for BEVs, but ZEV manufacturers are currently offering vehicles with warranties of 8 or more years and up to 500,000 miles on their products. [162,163,164,165,166] Staff estimates that the battery will be replaced every 500,000 miles and the cost of the replacement is assumed to be the size of the battery in kWh multiplied by the price per kWh at the time of the replacement.

For FCEVs, the consulting firm Ricardo has estimated that a fuel cell stack refurbishment is necessary every seven years and costs one third the cost of a new fuel cell stack at the time of refurbishment. [167]

Fleets generally do not rebuild older vehicles as there is poorer return on investment when the vehicle is approaching the end of its life. Staff does not model any rebuilds occurring after the vehicle is 20-years-old.

Based on the above assumptions, Table 31 shows when sample vehicles are assumed to incur midlife costs. This approach may overestimate the cost of ZEVs when compared with combustion vehicles. A table of when each representative vehicle is assumed to incur its midlife cost is shown in the Vehicle Attribute Appendix.

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[162] Department of Energy, *Batteries: 2020 Annual Progress Report*, 2020 (web link: https://www1.eere.energy.gov/vehiclesandfuels/downloads/VTO_2020_APR_Batteries_compliant_.pdf, last accessed December 2021).

[163] BYD, *The BYD K9*, 2019 (web link: https://en.byd.com/wp-content/uploads/2019/07/4504-byd-transit-cut-sheets_k9-40_lr.pdf, last accessed January 2022)

[164] New Flyer, *Xcelsior Charge*, 2019 (web link: https://www.newflyer.com/site-content/uploads/2019/06/Xcelsior-CHARGE-web.pdf, last accessed January 2022)

[165] Proterra, *Catalyst: 40 Foot Bus – Performance Specifications*, 2019 (web link: https://mk0proterra6iwx7rkkj.kinstacdn.com/wp-content/uploads/2019/06/Proterra-Catalyst-40-ft-Spec-Sheet.pdf, last accessed January 2022)

[166] Steinbuch, *Tesla Model S Degradation Data*, 2015 (web link: https://steinbuch.wordpress.com/2015/01/24/tesla-model-s-battery-degradation-data/, last accessed January 2022)

[167] Ricardo, *Economics of Truck TCO and Hydrogen Refueling Stations*, 2016(web link: https://cafcp.org/sites/default/files/8_Economics-of-Hydrogen-Refueling-Stations-Ricardo_CaFCP-Bus-Team-meeting-Aug2016.pdf)

Table 31. Frequency of Midlife Rebuilds

Vehicle Group	Midlife Occurrence (year)
Class 2b Cargo Van – Gasoline	N/A
Class 2b Cargo Van – Diesel	N/A
Class 2b Cargo Van – Battery-Electric	N/A
Class 2b Cargo Van – Fuel Cell Electric	7, 14
Class 5 Walk-in Van – Diesel	15
Class 5 Walk-in Van – Battery-Electric	N/A
Class 5 Walk-in Van – Fuel Cell Electric	7, 14
Class 6 Bucket Truck – Diesel	12
Class 6 Bucket Truck – Battery-Electric	N/A
Class 6 Bucket Truck – Fuel Cell Electric	7, 14
Class 8 Refuse Packer – Diesel	12
Class 8 Refuse Packer – Natural Gas	12
Class 8 Refuse Packer – Battery-Electric	N/A
Class 8 Refuse Packer – Fuel Cell Electric	7, 14
Class 8 Day Cab – Diesel	12
Class 8 Day Cab – Natural Gas	12
Class 8 Day Cab – Battery-Electric	10
Class 8 Day Cab – Fuel Cell Electric	7, 14
Class 8 Sleeper Cab – Diesel	8, 19
Class 8 Sleeper Cab – Natural Gas	8, 19
Class 8 Sleeper Cab – Battery-Electric	5, 11, 17
Class 8 Sleeper Cab – Fuel Cell Electric	7, 14

For example, the midlife costs of a 2024 MY day cab tractor would be:

- Diesel, natural gas: midlife overhaul in 2036 at a cost of $32,500
- Battery-electric: battery replacement in 2034 at a cost of $33,717 in 2034
- Fuel cell electric: Fuel cell stack refurbishments in 2031 and 2038 at a cost of $10,460 in 2031 and $5,544 in 2038

3.1.5.6 Registration Fees

Vehicles operating and registered in California must pay an annual registration fee. The registration fee varies based on the vehicle's cost, age, and weight. These calculations are different for combustion-powered vehicles and ZEVs.

Combustion-powered vehicles and ZEVs are subject to the following fixed fees based on the DMV online calculator.[168] These are constant annual fees for every vehicle which are shown in Table 32 and Table 33.

[168] California Department of Motor Vehicles, *California New Vehicle Fees*, 2021 (web link: https://www.dmv.ca.gov/portal/dmv/detail/portal/feecalculatorweb, last accessed January 2022).

Table 32. Fixed Registration Fees for ICE Vehicles

Diesel Fee Name	Amount
Current Registration	$61
CVRA Registration Fee	$122
CVRA Service Authority for Freeway Emergencies Fee	$3
CVRA Fingerprint ID Fee	$3
CVRA Abandoned Vehicle Fee	$3
CVRA California Highway Patrol Fee	$46
Current Air Quality Management District	$6
Current Cargo Theft Interdiction Program Fee	$3
CVRA Weight Decal Fee	$3
Alt Fuel/Tech Registration Fee	$3
CVRA Auto Theft Deterrence/DUI Fee	$4
Reflectorized License Plate Fee	$1
Total	**$258**

Table 33. Fixed Registration Fees for ZEVs

ZEV Fee Name	Amount
Current Registration	$61
Current California Highway Patrol	$28
CVRA Service Authority for Freeway Emergencies Fee	$1
CVRA Fingerprint ID Fee	$1
CVRA Abandoned Vehicle Fee	$1
Current Air Quality Management District	$6
Alt Fuel/Tech Registration Fee	$3
CVRA Auto Theft Deterrence/DUI Fee	$2
Reflectorized License Plate Fee	$1

ZEV Fee Name	Amount
Road Improvement Fee	$100
Total	**$204**

All vehicles registered in California must pay a Transportation Improvement Fee based on the retail price of the vehicle. As of 2021, the fee is $171 for vehicles priced between $35,000 and $60,000, and $192 for vehicles priced above $60,000.

All registered vehicles are assessed a Vehicle License Fee which is equal to the vehicle price multiplied by 0.65 percent and a separate percentage schedule. This separate schedule is shown in Table 34.

Table 34. Vehicle License Fee Decline over Time

Year	1	2	3	4	5	6	7	8	9	10	11+
Percentage	100%	90%	80%	70%	60%	50%	40%	30%	25%	20%	15%

For commercial ICE vehicles, vehicle owners are assessed an annual weight fee based on the vehicle's potential maximum loaded weight. For electric vehicles, the weight fee is based on its unladen weight. The estimated weight fees are shown in Table 35.

Table 35. Weight Fees for ICE Vehicles and ZEVs

Weight Class	Diesel Weight Fee	ZEV Weight Fee
Class 2b-3	$210	$266
Class 4-5	$447	$358
Class 6-7	$546	$358
Class 8	$1,270	$358
Class 7-8 Tractor	$2,064	$358

Overall, ZEV's pay lower registration fees over the vehicle's life although it may be higher in the initial years of registration. This difference is greater for heavier vehicles due to the large difference in annual weight fees.

3.1.6 Other Costs

The fleet transition to medium- and heavy-duty ZEVs would cause shifts in other costs beyond upfront and general operating costs.

3.1.6.1 Residual Values

The residual value represents the value of the vehicle at the point where the initial purchaser sells the vehicle to another party. This value depends on numerous factors including the type of vehicle, its age, and the vehicle's propulsion technology and becomes more significant when modeling vehicle replacement cycles that are less than 12 years. The residual value for a vehicle is calculated using the same methodology described for used vehicles in subsection "New and Used Vehicle Prices" on page 66. For combustion-powered vehicles, this is the price of the used vehicle when it is sold out of state. This analysis reflects the net change to the California. New vehicle sales in California are expected to increase and as a result more used combustion-powered vehicles are sold out of the state. The residual value represents the increase in sales out of state.

Sales between California fleets are not reflected within this analysis as these do not represent a net change to the state – the two fleets are exchange cash for a vehicle asset which represents no net change.

3.1.6.2 Depreciation

Depreciation represents an asset's loss in value over time. This loss can be claimed as an expense and used to decrease a business's tax burden. Vehicles owned and used by businesses can have their depreciation quantified using values provided by the Internal Revenue Service (IRS) Publication 946 regarding property depreciation which may be recovered when itemizing deductions from taxes.[169] These deductions are referred to as the Modified Accelerated Cost Recovery System (MACRS) and are considered to be cost-savings.

The cost-savings from depreciation can be calculated by multiplying the vehicle's purchase price by the MACRS depreciation rate and the corporate tax rate. Per the IRS publication, most trucks follow a 5-year depreciation schedule while tractors follow a 3-year deprecation schedule. ZEVs and combustion-powered vehicles use the same depreciation rates. The amount of deprecation year-over-year is shown in Table 36.

Table 36. Depreciation Rate by Age

Age	0	1	2	3	4	5	6+
Truck	20.00%	32.00%	19.20%	11.52%	11.52%	5.76%	0%
Tractor	33.33%	44.45%	14.81%	7.41%	0%	0%	0%

The vehicle value depreciated per year is multiplied by the corporate tax rate to determine the amount of tax savings per year. The California corporate tax rate is 8.84 percent, and the

[169] Internal Revenue Service, *Publication 946 (2020), How To Depreciate Property*, 2020 (web link: https://www.irs.gov/pub/irs-pdf/p946.pdf, last accessed January 2022).

federal corporate tax rate is 21 percent.[170,171] Public fleets are not assumed to claim depreciation as they do not file State or federal income taxes.

3.1.6.3 Insurance

Fleets purchase insurance policies to protect against financial loss and a variety of unexpected events including damaging other property, damage to the vehicle, medical coverage in the event of an accident, and others. Because ZEVs are anticipated to cost more than their combustion-powered counterparts, vehicle coverage is anticipated to be more costly as well.

Table 37 shows the estimated cost of various insurance coverage components based on several sources staff identified.[172,173,174]

Table 37. Estimated Annual Semi-Truck Insurance Policy Costs

Types of Insurance Coverage	Policy Cost
Primary Liability	$6,000
General Liability	$550
Umbrella Policy	$600
Physical Damage	$2,000
Bobtail Insurance	$375
Uninsured/Underinsured Motorist	$75
Occupational Accident	$1,900

Physical damage is the only coverage element that depends on the cost of the vehicle being operated. The other coverage types are not dependent on the cost of the vehicle. For

[170] Franchise Tax Board, *Business Tax Rates*, 2021 (web link: https://www.ftb.ca.gov/file/business/tax-rates.html, last accessed January 2022).
[171] Internal Revenue Service, *Publication 542, Corporation*, 2021 (web link: https://www.irs.gov/publications/p542, last accessed January 2022).
[172] Forerunner Insurance Group, *What does Average semi truck insurance costs for owner operators?*, 2018 (web link: https://www.forerunnerinsurance.com/what-does-average-semi-truck-insurance-costs-for-owner-operators/, last accessed January 2022).
[173] Commercial Truck Insurance HQ, *Average Semi Truck Insurance Cost*, 2019 (web link: https://www.commercialtruckinsurancehq.com/average-semi-truck-insurance-cost, last accessed January 2022).
[174] Strong Tie Insurance, *Why You Need a Commercial Semi Truck Insurance Coverage*, 2021 (web link: https://www.strongtieinsurance.com/semi-truck-insurance/, last accessed January 2022).

example, if truck were to crash into a signpost, the cost of the truck would not affect the cost of paying to replace the signpost.

The "Physical Damage" coverage costs 1/70th of the price of a new semi-truck; for the purpose of this analysis, staff assumes the "Physical Damage" insurance cost is proportional to 1/70th the cost of the vehicle when new. Insurance costs for a vehicle decline over time as the value of the vehicle decreases. Staff assumes the insurance costs decline at the same rate as shown in subsection "New and Used Vehicle Prices" on page 66.

3.1.6.4 Transitional Costs and Workforce Development

Transitioning to a new technology has inherent costs associated with its deployment, including shifts in operational and maintenance practices. These recurring costs include operator and technician trainings, purchasing and upgrading of software, securing additional spare parts, and others.

Limited information is available for this type of transitional cost, but discussions occurred on this topic during the development of the ICT regulation. Based on discussions with transit agencies, staff assumes that these "other costs" associated with ZEB deployments are equivalent to 2.5 percent of bus prices for all powertrains and should go down over time for ZEBs as they become more common.[175]

In the cost analysis for the proposed regulation, staff make similar assumptions that the workforce training and transitional costs are equal to 2.5 percent of the incremental cost difference between a baseline combustion vehicle and a ZEV given that the transitions transit agencies will be making are similar to changes made by trucking fleets. These costs continue until 2030 at which point the technology will have developed to a point where these transitional costs become BAU for trucking fleets.

3.1.6.5 Reporting Costs

Fleets subject to the proposed regulation would need to report information annually to demonstrate compliance. Reporting would include company contact information, vehicle registration information, and engine family numbers for tractors approaching the end of their useful life. Staff estimates that to report annually, a fleet of 50 vehicles would need an average of 12.5 hours, and would be proportionally longer based on the number of vehicles. Staff anticipates most fleets would already have the information requested available in databases. This time estimate includes collecting information from vehicles, placing the information into a spreadsheet, verifying the information, and reporting it into a CARB database. The hourly staffing cost is assumed to be $24.13 per hour for the employee assigned to pull the information.[176]

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[175] Transit Agency Subcommittee-Lifecycle Cost Modeling Subgroup, Report of Findings, 2017.
[176] U.S. Bureau of Labor Statistics, *Occupational Outlook Handbook – Diesel Service Technicians and Mechanics*, 2021 (web link: https://www.bls.gov/ooh/installation-maintenance-and-repair/diesel-service-technicians-and-mechanics.htm, last accessed January 2022).

3.1.6.6 Battery Recycling, Repurposing, and Disposal

The energy capacity of the batteries used in ZEVs will naturally degrade over their useful lives and require battery replacements. When battery capacity is not sufficient for meeting daily range needs for a truck or bus, it is expected that there will be a second life for the batteries. Used batteries can be repurposed into other applications such as stationary storage, then at the end of those battery lives can be recycled and non-recyclable materials can be disposed.

The cost for battery recycling at the end of battery life is not included here, because this cost could be offset by the residual value of the battery. The end of life may be a revenue source depending on whether the battery can be recycled and repurposed or could become a cost if it must be disposed of. Light-duty vehicle batteries are already being repurposed for second life applications including stationary storage.[177,178] Even today, some lithium-ion battery manufacturers provide an attractive residual value to customers upon the retirement of a battery. Therefore, staff believes that the residual value will offset the recycling cost and become a revenue source, but does not include a residual battery value in the economic analysis.

3.1.7 Total Costs

The proposed regulation would increase the number of medium- and heavy-duty ZEVs purchased in California relative to the Legal Baseline scenario. This means that all costs would be above and beyond the costs already expected with the ACT regulation. The increased ZEVs sales have higher upfront capital costs initially for the vehicle and infrastructure investments, but lower operating costs over time resulting in net savings for truck transportation in California. When assuming all costs are borne by fleets operating in California the proposed regulation results in a net cost of -$12.4 billion between 2020 and 2050 compared to the Legal Baseline scenario. This represents a substantial net decrease in costs and does not include indirect health cost-savings. Figure 21 and Table 39 illustrates the incremental difference in costs between the proposed regulation and the Legal Baseline scenario. Note that the incremental cost increases and decreases are mainly due to the number of ZEVs purchased in a given time frame, the actual incremental cost of ZEVs is declining steadily over this timeframe. In Figure 21, the cost components are grouped as shown Table 38.

[177] Nissan Motor Corporation, *Nissan LEAF batteries to light up Japanese town*, 2018 (web link: https://newsroom.nissan-global.com/releases/180322-01-e?lang=en-US&la=1&downloadUrl=%2Freleases%2F180322-01-e%2Fdownload, last accessed January 2022).

[178] BMW Group, BMW Group, *Northvolt and Umicore join forces to develop sustainable life cycle loop for batteries* (web link: https://www.press.bmwgroup.com/global/article/detail/T0285924EN/bmw-group-northvolt-and-umicore-join-forces-to-develop-sustainable-life-cycle-loop-for-batteries, last accessed January 2022).

Table 38. Summarized Cost Items

Cost Category	Components
Vehicle Cost	Vehicle Cost, Sales Tax, Federal Excise Tax, Residual Values
Fuel Cost	Gasoline, Diesel, Electricity, Hydrogen Fuel Cost, Fuel Taxes
LCFS Revenue	LCFS Revenue
Infrastructure	Charger Costs, Infrastructure Upgrades, Charger Maintenance
Maintenance	Vehicle Maintenance Costs, Maintenance Bay Upgrades
Midlife	Midlife Costs
Other	DEF Consumption, Registration Fees, Depreciation, Insurance, Transitional Costs, Reporting Costs

Figure 21. Total Estimated Direct Costs of Proposed Regulation Relative to the Legal Baseline Scenario (million 2021$)

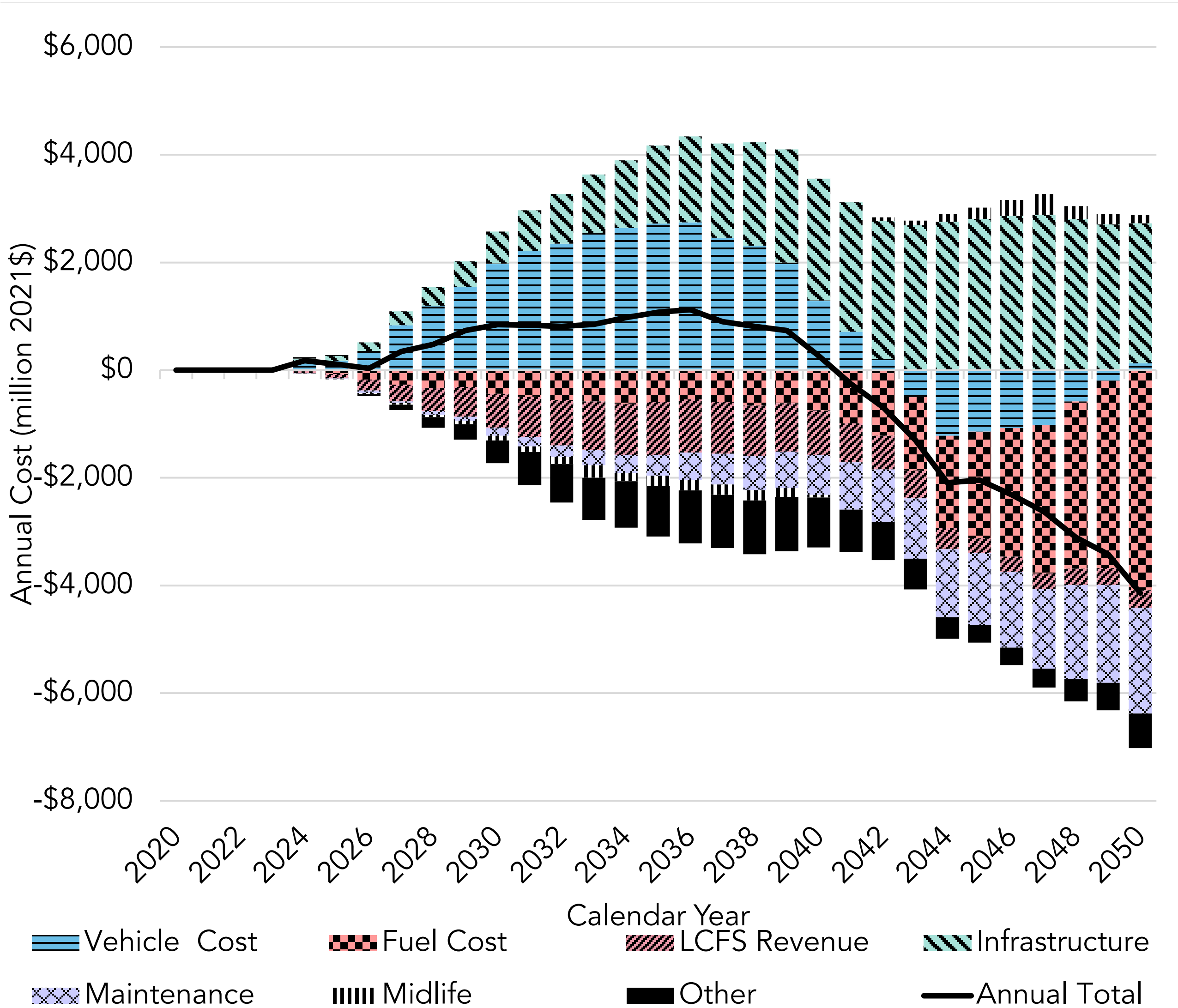


Table 39. Total Incremental Direct Costs of Proposed Regulation Relative to Legal Baseline Scenario (million 2021$)

Year	Vehicle Price	Sales and Excise Tax	EVSE & Infrastructure Installation	Maintenance Bay Upgrades	Fuel Cost	DEF Consumption	LCFS Revenue	Maintenance Cost	Midlife Costs	Registration Fees	Transitional Costs	Residual Values	Depreciation	Insurance Cost	Reporting Cost	Total Costs	Total Savings	Total*
2024	$152	$22	$39	$9	-$25	$0	-$34	-$9	-$2	$0	$26	$0	-$6	$3	$3	$254	-$76	**$178**
2025	$213	$47	$97	$13	-$72	-$1	-$79	-$25	-$5	-$2	$33	-$93	-$24	$7	$3	$413	-$301	**$112**
2026	$533	$226	$157	$13	-$178	-$4	-$198	-$62	-$19	-$8	$32	-$404	-$80	$19	$3	$983	-$953	**$30**
2027	$961	$299	$255	$78	-$269	-$8	-$310	-$102	-$35	-$17	$61	-$425	-$177	$34	$3	$1,691	-$1,343	**$348**
2028	$1,257	$244	$354	$75	-$335	-$11	-$425	-$139	-$47	-$24	$57	-$308	-$266	$42	$3	$2,032	-$1,555	**$477**
2029	$1,664	$379	$474	$121	-$312	-$17	-$555	-$193	-$66	-$35	$71	-$495	-$365	$57	$3	$2,769	-$2,038	**$731**
2030	$2,079	$392	$595	$117	-$442	-$23	-$635	-$264	-$87	-$52	$67	-$489	-$487	$67	$4	$3,321	-$2,479	**$842**
2031	$2,381	$484	$751	$159	-$500	-$30	-$748	-$333	-$109	-$72	$0	-$650	-$595	$81	$4	$3,860	-$3,037	**$823**
2032	$2,627	$461	$925	$180	-$561	-$37	-$851	-$398	-$130	-$90	$0	-$742	-$683	$92	$4	$4,289	-$3,492	**$797**
2033	$2,849	$368	$1,084	$168	-$588	-$43	-$917	-$451	-$228	-$108	$0	-$667	-$732	$95	$4	$4,568	-$3,734	**$834**
2034	$3,004	$469	$1,260	$209	-$640	-$51	-$969	-$537	-$152	-$136	$0	-$835	-$778	$102	$4	$5,048	-$4,098	**$950**
2035	$3,149	$455	$1,449	$235	-$603	-$59	-$1,010	-$615	-$193	-$164	$0	-$884	-$829	$107	$4	$5,399	-$4,357	**$1,042**
2036	$2,881	$344	$1,594	$187	-$569	-$67	-$1,008	-$691	-$199	-$193	$0	-$479	-$827	$101	$4	$5,111	-$4,033	**$1,078**
2037	$2,635	$372	$1,750	$206	-$617	-$75	-$992	-$775	-$195	-$226	$0	-$550	-$788	$98	$4	$5,065	-$4,218	**$847**
2038	$2,547	$397	$1,923	$229	-$694	-$84	-$968	-$859	-$190	-$259	$0	-$634	-$762	$98	$4	$5,198	-$4,450	**$748**
2039	$2,311	$366	$2,106	$247	-$659	-$92	-$930	-$919	-$169	-$286	$0	-$681	-$731	$94	$4	$5,128	-$4,467	**$661**
2040	$1,429	-$103	$2,262	$284	-$809	-$99	-$847	-$1,024	-$53	-$309	$0	-$31	-$584	$62	$4	$4,041	-$3,859	**$182**
2041	$923	-$49	$2,402	$285	-$1,055	-$107	-$751	-$1,162	$8	-$340	$0	-$160	-$385	$39	$4	$3,661	-$4,009	**-$348**
2042	$464	$16	$2,563	$315	-$1,293	-$116	-$650	-$1,294	$67	-$369	$0	-$271	-$254	$25	$4	$3,454	-$4,247	**-$793**
2043	-$351	-$264	$2,688	$228	-$1,446	-$119	-$536	-$1,348	$86	-$379	$0	$113	-$81	$2	$4	$3,121	-$4,524	**-$1,403**
2044	-$1,034	-$190	$2,756	$178	-$1,799	-$122	-$414	-$1,436	$140	-$394	$0	$7	$121	-$12	$4	$3,206	-$5,401	**-$2,195**
2045	-$950	-$103	$2,811	$191	-$2,068	-$126	-$289	-$1,525	$207	-$409	$0	-$92	$221	-$17	$4	$3,434	-$5,579	**-$2,145**
2046	-$877	-$48	$2,867	$199	-$2,482	-$131	-$296	-$1,606	$297	-$421	$0	-$150	$239	-$17	$4	$3,606	-$6,028	**-$2,422**
2047	-$830	$2	$2,889	$203	-$2,851	-$135	-$304	-$1,681	$379	-$431	$0	-$193	$225	-$14	$5	$3,703	-$6,439	**-$2,736**
2048	-$399	$59	$2,806	$0	-$3,205	-$140	-$314	-$1,751	$240	-$442	$0	-$241	$174	-$10	$5	$3,284	-$6,502	**-$3,218**
2049	-$27	$92	$2,704	$0	-$3,585	-$145	-$324	-$1,816	$195	-$451	$0	-$263	$85	-$4	$5	$3,081	-$6,615	**-$3,534**
2050	$285	$129	$2,598	$0	-$4,199	-$157	-$341	-$1,966	$154	-$483	$0	-$286	-$8	$2	$5	$3,173	-$7,440	**-$4,267**
Total*	$29,878	$4,868	$44,159	$4,127	-$31,856	-$1,998	-$15,697	-$22,982	-$107	-$6,102	$347	-$9,904	-$8,378	$1,155	$106	$84,640	-$97,024	-$12,384

*Note: Totals may differ due to rounding

Further detailed information on the costs of the different fleets subject to the proposed regulation versus the Legal Baseline are discussed in more detail in the Additional Cost Information Appendix.

Deploying more medium- and heavy-duty ZEVs due to the proposed regulation would result in a net decrease in costs to the California economy. Fleets would be expected to have higher vehicle costs and infrastructure expenses, but would also save money overall on fuel, LCFS revenue, maintenance savings, increased depreciation benefits, and other factors. Despite these potential savings, some fleets remain reluctant in shifting to ZEV technology.

The issues affecting decision-making regarding ZEVs are being analyzed in numerous reports by speaking with fleets.[179] Common themes identified include:

- **High vehicle upfront costs.** Today, a ZEV can range from 20 percent higher cost to as much as 2 to 3 times more than a similar conventional vehicle. While these costs are anticipated to decline, the higher upfront cost of ZEVs places a significant barrier in vehicle purchasing patterns. These costs are often a more significant barrier to smaller fleets with limited access to capital and higher borrowing costs. A combination of declining costs, incentives, and innovative financing models can defray these upfront investments and reduce the impact of these issues.
- **Inertia of combustion-powered vehicles**. Diesel and gasoline vehicles enjoy an inherent advantage versus newer technologies solely due to their established footprint in the market. Business models, duty cycles, agreements, and other core business practices are based on the established trends of fossil fuel powered vehicles. Fleets would need to spend additional time and resources planning for a transition to ZEV technologies that does not exist when staying with the status quo.
- **Uncertainty and lack of data.** Fleets have a wealth of information available about how their existing vehicles operate based on historical data which has been gathered for decades. However, this data currently does not exist for ZEVs. Information on medium- and heavy-duty ZEVs such as prices, residual values, battery deterioration, fuel economy, maintenance, and other factors are not as readily available for fleets. This information gap creates challenges in the decision-making process for fleets.
- **One-to-one Replacement.** Fleets have voiced concerns that a ZEV would not be able to perform the same work as an existing combustion-powered vehicle on a one-to-one basis due to payload, mileage, or other issues. Today, ZEVs cannot meet every duty cycle with a one-to-one replacement; however, ZEVs have shown that they can meet some duty cycles on a one-to-one basis today and as the technology continues to improve, more applications can transition to zero-emission with a one-to-one replacement.
- **Electricity rate structures.** Typical commercial and industrial rate structures are not always optimized for medium- and heavy-duty electrification. These rates have been traditionally designed for steady electricity usage with high fixed loads, not the

[179] Electrification Coalition, *Electrifying Freight: Pathways to Accelerating the Transition*, 2020 (web link: https://www.electrificationcoalition.org/wp-content/uploads/2020/11/Electrifying-Freight-Pathways-to-Accelerating-the-Transition.pdf, last accessed January 2022).

intermittent usage associated with ZEV charging. This can result in higher electricity costs for fleets that are charging their vehicles in low-duration, high-power sessions if charger utilization is low. In response to these issues, the state's 3 largest investor-owned utilities, PG&E, SCE, and SDG&E, have all proposed commercial ZEV electricity rates. These new rates address issues that fleets are currently facing and will lower the cost of charging for ZEVs. This makes them a more competitive option versus their combustion counterparts. Further efforts are being made by the public utilities.

- **Stranded assets.** Fleets who have made investments in combustion-powered vehicles and infrastructure want to ensure they use their assets for their full useful life. The proposed regulation allows fleets to keep their vehicles for their full useful life as defined SB 1 which ensures existing vehicles and their supporting infrastructure can be used until the end of that asset's lifetime. Therefore, economic impacts of asset "stranding" are not likely to occur as no assets need be stranded. To the degree fleets opt to retire or replace vehicles early, they will be doing so because they view that course as the superior economic compliance choice.
- **Infrastructure planning and installation.** Switching from primarily diesel and gasoline to ZE technologies represents a paradigm shift for fleets. ZEVs require a completely different refueling strategy to fleets that can be a challenge with insufficient planning. Some issues identified include lead times for construction and interconnection, grid reliability, accommodating site layout and parking considerations, and site load management. However, numerous efforts are underway to address these issues. Under direction of SB 350, CPUC has approved applications from the state's investor-owned utilities for nearly $700 million over 5 years to support utility investments in medium-duty, heavy-duty, and off-road vehicle electrification. These programs will provide utility experience in delivering power to fleet's locations. The CEC has recently launched a $50 million program to fund medium-duty, heavy-duty, and off-road infrastructure titled EnergIIZE.[180] The program is a part of CEC's 2020-2023 investment plan to invest $129.8 million in medium- and heavy-duty ZEVs and infrastructure by 2023.[181] Private companies have also formed to streamline the process of fleet electrification by offering an all-in-one package to fleets. These programs are not included in the staff cost analysis and would lower the actual cost to fleets.

3.1.8 Cost-Effectiveness

Overall, the proposed regulation would result in significant emissions reductions but the net costs are lower than the Legal Baseline. For this reason, the costs and benefits are compared

[180] California Energy Commission, *Energy Commission Announces Nation's First Incentive Project for Zero-Emission Truck and Bus Infrastructure*, 2021 (web link: https://www.energy.ca.gov/news/2021-04/energy-commission-announces-nations-first-incentive-project-zero-emission-truck, last accessed January 2022).

[181] California Energy Commission, *CEC Approves $384 Million Plan to Accelerate Zero-Emission Transportation*, 2020 (web link: https://www.energy.ca.gov/news/2020-10/cec-approves-384-million-plan-accelerate-zero-emission-transportation, last accessed January 2022).

as a benefit-cost ratio. Table 40 shows the estimated benefit-cost ratio for the proposed regulation.

Table 40. Benefit-Cost Ratio of the Proposed Regulation (billion $2021)

	Total Costs (TC)*	Cost-Savings (benefit)*	Health Benefits*	Tax and Fee Revenue	Total Benefit (TB)**	Net Benefit (TB – TC)	Benefit-Cost Ratio (TB ÷ TC)
Proposal	$84.6	$97.0	$61.7	-$36	$122.7	$38.1	1.5

*Total Costs and Cost-Savings are shown in Table 39 and Health Benefits in Table 10.
**Total Benefit = Cost-Savings + Health Benefits + Tax and Fee Revenue.

3.2 Direct Costs on Typical Businesses

Table 41 illustrates an example delivery fleet that owns 100 Class 5 walk-in vans and 100 Class 8 day cab tractors. This example can represent a fleet who moves goods to and from warehouses along freight corridors and to local distribution hubs. The costs from 2020-2050 are shown for a fleet in the Legal Baseline that only owns diesel vehicles purchased new in California, and under the ACF proposal scenario where the fleet would transition all their vehicles from diesel to battery-electric. In the baseline, the fleet operates their vehicles 10 years before replacing them and as a result buys 10 box trucks and 10 day cabs tractors per year. Under the proposed regulation, the fleet would meet the ZEV milestone targets set under the high priority fleet requirements and add ZEVs to the fleet. In the early years of the proposed regulation, the fleet can comply by ensuring a portion of their new purchases are ZEVs, but as the fleet approaches its 100 percent requirements it will need to accelerate replacement to ensure all diesel-powered vehicles leave the fleet and are replaced by ZEVs. This scenario assumes the fleet meets the minimum compliance requirements and assumes the fleet does not purchase any ZEVs early to avoid accelerated replacement. All other mileage and cost assumptions are the same as described previously in this section.

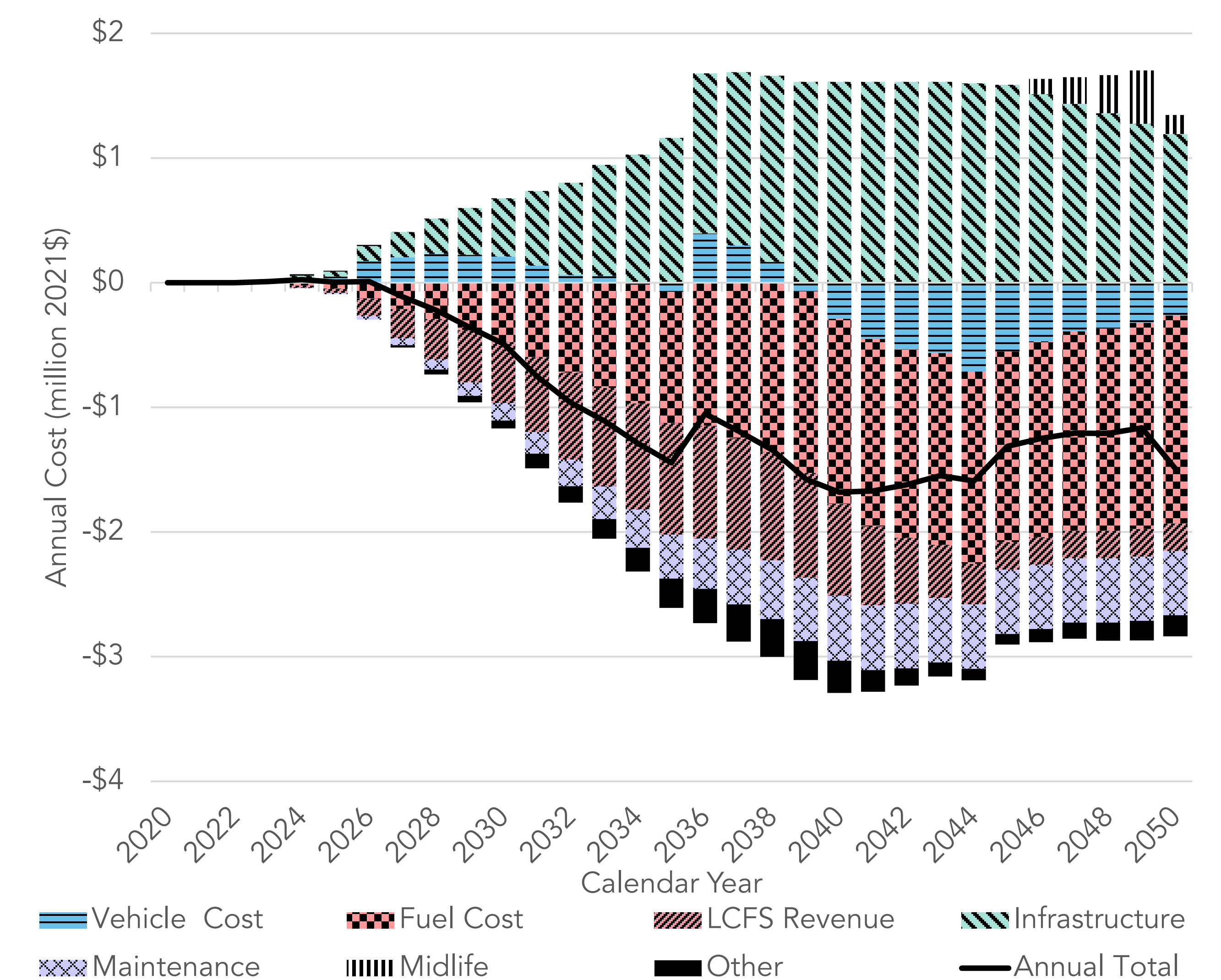
The costs over the analysis period are lower for the battery-electric fleet as compared to the diesel fleet (even with infrastructure costs included); however, the upfront capital expenses are higher initially but become lower after about 2035. Access to capital or financing will be critical for fleets to take advantage of the overall savings of medium- and heavy-duty ZEVs. Figure 22 shows the estimated costs for examples of a typical business.

Table 41. Typical Business Cumulative Cost Example 2024 to 2050 (2021$)

Cost line items	Legal Baseline 2030	ACF Proposal 2030	Legal Baseline 2040	ACF Proposal 2040	Legal Baseline 2050	ACF Proposal 2050	Difference 2050
Vehicle Price	$14,685,731	$15,642,581	$45,035,881	$47,818,215	$75,443,467	$73,298,665	-$2,144,802
Sales and Excise Tax	$2,698,173	$2,865,414	$6,655,722	$6,938,354	$10,613,271	$10,277,552	-$335,719

Cost line items	Legal Baseline 2030	ACF Proposal 2030	Legal Baseline 2040	ACF Proposal 2040	Legal Baseline 2050	ACF Proposal 2050	Difference 2050
EVSE & Infrastructure Costs	$0	$1,521,346	$0	$13,334,088	$0	$28,131,027	$28,131,027
Maintenance Bay Upgrades	$0	$48,274	$0	$219,195	$0	$230,975	$230,975
Fuel Cost	$31,129,984	$29,577,440	$68,629,847	$56,212,495	$107,407,314	$79,251,569	-$28,155,744
DEF Consumption	$420,289	$376,413	$904,788	$509,296	$1,384,947	$509,296	-$875,651
LCFS Revenue	$0	-$1,667,673	$0	-$9,745,633	$0	-$12,987,057	-$12,987,057
Maintenance Cost	$10,338,830	$9,849,816	$23,200,191	$18,928,186	$36,061,552	$26,624,399	-$9,437,153
Midlife Costs	$1,040,667	$1,040,667	$1,040,667	$1,040,667	$1,040,667	$2,263,707	$1,223,040
Registration Fees	$3,476,624	$3,345,371	$7,797,402	$6,338,450	$12,124,155	$8,639,178	-$3,484,977
Transitional Costs	$0	$214,835	$0	$214,835	$0	$214,835	$214,835
Residual Values	-$5,317,209	-$5,317,209	-$11,920,089	-$13,200,401	-$18,847,839	-$19,214,791	-$366,952
Depreciation	-$3,517,882	-$3,748,519	-$12,059,103	-$12,928,904	-$20,648,988	-$20,114,349	$534,639
Insurance Cost	$1,420,767	$1,463,448	$3,227,538	$3,296,439	$5,048,820	$4,898,627	-$150,193
Reporting Cost	$0	$9,652	$0	$21,717	$0	$33,782	$33,782
Total	**$56,375,973**	**$55,221,857**	**$132,512,843**	**$118,996,999**	**$209,627,367**	**$182,057,416**	**-$27,569,951**

Figure 22. Estimated Costs of Proposed Regulation to the Example Typical Business (million 2021$)



3.3 Direct Costs on Small Businesses

The example small business modeled is a drayage truck owner-operator subject to the drayage truck requirements. Drayage truck owners generally own 1 to 3 tractors and represent approximately 25 percent of drayage businesses. This percentage is based on vehicle identification numbers for tractors registered at the San Pedro Bay and Oakland seaports compared to California's DMV address registration data.

In the Legal Baseline scenario, the operator purchases a 2014 MY diesel day cab tractor in 2022 and operates it for 12 years. Following that, the operator would continue the pattern of purchasing an 8-year-old diesel day cab tractor and operating it for 12 years. In this example, the drayage operator purchases 8-year-old used tractors in 2034 and 2046.

Oregon’s proposed clean truck rules give manufacturers an off ramp from sale requirements

By **Monica Samayoa** (OPB)
April 1, 2025 8:10 p.m.

Daimler Trucks North America will be manufacturing two new models of electric heavy duty trucks at its factory in Portland.
Courtesy of Daimler Trucks North America

Environmental regulators are proposing rules that would offer truck manufacturers a pathway to meet Oregon’s medium- to heavy-duty zero-emission trucks guidelines, even if they don’t sell an electric truck.

Officials say this would give the trucking industry time to develop more zero-emission heavy-duty vehicles while still following Oregon Gov. Tina Kotek's request to keep the rules.

Under the Oregon Department of Environmental Quality's proposed Clean Truck Rules, the Oregon Optional Credit Program would provide credits to truck makers who continue to sell diesel trucks in 2025 and 2026. Those credits would offset penalties the truck makers might otherwise incur by failing to sell cleaner vehicles.

DEQ Senior Transportation Policy Advisor Gerik Kransky said the program would support an eventual transition to zero-emission vehicles.

"There have been sort of limits on availability of all vehicles, and this optional credit program is designed to ensure that there are credits available for manufacturers to sell all vehicle types starting now, and we think that will help get the manufacturers accustomed to engaging with the credits and deficits," he said.

Kransky said a requirement to participate in the program would be to agree to "no sales restrictions" of internal combustion vehicles.

That requirement comes after Portland-based Daimler Truck North America abruptly halted sales of its internal combustion engine vehicles in December after receiving incorrect information from DEQ about how it would receive credits when the temporary rules were adopted. The company resumed sales in mid-January after DEQ clarified the program's rules.

Kransky said there are still some manufacturers withholding sales of their diesel trucks because they want to avoid a penalty from the agency. He said because of this, DEQ created the credit program that would provide 100% of credits needed for manufacturers of large trucks to stay in compliance with the law through at least 2026 without financial penalties.

Those include companies that make 18-wheelers. It would provide 50% worth of credits for all other truck classes, such as pickups, vans and delivery trucks.

DEQ may consider extending the credit program based on the state's greenhouse gas emissions, public health and truck market conditions.

DEQ's Clean Truck Rules are trying to align with California's vehicle and truck emission standards. Oregon is one of 10 states that have adopted California's standards for these vehicles.

Kransky said "the credit program does not change the zero emissions vehicle delivery requirements" under Oregon law, and the state would stay aligned with California.

The U.S. Environmental Protection Agency under the Trump administration has targeted California's clean vehicle rules as being too costly, and Republicans have said they are looking for a path to repeal federal waivers that allow the emissions restrictions.

Continued pushback

Besides the addition of the credit program, Oregon's Clean Truck Rules are facing other proposed changes. Those changes would allow truck companies up to three additional years to be in compliance with state emissions rules. They also would permanently delay rules limiting nitrogen oxide pollution from fossil fuel engines.

Leaders in the trucking industry have said Oregon's rules are not ready to be implemented, saying there are not enough zero-emission trucks that could meet industry needs for hauling heavy loads and driving long distances. They've also pointed out the lack of public charging infrastructure for heavy-duty trucks.

Meanwhile, environmental and public health advocates say the rules have to move forward to reduce the state's greenhouse gas emissions. According to DEQ, the transportation sector accounts for 35% of Oregon's overall greenhouse gas emissions.

The push and pull over the rules has also prompted Kotek to send a letter to DEQ in March requesting the agency find a way "to quickly develop a solution" for the largest truck makers.

Last month, Environmental Quality Commissioner Chair Matt Donegan questioned whether the rules were ready to be implemented later this year and suggested a one- to two-year delay may not be enough time to address all the issues.

State Rep. Shelly Boshart-Davis, R-Albany, said the proposed rules from DEQ still won't work.

"I've come to a conclusion that either DEQ doesn't want to make this work or doesn't know how to make this work because there's no manufacturers out there or dealerships, or anybody, that says this will work," she said.

Representative Shelly Boshart Davis, R-Albany, Feb. 5, 2024, on the opening of the legislative short session at the Oregon state Capitol in Salem, Ore.
Kristyna Wentz-Graff / OPB

Boshart-Davis is the chief sponsor of a House bill that would delay the implementation of the Advanced Clean Truck rules to 2027. The bill is set for a work session on April 8.

She's heard from truck manufacturers that sales are down because they are trying to sell a zero emissions truck that would keep them in compliance with the rules before they sell a diesel engine. Because of that, truck manufacturers and dealers have not been able to sell any diesel-powered vehicles, she said.

DEQ's rules do not ban the sale of diesel truck engines, rather they increase the required

Boshart-Davis also said the proposed credit program is not a program that California has and questioned if Oregon is opening itself to legal risk by diverging from California's rules.

"This credit process or this credit scheme, whatever you want to call it, isn't happening in California, so therefore, it's not identical," she said. "And so doing this takes a risk and puts people up for risk of litigation to be sued because they're not following this. So legally this is not identical to California."

DEQ is seeking public comment on the rules through April 23. The agency will hold a public hearing on April 17. The Environmental Quality Commission is set to vote on the proposed rules in July.

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Oregon could again delay clean truck rules to give technology, chargers time to catch up

The Oregon Department of Environmental Quality staff have recommended a plan for adopting clean truck rules, but some commissioners say the industry may need a longer delay to keep up with the rules.

March 13, 2025

Daimler resumes diesel truck sales in Oregon

Daimler Truck North America resumes sales of its diesel trucks in Oregon on Monday, after clarifying recently implemented sales rules with the Oregon Department of Environmental Quality.

Jan. 14, 2025

Tags: Environment, Transportation, Climate Change

News

Statements by Colorado State Agencies and Auto Industry Following Adoption of Agreement on Electric Vehicles

August 16, 2019 - Statewide

After the 8-1 vote by the Colorado Air Quality Control Commission (AQCC) approving a joint alternative regulatory proposal on Zero Emission Vehicle (ZEV) regulation, the Colorado Department of Transportation (CDOT), Colorado Department of Public Health and the Environment (CDPHE), Colorado Energy Office (CEO), Alliance of Automobile Manufacturers and Association of Global Automakers released the following statements:

“With transportation on track to become the number one source of emissions in Colorado, we must reduce congestion on the road and pollution in the air,” **said CDOT Executive Director Shoshana Lew**. “With the adoption of this rule, government and industry will work together to achieve a win-win, by making cleaner vehicle choices available to Coloradans consumers sooner. We are grateful to the automakers for working with us to reach agreement on a negotiated Zero Emissions Vehicle rule — the first of its kind in any state.”

“We are charged up and ready to roll. The adoption of the zero-emission vehicle standard is a clear demonstration of our unrelenting commitment to making sure that every Coloradan has clean air to breathe,” **said Colorado Department of Public Health and Environment Executive Director Jill Hunsaker Ryan**.

"Colorado already has one of the strongest electric vehicle markets in the country, both because we have multiple policies that support EV adoption—and Colorado consumers demand EVs," **said CEO Executive Director Will Toor**. "The Zero Emission Vehicle standard just adopted by the Air Quality Control Commission will turbocharge the market here. We believe this will get a million EVs on the road by 2030, which is critical to meeting clean air standards and Colorado's greenhouse gas reduction goals. We look forward to working with auto manufacturers in this cooperative effort."

“We are appreciative of the Polis administration for working with automakers to develop a plan that will help the auto industry transition into the ZEV program,” **said David Schwietert, the interim president and CEO of the Alliance of Automobile Manufacturers**. “Automakers want to put more electric vehicles on the roads in Colorado, and AQCC's decision, coupled with Colorado’s extensive investments in consumer incentives and infrastructure, will help pave the way to do just that.”

“This collaboration between automakers and state officials represents a forward-thinking process that addresses the challenges of increasing electrification with smart and innovative regulatory policy,” **said John Bozzella, Global Automakers’ president and CEO**. “As a result, the goals of all parties are advanced and will lead to more electric vehicles in Colorado.”

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Sorry, California – Gov. Polis claims Colorado is now the top state for EV adoption

By Sam Brasch · Dec. 4, 2024, 2:55 pm

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An electric vehicle hooked up to a charging station in Superior, Colorado, June 12, 2024.

A new report suggests no state is adopting plug-in vehicles faster than Colorado.

The latest data come from the Northeast States for Coordinated Air Use Management, a regional association of air pollution agencies along the East Coast. The group produced the report to measure the impact of state-level EV policies.

By analyzing national vehicle sales figures, the consortium found EVs accounted for 25.3 percent of new cars sold or leased in Colorado in the third quarter of 2024. California, by comparison, reported a 24.3 percent EV market share over the same period.

The small difference means Colorado has overtaken the Golden State, which has spent years setting the pace for EV adoption nationwide. The states with the next largest EV market share are Washington, Nevada, Oregon and New Jersey.

"It's the first time any state has exceeded the EV market share in California," said Will Toor, the director of the Colorado Energy Office. "It just illustrates all the work done in Colorado to make sure that EVs are affordable and charging is available and convenient."

Gov. Jared Polis also celebrated Colorado pulling ahead of other states in the race to transition away from fossil fuel-powered vehicles. In a press release sent on Wednesday, he said Colorado residents have opted for EVs because they're fun to drive, quiet and affordable, partially due to generous rebates pushed by his administration.

The latest surge in EV adoption comes amid what's likely a peak of incentives available to Colorado residents. The state currently offers a $5,000 EV tax credit, but the discount

Trump has also signaled its intentions to kill the federal EV tax credit, which can cut the cost of a new EV by up to $7,500.

The new rankings, however, measure sales of all cars capable of plugging into an outlet. The category includes battery-powered vehicles and plug-in hybrids, which carry an internal combustion engine and a rechargeable battery pack. California had a slightly higher market share for pure battery-powered EVs in the third quarter of 2024, according to the Northeast States for Coordinated Air Use Management.

Jeremy Hunt, an EV analyst for the consortium of air quality regulators, said the data is a "snapshot," and he wouldn't be surprised if the EV adoption ranking shifts in the future. At the same time, the report reveals some interesting trends, like Colorado earning the top spot by embracing EVs made by manufacturers other than Tesla.

In California, Tesla accounted for 10.6 percent of passenger cars sold during the third quarter of 2024 compared to 4.5 percent in Colorado. By adopting plug-in hybrids and non-Tesla EVs at a faster clip, Colorado nevertheless managed to surpass California's EV adoption rate.

Colorado Nissan dealers are likely one factor driving the pattern. In the last year, the car sellers have leveraged the state EV tax credit to offer rock-bottom lease deals on the Nissan Leaf and Nissan Ariya, two relatively affordable EV models. Boulder Nissan, for example, will lease an entry-level Nissan Leaf for $5 per month after a Colorado resident pays roughly $1,900 in dealer fees plus relevant sales taxes.

A similar report from the Colorado Auto Dealers Association released in October found Colorado ranked second in the country for EV market share. Those figures measured EV sales during the first three quarters of 2024 rather than only the third quarter of 2024. Both reports are based on data compiled by Experion, one of the country's top sources of automotive sales data.

Margo Finer, a spokesperson for the auto dealers association, told CPR News the group was still reviewing the latest report. If Colorado has taken the lead for EV adoption, Finer said it would be great news, but her group wasn't ready to confirm the updated ranking.

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ELECTRIC VEHICLES COULD CREATE HUNDREDS OF THOUSANDS OF NEW AMERICAN JOBS—IF POLICIES HOLD

March 14, 2025 | By: Logan Pierce and Jen Callahan

While there remains great momentum behind developing domestic supply chains to produce electric vehicles (EVs) in the United States, any new steps to roll back supporting policies risk forfeiting the thousands of jobs that could be gained. As just one example, we estimate that if funding for the National Electric Vehicle Infrastructure (NEVI) program is eliminated (it was paused earlier this month), 13,000 charging infrastructure jobs could fail to materialize. That's based on announced NEVI charging deployment and the ratio of jobs per charger.

For U.S. officials wanting to increase auto manufacturing jobs, following through on policies that incentivize investment in the United States, like those in the Inflation Reduction Act of 2022, is the best way to achieve it. Together with the billions of dollars of new investment in clean energy projects across the United States, these policies are expected to create hundreds of thousands of jobs.

Like many new technologies, EVs are vulnerable to being smeared as "job killers." Don't believe it. Multiple studies have found that EVs require more labor hours to build than internal combustion engine vehicles, primarily due to battery assembly and production. Right now, most automakers in the United States outsource production of EV powertrain components like high-voltage batteries to foreign suppliers; this is what's behind claims that EVs could require approximately 30% fewer hours and to build. However, if automakers bring that battery production in house and onshore the production of EV powertrain components, the EV transition could lead to more auto manufacturing jobs than there are today.

Analysis from FEV Consulting found that with high levels of vertical integration, EVs would mean more labor in auto manufacturing. Additionally, research from the Economic Policy Institute put things in sharp relief by highlighting two distinctly different futures: It estimated an increase of more than 150,000 jobs in the United States by 2030 as the auto industry transitions toward EVs if there is greater domestic manufacturing of vehicles and EV parts and if sales of American-made vehicles increase. In an alternate future of policy inaction where EV parts and sales are increasingly reliant on imports, however, the study projected job losses in the tens of thousands as EV sales continue to grow.

Indeed, there's a big opportunity for new domestic industries in battery production and charging infrastructure. Demand for EVs will drive demand for batteries, and ICCT research estimated that this could create up to 125,000 new jobs in the United States in battery manufacturing, battery component manufacturing, and battery recycling by 2032. This is a conservative estimate that does not account for any jobs upstream of battery production and assembly, such as in construction, mining, material extraction, and refining. As of September 2023, we had already identified 15 lithium-ion battery material production plants that extract or process raw materials in Michigan, 11 in Tennessee, seven in Indiana, seven in Texas, six in Kentucky, six in Ohio, and many more across the country. More facilities that extract or process lithium and other raw battery materials can be expected to open if the industry continues to expand, and jobs in such plants are over and above the jobs estimated for battery manufacture and recycling.

Beyond this, EVs will require building a nationwide network of charging infrastructure at homes, workplaces, and various public locations. This will create new jobs in charger assembly, electrical installation, charging software maintenance and repair, and planning and design related to siting chargers. [ICCT research estimated](#) that demand for light-duty EV charging infrastructure could create about 140,000 jobs by 2032, with potentially more jobs to come after that.

The Inflation Reduction Act of 2022 provides incentives for domestic production of EV components by offering tax credits for consumers who purchase and automakers that build EVs in the United States. With these in place, automakers are indeed making steps to vertically integrate EV production. Additionally, in September 2024, the U.S. Department of Energy announced more than $3 billion in federal investment in this sector that could create over 12,000 jobs. We're already seeing signs of these jobs as private companies have announced more than 230,000 EV-related jobs as of February 2025.

We're talking about a lot of good jobs—potentially. Thousands of positions are only likely to materialize if existing policies are brought to fruition. If policies are instead weakened or eliminated, there's a very real risk that job gains will not be realized.

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Powering the future: Assessment of U.S. light-duty vehicle battery manufacturing jobs by 2032

Anh Bui and Peter Slowik

SUMMARY

Localizing the electric vehicle (EV) battery supply chain is a strategy that can strengthen the United States' economic resilience, reduce dependence on foreign supply chains, support job growth, and vest U.S. workers and communities in the transition to zero emissions. Federal regulations, such as the new multi-pollutant standards from the U.S. Environmental Protection Agency (EPA) for light-duty and medium-duty vehicles for model years 2027 and beyond, along with federal incentives and supply chain investments, further support this direction. As EV adoption is expected to accelerate, establishing a robust domestic battery supply chain can help to meet growing demand for EVs while creating high-quality jobs.

Through an extensive literature review and collection of company announcements, this paper estimates a jobs-per-gigawatt-hour (GWh) ratio for the production of battery packs and cell components for light-duty vehicles (LDVs) and for the recycling of batteries, and then scales these estimates by GWh based on various U.S. domestic production scenarios. For the analysis of battery packs, we consider three scenarios. The first scenario is based on estimates of battery demand needed to support growth in the light-duty EV fleet to 69% of new sales by 2032, based on EPA's final Multi-Pollutant Emissions Standards for Model Years 2027 and Later Light-Duty and Medium-Duty Vehicles. The second and third scenarios are bottom-up assessments of U.S. battery production capacity based on company announcements through September 2024.

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January 9, 2025

Deaths by Dirty Diesel | Lives Saved by ACT

Illinois

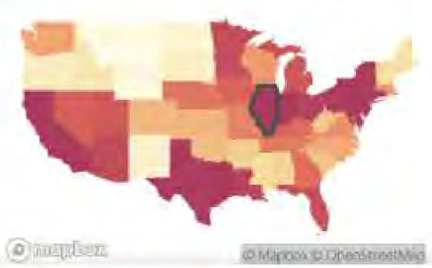
All counties, select to filter

2026

View historical data (2023)

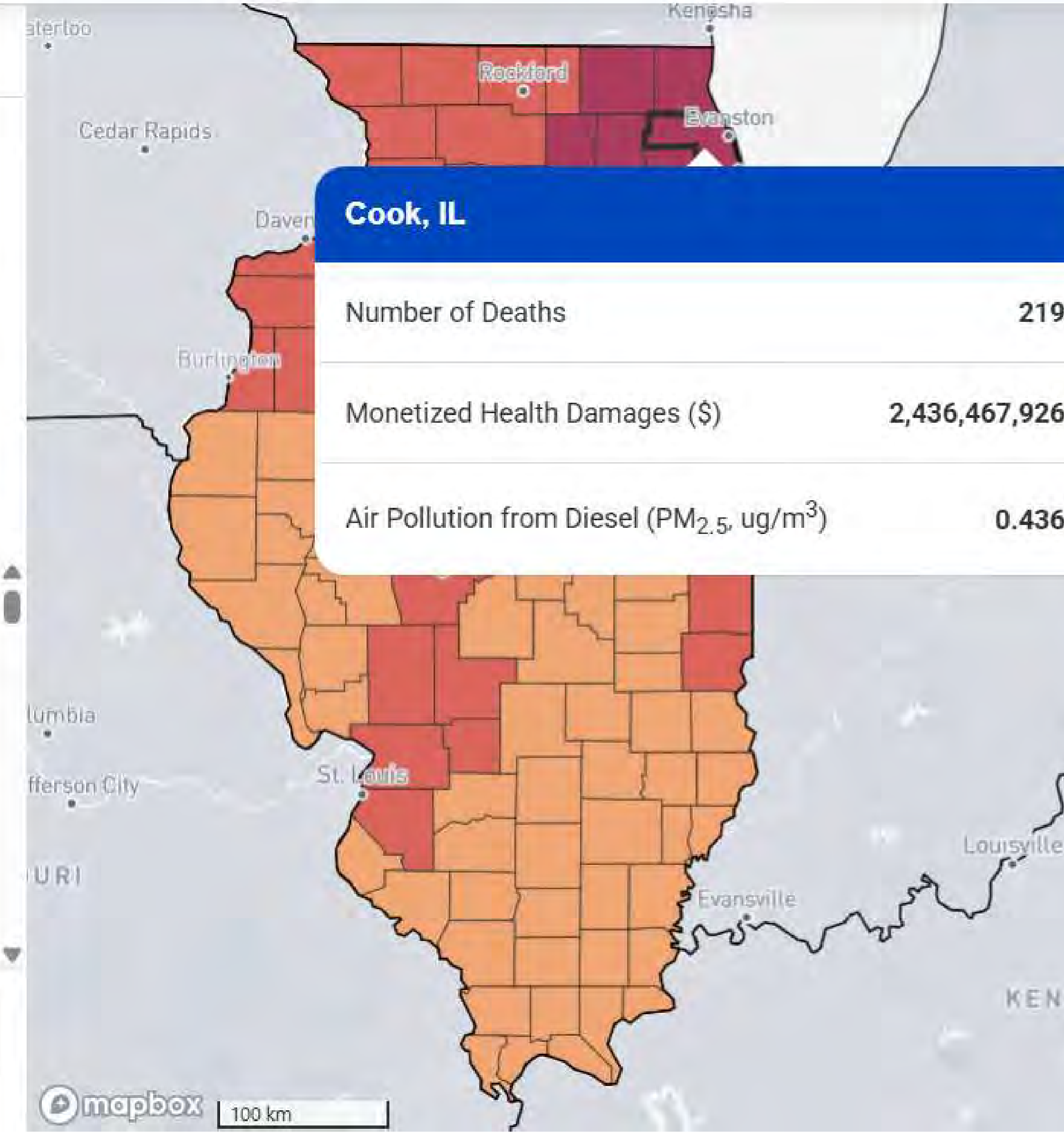
Cancer risk from diesel soot in Illinois

Ranking: 2 of 49



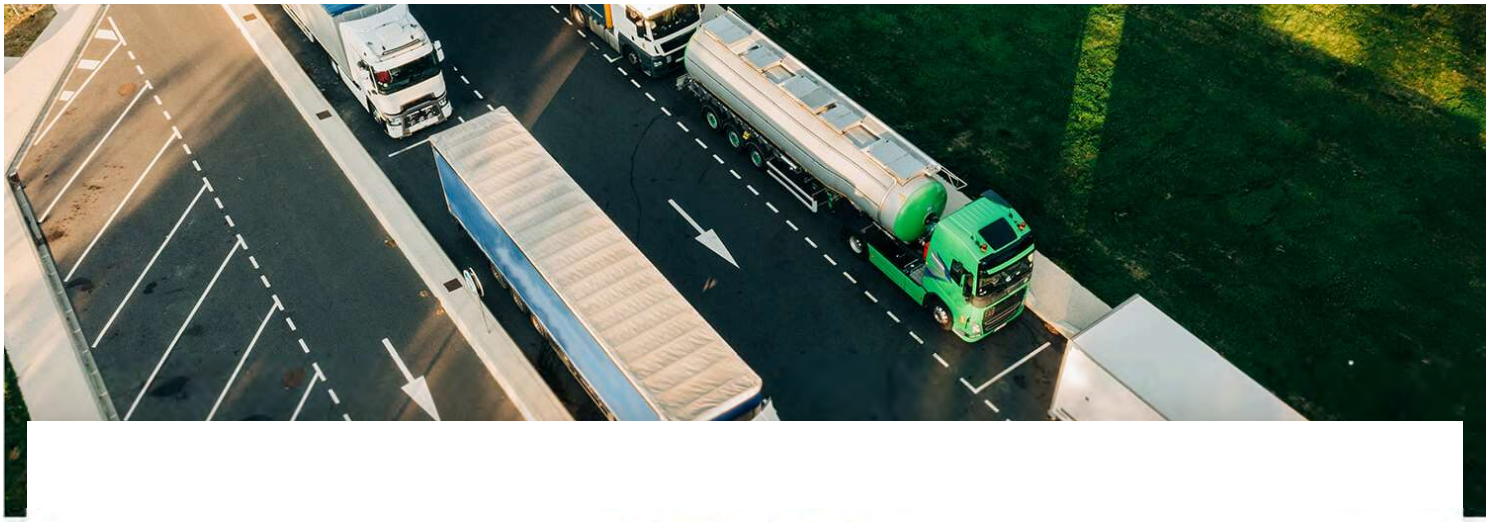
County Data | Metro Area Data

Designed and developed by **ZevRoss Spatial Analysis**.



Cook, IL

Number of Deaths	219
Monetized Health Damages ($)	2,436,467,926
Air Pollution from Diesel ($PM_{2.5}$, ug/m^3)	0.436



Transportation

CLEAN AIR TASK FORCE

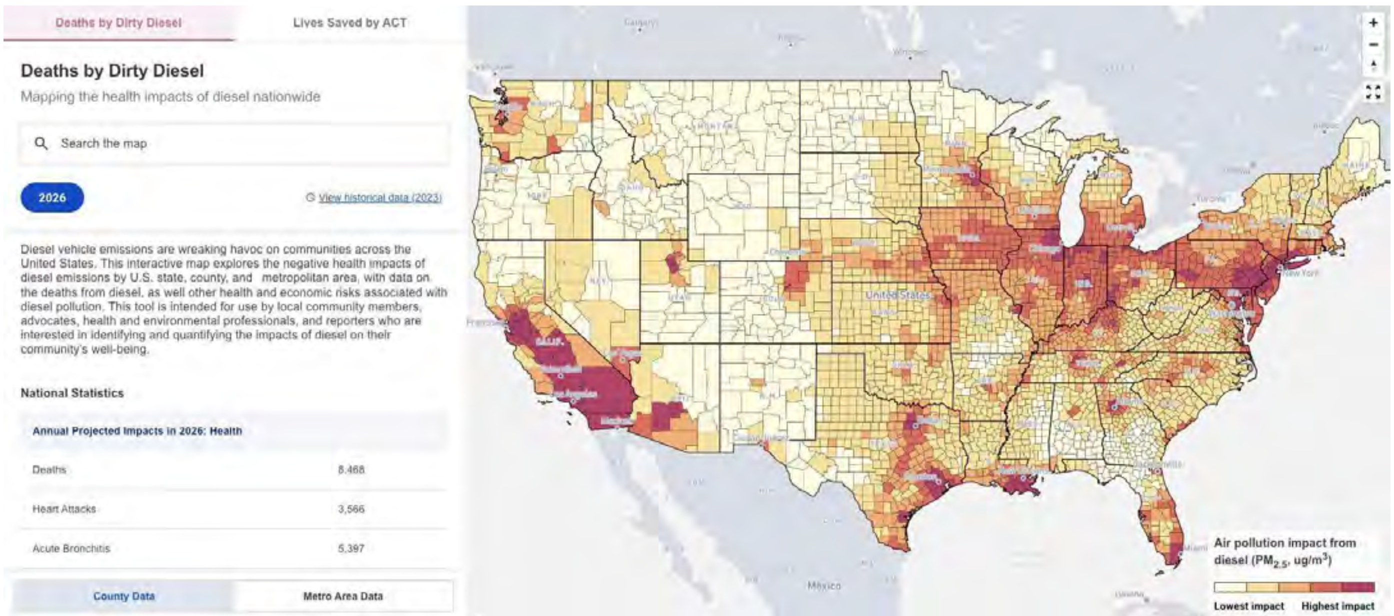
The Advanced Clean Trucks rule saves lives, so why is Congress trying to axe it?

April 23, 2025

 Veronica Saltzman  Tom Walker  John Graham

Diesel trucks and other diesel-fueled equipment are significant sources of particulate matter, including fine particulate matter (PM2.5) – a dangerous air pollutant that is small enough to penetrate deep into the lungs and bloodstream. There is "no safe threshold under which exposure to ambient PM has no adverse health effects," and both short- and long-term exposure to PM2.5 lead to a variety of harmful health effects.

Short term spikes in PM2.5 are linked to increased mortality in infants, increased hospital admissions and emergency department visits for heart attacks, strokes, and chronic obstructive pulmonary disease, and increased severity of asthma attacks and hospitalization for asthma among children. The effects of long-term exposure to PM2.5 are even more severe, resulting in higher risk of premature death from heart disease, stroke, influenza, pneumonia, and lung cancer. More recent research also links long-term exposure to PM2.5 to death from chronic kidney disease, hypertension, and dementia.



As detailed in CATF's updated Deaths by Dirty Diesel map (2026), diesel pollution causes death and severe health impacts in communities across the United States.

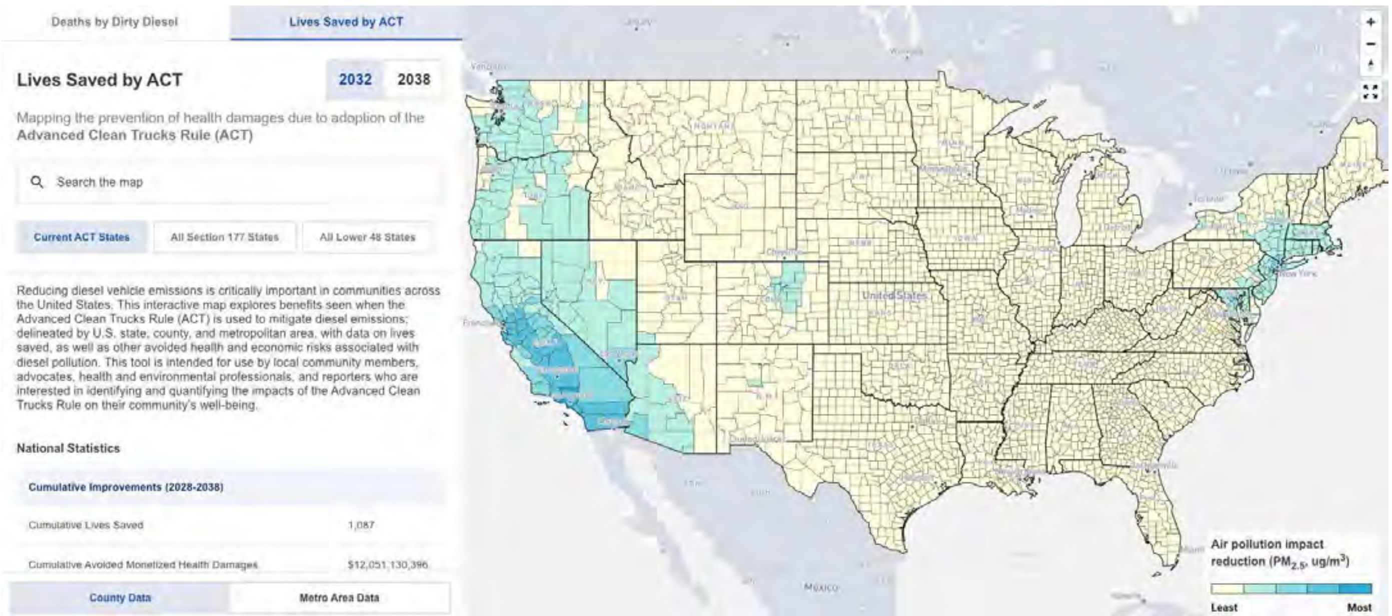
Despite the widespread harm to public health from diesel pollution, Congress and the Executive branch are taking steps to worsen pollution by attacking the Advanced Clean Trucks rule (ACT).

CATF's updated map shows the benefits of diesel pollution mitigation policy

In April 2023, the U.S. Environmental Protection Agency granted California a waiver under the Clean Air Act to implement ACT, designed to reduce emissions of nitrogen oxides, PM2.5, other criteria pollutants, air toxics, and greenhouse gases. Ten other states have since adopted the rule under section 177 of the

Clean Air Act, recognizing ACT as a powerful tool for improving air quality and protecting public health.

To illustrate the potential for progress, Clean Air Task Force has updated its [Deaths by Dirty Diesel map](). Now, for the first time, the tool includes a section on ACT that highlights the lives that could be saved if states adopt and implement the rule.

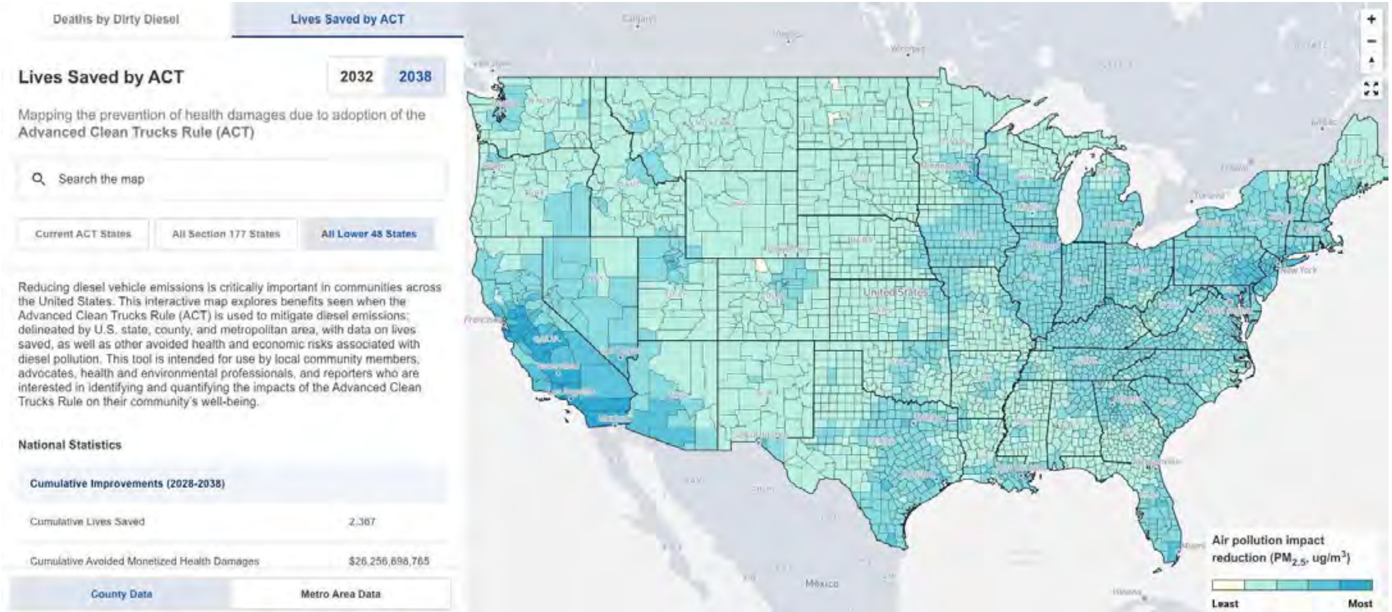


PM2.5 pollution reduction if states that have already implemented ACT are allowed to enforce the regulation (2032)

The ACT-focused maps present six possible futures, each representing different levels of state adoption and implementation of ACT rule. Users can explore public health benefits projected for 2032 and 2038 based on:

- States that have already adopted ACT
- A scenario where states that have adopted any California clean vehicle rule ("section 177 states") adopt ACT
- A scenario where all 48 contiguous states adopt ACT

These scenarios offer a stark look at the stakes. If ACT is allowed to stand in states where it has already been implemented, it could save more than 1,000 lives and prevent approximately $12 billion in health-related damages over the next decade, especially in port regions and along major coastal freight corridors. Broadening adoption would deliver benefits across the heartland, more than doubling the number of lives saved.



PM2.5 pollution reduction if all 48 contiguous states adopt ACT (2038)

Despite benefits for human health, ACT and other tools to clean up the air are under attack

In March 2025, EPA launched what it called the "biggest deregulatory action in U.S. history," aiming to roll back 31 regulations, including regulations on emissions from light, medium, and heavy-duty vehicles. EPA has also frozen funding promised to schools to replace dirty diesel bus fleets with electric buses, and EPA's attempt to freeze $20 billion in climate grants is impacting the sale of electric drayage trucks that could cut harmful pollutants from high-emitting ports.

Meanwhile, Republicans in Congress are attempting a novel use of the Congressional Review Act to attack several California vehicle rules, including ACT and the Omnibus Low NOx Emissions rule. This move would override states' ability to set strong vehicle standards to protect their citizens from pollution.

Diesel pollution continues to plague communities across the country. As our maps show, ACT is a critical tool for combating this pollution. Attacks on ACT and other regulatory tools for cleaning up the air demonstrate a blatant disregard for human health. We urge Congress and the Administration to leave ACT and other important regulations in place.

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Today, North Carolina Governor Roy Cooper issued an executive order directing the N.C. Department of Environmental Quality to draft regulations for the adoption of the Advanced Clean Trucks rule.

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WAYS TO GIVE

BLOG

DEPLOY CHARGING INFRASTRUCTURE IN “NO REGRETS” FREIGHT ZONES AND CORRIDORS TO KEEP U.S. COMMERCIAL TRUCK ELECTRIFICATION ALIGNED WITH CLIMATE GOALS

December 13, 2023 | By: Yihao Xie and Ray Minjares

arlier this year, the U.S. Environmental Protection Agency (EPA) roposed a third phase of greenhouse gas standards on heavy-luty vehicles and engines for model years 2027 and later, to ccelerate road freight decarbonization. Many public comments upported it, but truck manufacturers including Volvo and)aimler have asked the EPA for a three-year delay of the rule. 'heir principal argument is that charging infrastructure will not e available to support the number of electric truck sales the rule vould encourage.

Vill infrastructure not be available in sufficient quantities? Well, ve see that significant public investment has already been made, rivate investments have already led to groundbreaking on harging sites, ribbons have been cut at publicly accessible truck harging depots, and truck manufacturers themselves are uilding the infrastructure.

Beyond that, the reality is we don’t need to build everything verywhere, all at once. It makes strategic and economic sense in he near term to electrify the largest number of trucks along the mallest number of roadways where the business case is trongest (“no regrets” zones and corridors). And the assessment ve present below shows that strategic infrastructure deployment ı a limited number of freight hubs and corridors would be nough to ensure the EPA proposal can be met with sales of lectric trucks.

Ve illustrate this with the infrastructure needs of long-haul rucks, just one of many vehicle categories covered in the EPA roposal. Here we define a long-haul truck as a vehicle that ravels 500 miles daily and a long-haul corridor as one continuous egment at least 300 miles long.

Despite being less than 20% of the vehicles in the U.S. heavy-duty leet, long-haul trucks are responsible for an outsized share of laily traffic volume (Table 1). Previous analysis demonstrated that attery-powered long-haul tractors offer the strongest business ase when compared with other zero-emission alternatives. When coupled with megawatt charging in the second half of this lecade, battery-powered long-haul tractors are estimated to be he only zero-emission powertrain with the potential to achieve a ower cost per mile than long-haul diesel tractors.

able 1. Projected vehicle stock, activity, and energy consumption f commercial vehicles in the United States in 2030.

	Vehicle stock	Zero-emission vehicle stock	Fleet-wide average daily vehicle miles traveled (eVMT)	Fleet-wide average daily zero-emission vehicle miles traveled (eVMT)	Fleet-wide average daily zero-emission vehicle energy consumption (MWh)
Class 4-8 long-haul vehicles	2 million	70,000	469 million	18 million	35,000

All Class 4-8 vehicles	11 million	1.1 million	1.1 billion	94 million	140,000
Long-haul vehicle share	18%	6%	43%	19%	25%

ource: Ragon et al. (2023)

o assess the minimum infrastructure needs of these long-haul rucks in 2030, we: (1) examined freight traffic patterns, including ur own national infrastructure analysis ; (2) revisited the nfrastructure work of CALSTART and EPRI to inform our efforts nd consider our analysis against their assumptions; and (3) onsulted with industry experts to understand which long-haul orridors to prioritize. Our goal was to find the smallest number f roads with the highest traffic volume that could support 18 nillion long-haul electric truck miles (eVMTs) in 2030. These 18 nillion eVMTs are the electric truck activity spurred on by the nflation Reduction Act, as estimated under our moderate cenario in this paper. That amount would also be enough to eep zero-emission trucks in commercial road freight aligned vith international climate goals. We also considered a second cenario: the charging infrastructure for long-haul trucks needed o match the EPA Phase 3 proposal assuming manufacturers omply only with electric vehicle sales.

irst, we find that public charging plazas along 1,800 miles of U.S. oads, identified as Tier 1 in Figure 1, would be enough to align ong-haul truck electrification with international climate goals in 030. The Tier 1 corridors are just 0.06% of paved road miles in the Jnited States in 2020 or about 3% of the U.S. National Highway reight Network. To arrive at 18 million daily eVMT on these orridors, we assume that one out of every four long-haul truck niles are electric. Forthcoming sales requirements for zero-mission trucks in California, Oregon, and Washington paired vith total cost of ownership parity expected between battery-lectric and diesel-powered long-haul tractors in Texas by 2027 ut this within reach.

igure 1. Tier 1, 2, and 3 priority corridors for electrifying long-haul ruck activity in 2030 in line with international climate goals.

he Tier 2 corridors are where additional infrastructure would be eeded in 2030 to achieve 18 million daily eVMT if instead only 5% of long-haul truck miles along Tier 1+2 corridors are electric. ier 3 corridors expand the map and show where infrastructure vould be needed if only 10% of long-haul truck miles along Tier +2+3 corridors are electric in 2030. Even the combined Tier 1, 2, nd 3 corridors are still just 0.2% of paved road miles in the United

States in 2020 or less than 10% of the U.S. National Highway Freight Network.

Second, the EPA proposal requires even less infrastructure than the first scenario because fewer electric trucks would be on U.S. roads. We project that the EPA proposal could generate close to 9 million long-haul eVMT per day, half as much as considered above. Approximately 1,000 total road miles across three corridors in California and Texas would be enough to comply with that; this assumes that 25% of long-haul truck miles on these roads are electric in 2030 and that manufacturers choose to comply only with electric truck sales, which the EPA rule would not require.

If, instead, only 10% of long-haul truck miles are electric, charging needs resulting from the EPA rule would require infrastructure deployment along 2,100 miles of the Interstate Highway System. This is shown in Figure 2 and the amount is still a fraction of a percent of U.S. paved roads and less than 4% of the national highway freight network.

Figure 2. Priority corridors for electrifying long-haul activity in ne with maximum electrification required by the EPA Phase 3 proposed standard if 10% of long-haul truck miles are electric in 2030.

Despite manufacturer concerns, this analysis highlights the mited nature of the infrastructure required to meet the projected needs of long-haul electric trucks in 2030. Even an electrification scenario more ambitious than the EPA proposal nd aligned with international climate goals would require public charging infrastructure for long-haul trucks across less than 1% of

J.S. roads. Infrastructure at this scale would not be expected to be a major barrier to achieving greater greenhouse gas reductions, should the EPA choose to strengthen its proposal.

Deploying infrastructure in phases and starting strategically in the highest-priority locations would be enough for long-haul trucks in the near term. Our analysis shows that the infrastructure needs of the EPA proposal and of even more ambitious proposals can be met.

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Yihao Xie

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Heavy-Duty Vehicles Program Director and San Francisco Managing Director

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Phasing in U.S. Charging Infrastructure

An Assessment of Zero-Emission Commercial Vehicle Energy Needs and Deployment Scenarios

Michael Joseph
Bill Van Amburg
Mark Hill
Bharadwaj Sathiamoorthy

August 2023

Acknowledgments

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CALSTART

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Table of Contents

List of Acronyms

Acronym	Definition
ACF	Advanced Clean Fleets rule
ACT	Advanced Clean Trucks rule
bhp-hr/mile	Brake horsepower-hour per mile
CaaS	Charging-as-a-Service
CARB	California Air Resources Board
CEC	California Energy Commission
CPUC	California Public Utilities Commission
EPA	U.S. Environmental Protection Agency
EVSE	Electric vehicle supply equipment
FHWA	Federal Highway Administration
Global MOU	Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles
HPMS	U.S. Highway Performance Management System
ICCT	International Council on Clean Transportation
kW	Kilowatts
MHDV	Medium- and heavy-duty vehicle
MWh	Megawatt-hours
NEVI	National Electric Vehicle Infrastructure Formula Program
NHFN	National Highway Freight Network
NREL	National Renewable Energy Laboratory
PNNL	Pacific Northwest National Laboratory
SCAQMD	South Coast Air Quality Management District
VMT	Vehicle miles traveled
ZE-MHDV	Zero-emission medium- and heavy-duty vehicle

Figures and Tables

Figures

Tables

Executive Summary

To assess the feasibility of zero-emission infrastructure buildout at a nationwide scale, CALSTART projected the infrastructure required to supply the electricity needed for zero-emission medium- and heavy-duty vehicle (ZE-MHDV) adoption rates in 2027, 2030, and 2035. These rates meet the targets set by the Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles (Global MOU), signed by the United States in 2022.

This analysis shows that the infrastructure necessary to meet energy needs of ZE-MHDVs can be **phased in** around favorable launch areas. This phased approach can manage distribution grid upgrade timelines and maximize utilization even with the Global MOU's attainable market penetration rates, which exceed those proposed by U.S. regulators. **The accelerating pace of ZE-MHDV energy needs can be managed through market-driven, overlapping, and concurrent growth of an integrated transportation-energy system**.

To develop this analysis and resulting roadmap, CALSTART modeled energy needs and showed how prioritizing favorable launch areas and using innovative deployment strategies can accommodate capacity constraints during buildout. Favorable regions include where 1) industry concentrates, 2) public and private funds have high leverage, 3) policy is supportive, 4) energy will cost less, or 5) distributed grid modernization will occur. Buildout in this scenario concentrates first around return-to-base depot infrastructure in key industry clusters that form recharging hubs, then in key corridors enabling regional hub-to-hub operations, and finally in national network nodes.

In sum, this **phase-in strategy** enables:

- **Faster deployment by focusing on priority launch areas.** More ZE-MHDVs can be supported in less time than in linear, unphased growth scenarios.
- **Cost-effective implementation.** Costs can be shifted forward and less important areas left to future deployment, while total energy demand can be supplied through targeted upgrades and management strategies, sharing arrangements, public charging, and other onsite optimizations—reducing per-vehicle infrastructure costs.
- **A clear vision that helps utilities, government, and investors target actions** to integrate grid modernization and ZE-MHDV adoption, as well as maximize co-benefits.
- **Coordination that leverages public funds and unleashes private investment**.

I. Infrastructure Buildout to 2035

Introduction

The development of widely available recharging infrastructure for zero-emission medium- and heavy-duty vehicles (ZE-MHDVs) is critical to support the transition to these vehicles expected in the United States over the next decades. ZE-MHDVs are ready to expand into all regional applications and longer-range routes. Deploying energy delivery systems—a package of technology products and supportive system developments making up a *recharging infrastructure* that supports the introduction of ZE-MHDVs—is crucial. Infrastructure deployments must keep pace with the rapid growth of ZE-MHDVs or risk slowing the acceleration of the market.

Over the last few years, industry has made major commitments to build out this infrastructure. Moreover, a growing ecosystem of infrastructure suppliers and solutions are in place to support these investments and manage this transition. Nevertheless, a particular fleet's choice to transition to ZE-MHDVs can be influenced by uncertainty over the availability of recharging infrastructure. Exposure to potential unforeseen costs involved in infrastructure deployment could affect and divert a fleet's pathway toward transitioning to ZE-MHDVs, despite potential advantages regarding total cost of ownership. This concern is particularly acute with respect to electric recharging infrastructure; the delivery of electrons is different from the liquid or gaseous refueling systems fleets may be used to and involves questions regarding the pace of transportation electrification and integration into the larger electric grid.[1]

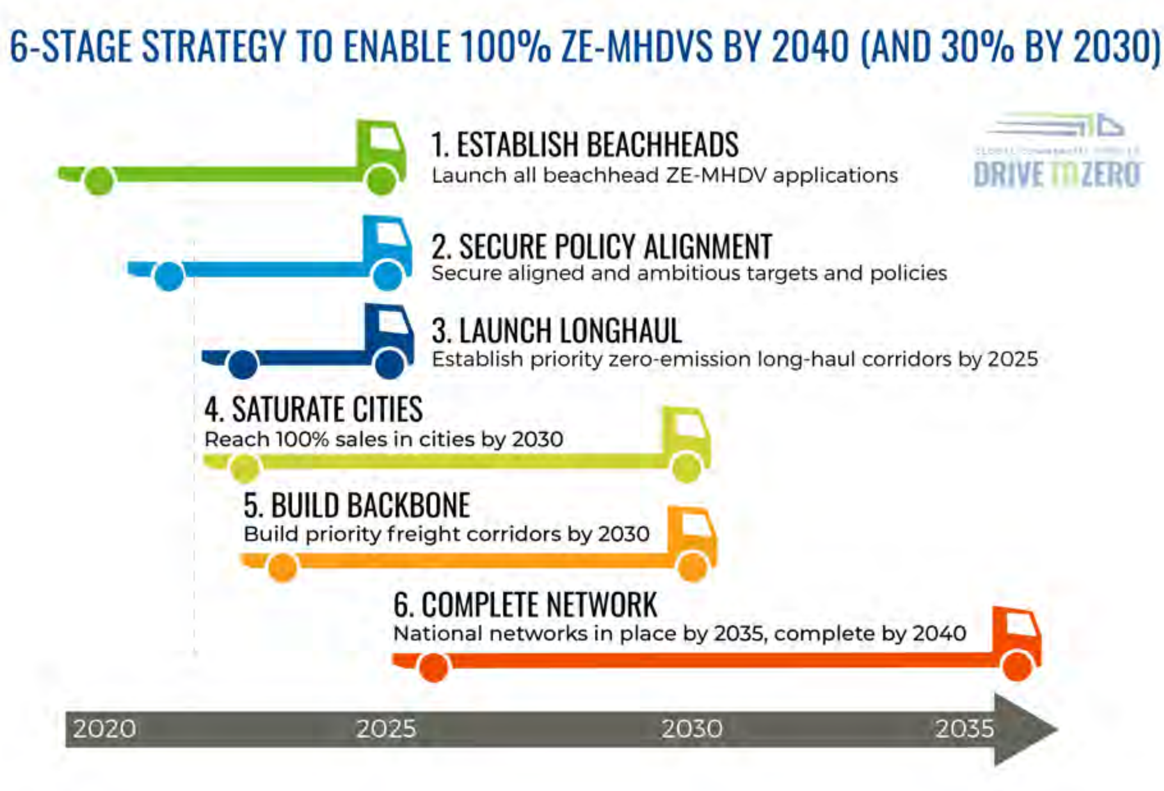
To assess the feasibility of infrastructure buildout at a national scale, CALSTART projected the infrastructure necessary to deliver the electricity needed to meet the ZE-MHDV adoption rates in 2027, 2030, and 2035 set by the Global Memorandum of Understanding on Zero-Emission Medium- and Heavy-Duty Vehicles (Global MOU); these rates represent a feasible pathway to 100 percent ZE-MHDVs by 2040 (CALSTART, 2022b). CALSTART

[1] This analysis focuses on electric infrastructure and leaves the deployment of other zero-emission refueling infrastructure for future studies; recent work has, however, considered the role of other refueling technologies within some of the duty cycles involved in these projections (CALSTART, 2023a).

developed a scenario in which these needs emerge based on current vehicle activity patterns and ZE-MHDV adoption trends. In keeping with CALSTART's overall strategy toward market acceleration and transformation, it was assumed that most of this investment will be through private entities, utilizing innovative strategies many CALSTART members have shared in public discussion on the topic (CALSTART, 2022a; CALSTART, 2022c).

This projection shows how the accelerating pace of ZE-MHDV energy needs can be managed through market-driven, overlapping, and concurrent growth of a supportive ZE-MHDV ecosystem in a **phased** transition. Deployment concentrates first around return-to-base depot infrastructure and in regional recharging hubs within key geographies supporting the full range of regional operations, then in key corridors enabling regional hub-to-hub operations, and finally in built-out networks connecting corridors to each other and to other critical infrastructure along the larger surface transportation network. This assessment was structured to build on and further detail the Drive to Zero implementation roadmap (CALSTART, 2022b). The 2040 ZE-MHDV roadmap's core strategy (Figure 1) breaks up the activity needed to reach full sales penetration into six overlapping stages, with smart infrastructure phasing as a critical, enabling component of five of the stages.

Figure 1. Drive to Zero Six-Stage Strategy (CALSTART, 2022b)



With the **who** and **what** of the ZE-MHDV transition—who is investing in it and the pathway they are on to 100 percent ZE-MHDVs—already known, this study analyzes **where** ZE-MHDVs are likely to appear, **why** they appear in those locations, **when** they will need infrastructure, and **how** this phased buildout process will accommodate them. This first section presents this projection, detailing the scale and pace of the transition in terms of energy delivery needs and the phases to meet those needs.

Energy Needs of the U.S. ZE-MHDV Transition

ZE-MHDV Adoption Rates

To determine *where* ZE-MHDVs will appear, this analysis used projected commercial vehicle ZE-MHDV market sales from the Drive to Zero zero-emission vehicle market assessment (CALSTART, 2021a). The sales estimations are based on a multifactor forecast, which includes technology readiness and viability for key MHDV duty cycles, total cost of ownership, and production scalability inputs for the primary commercial vehicle categories.

The adoption rates represent the 2040 goal of the Global MOU. Global MOU signatories have pledged to reach 100 percent new ZE-MHDV sales by 2040 and 30 percent new ZE-MHDV sales by 2030; the United States became a signatory in 2022. The Global MOU, co-led by the Government of The Netherlands and Drive to Zero, also aligns with the Paris Agreement to reach net-zero by the middle of the 21st century and to drastically cut emissions to keep the rise in mean global temperature below 2.0 degrees Celsius and limited as far as possible to 1.5 degrees Celsius. This standard is aligned with the targets announced by most major global original equipment manufacturers who have set 2040 as the date by when all new vehicle sales will be zero-emission or fossil-free (CALSTART, 2021a).

The Global MOU adoption rates assume this transition will occur through a phased "beachhead" strategy with respect to market acceleration and technology adoption. In the beachhead strategy, first-mover technology applications like transit buses, cargo vans, and school buses dominate markets. From there, supportive services and a supply chain develops behind these early applications (CALSTART, 2022c).

The ZE-MHDV sales rates assumed in this analysis constitute a share of the total commercial vehicle population, which is significantly higher than those proposed by certain regulatory targets. This includes the U.S. Environmental Protection Agency's (EPA's) recently proposed Phase 3 ruling targets for MHDVs, as well as the Advanced Clean Trucks (ACT) rule of the California Air Resources Board (CARB)—already adopted by several states—and the Advanced Clean Fleets (ACF) rule. These rates also align with other forward-looking rates of adoption used in infrastructure assessments such as those from the International Council on Clean Transportation (ICCT) (ICCT, 2023).

Where and How Energy Needs Will Arise

Using these rates, energy needs and where they will appear were projected by considering how new ZE-MHDV sales, and the infrastructure to support them, would be distributed across the United States. The purpose of this projection was to show that these needs arise from the travel patterns on the existing transportation network used by commercial vehicles. In other words, while individual fleet transitions will collectively add up to a total energy need, they will do this within a travel market with spatially differentiated and regional variations. To demonstrate this, new sales were distributed in relation to vehicle miles traveled (VMT) by commercial vehicles (Classes 3–8) on relevant segments of the ZE-MHDV road network, which was defined as the National Highway Freight Network (NHFN) within the lower 48 U.S. states.[2]

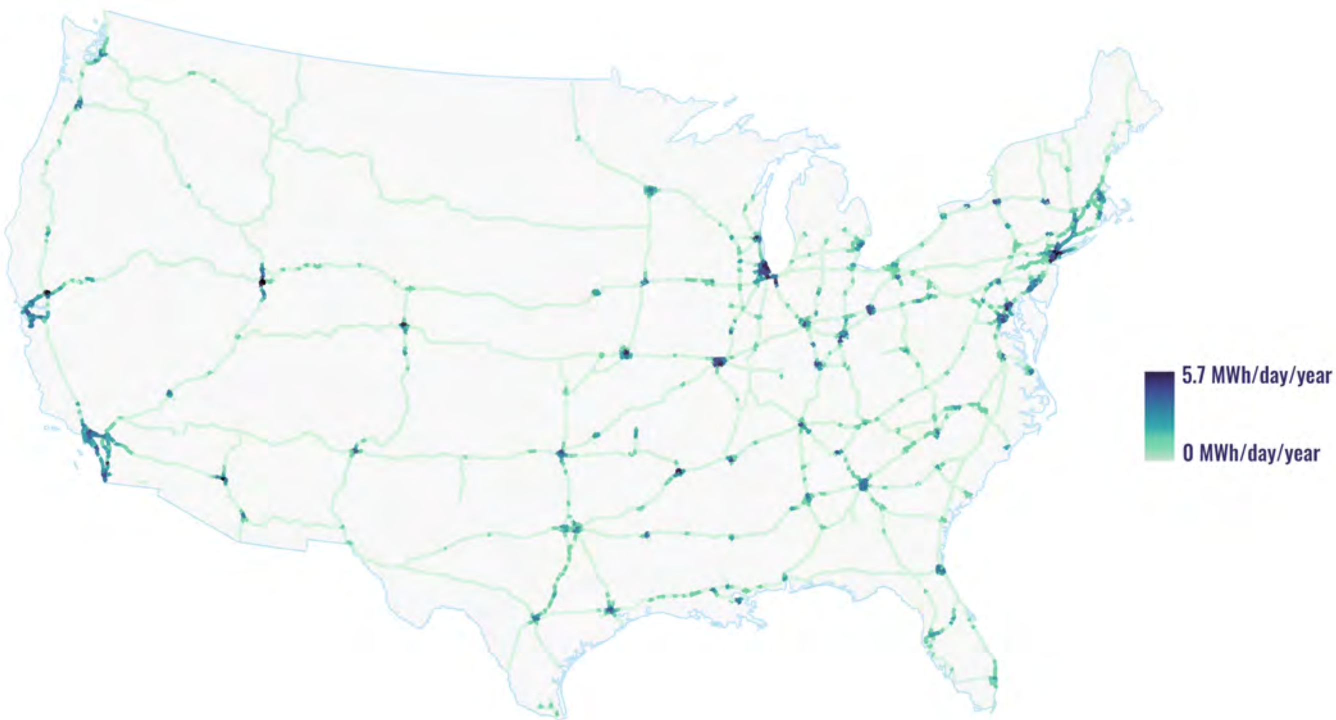
Using Federal Highway Administration (FHWA) Highway Performance Management System data, commercial vehicle activity was calculated on individual road segments and then aggregated into uniform 10-square-mile travel areas (i.e., an analytic grid) across the network. VMT for travel on individual road segments was then calculated within these areas, which was used as a basis for determining new ZE-MHDV introductions by way of a scaling factor. The energy used by travel through an area vis-à-vis all travel on NHFN was related to the energy of potentially introduced ZE-MHDVs in that area to the total ZE-MHDVs forecasted by the Global MOU scenario, given their energy usage, typical range, and other factors. The assumption behind this approach, one of several possible currently being explored, was that the energy used to travel through each area on NHFN will be supplied in similar proportions by a share of newly introduced ZE-MHDVs in the future.[3] More detailed information on the methodology is available in the Appendix.

[2] NHFN was used given inter-regional and inter-state commercial vehicle travel utilizes much of the freight network. Other states and territories were excluded at this time to focus on the deployment scenarios involving the majority of this network.

[3] This analysis assumes vehicle range and travel patterns are constant through the duration of the projection. There are indicators that these may shift and become more efficient with vocational specialization among ZE-MHDVs.

The introduction of ZE-MHDVs across the road network then presents a consequential change in energy delivery needed to support these vehicles, both in space and over time (Figure 2).

Figure 2. Average Annual Increase in Daily Energy Consumption from New ZE-MHDV Sales, 2023-2035

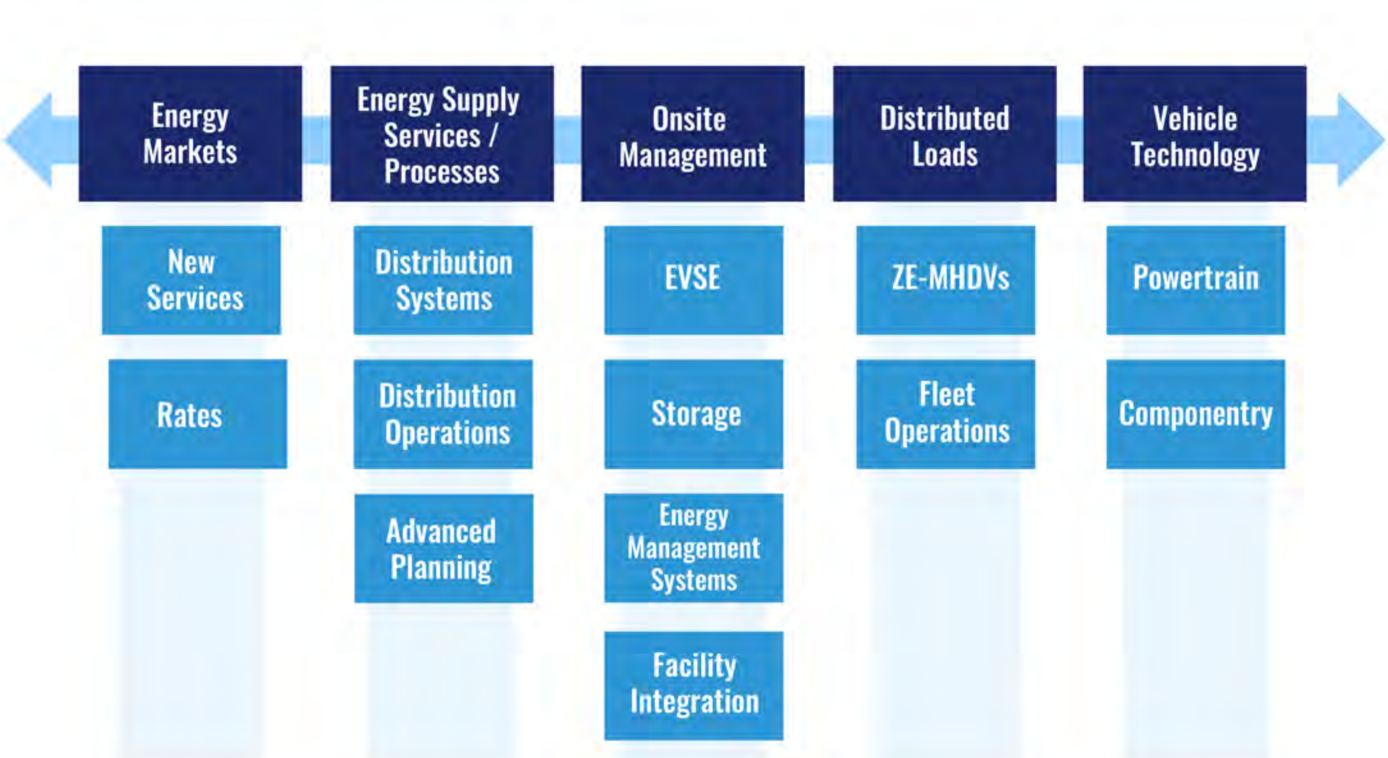


Interpreting these needs correctly is critical for understanding the energy transition and the feasibility of accommodating ZE-MHDVs. First, the spatial variation in energy needs is clearly significant. Needs cluster in areas with high VMT, which include 1) major commercial vehicle centers (including cities but also areas experiencing major industry land uses, like warehousing) and 2) major freight corridors, but also 3) areas where commercial vehicle travel in general is nationally very high. Only after acknowledging this fact can needs represent a total growth in energy demand. Notably, this analysis shows that needs from new deployments are of a magnitude similar to that established in other studies, when adjusting for the more aggressive ZE-MHDV penetration rates of the Global MOU (ICCT, 2023).

Next, there is the change in the amount of energy needed over time. This analysis shows that total electrification needs necessitate a change in the overall energy system to deliver enough energy and manage enough volume to support the consumption of hundreds of thousands of additional megawatt-hours (MWh) per day. Figure 2 above expresses this in terms of an annual rate of change in the daily consumption of energy along the transportation system. In some areas, the average annual increase in daily energy consumption over the timeline of this analysis ranges from increases of up to 0.3 MWh per day to, at the high end, 5.5 MWh per day in certain areas. In some areas, energy systems will need management strategies and upgrades year after year to address a significant change.

Finally, it is important to note that this change in energy needs ultimately represents a change in an energy system. Following both industry and research advances in this area, this study does not approach the necessary change in energy as a simple need for additional capacity—at the same rate, year over year—on the existing system. This analysis underscores that consumption of energy by vehicles constitutes a suite of needs, which can be met in various ways. An optimized ZE-MHDV energy system that finds solutions in several optimization areas will be crucial (Figure 3).

Figure 3. Energy System Optimization Areas



Solutions can be found across each of the axes above to meet the new demand increases across the transportation network. Broad changes at scale in the market itself can form a solution; so, too, can wider grid modernization efforts, including both transmission and distribution system planning and operation improvements to include advance short-term and long-term grid upgrades and the accelerated support for integration of smart energy management technologies, platforms, and services in advance of requests for their deployment (U.S. Department of Energy, 2020). Optimization can also occur by deploying these energy management technologies on or near sites through its configuration. Then, the vehicles (as loads) can be managed through smarter operations, and the actual componentry and vehicle technology can change. Each axis in Figure 3 is a resource for composing solutions to net demand increase issues.

Recent studies on the distribution system generally concur that these upgrades can be made cost effectively and for a fraction of utility investment generally (E3, 2021). They also show that investment in one area may in fact enable, supplement, or substitute investments in others. Increased ability to manage consumption of more MWh is needed, but investments in storage, for example, may ultimately prove a solution in some contexts. In general, this assessment was framed in such a way to make room for multiple development areas in order to cope with energy demand and spur overall energy system modernization.

For the purposes of analysis, the scope of system investments was limited to the deployment of electric vehicle supply equipment (EVSE) necessary to support energy demand, including chargers, make-ready improvements, and storage systems (i.e., onsite storage). Significant distribution system upgrades, onsite generation, and many of the energy system services and other elements in Figure 3 were excluded, but site management and even operational considerations were taken into account for the management of ZE-MHDVs as distributed and variable loads. See the Appendix for more detail on these assumptions.

Where Infrastructure Deployment Will Need to Meet Demand

Next, CALSTART projected the deployment over time necessary to respond to these needs.[4] The detail of the methodology is discussed further in the Appendix.

The analysis considered two options for projections:

- First, the *maximum* number of deployments and their power rating to satisfy energy demand caused by the introduction of a new ZE-MHDV in an area.
- Next, an *optimum* number of energy supply infrastructure to meet new ZE-MHDV introduction over time, which constitutes a phased-in investment scenario.

In the **unoptimized projection**, the *most infrastructure possible* to supply the needs for each new vehicle introduced was deployed. Furthermore, deployment was uniform and indifferent to where each new vehicle would be located, as well as to the timing of investment. Redundancies in deployment were not considered in both time and space, and deployment densified in all areas across the travel network at a constant and undifferentiated rate. The location and pace of deployment had the character of an adoption curve; it did not represent the geography of energy needs corresponding to that curve.

In the **optimized projection**, factors were employed to localize the areas where investment could respond to the most important increases in energy needs over the analysis timeline (from the present to 2035), while accounting for the full pace and scale of the energy needs involved across the network.

The first factor included in the optimized scenario was infrastructure **utilization**. Optimal utilization can achieve a lower levelized cost of infrastructure per unit of electricity delivered to vehicles (Phadke et al., 2021; Borlaug et al., 2020). The optimized projection did not assume buildout was one-to-one with the number of vehicles introduced and was based on assumed rates of charger utilization that could deliver energy needed for the total number of ZE-MHDVs as they are introduced.

[4] Exact deployment locations and configurations were not projected onto parcels of land but were assumed to be within the analysis grid, i.e., within areas accessible by NHFN.

The next factor was the general importance or **priority** of the area for deployment. By concentrating deployments in a particular area, deployment can accommodate more of the share of the distribution of demand. In order to establish priority areas, four general types of priorities were considered:

- **Identified investment priority**: An area has already been indicated as a priority for investment by industry or by supportive federal money such as U.S. Department of Energy ZEV Corridor Planning Partnership Grants.
- **Political, social, and equity priorities**: An area has adopted ACT, or has signed on to or supported the Global MOU, and will benefit from investment in terms of air quality.
- **Industry clustering**: There is a concentration of sectoral activity (i.e., fleet location and growth) in MHDV transportation services, such as warehouses, logistics, or other sectors.
- **Potential for energy system improvements and energy cost reduction**: The overall lowering of levelized cost of energy within regions and the growth of distributed energy resources highlight potential areas where grid improvements of the types needed for EVSE installations will be a priority through 2035.

The optimized projection assumed investments will happen across the national network continually throughout the analysis period but are concentrated first in areas that receive high rankings across all of the above priorities. These investment priority factors and utilization efficiencies combine to provide an optimized geography of investment in "priority launch areas," which maximize utilization and investment benefits (Table 1).

Table 1. Priority Launch Area Definitions

Priority Launch Area	Profile	Ranking
Clusters	Concentrated areas of industry activity; where investment, political, social, equity, economic, and energy investments align	Top 33 percent of areas with composite score of priority factors
Corridors	Connectors outside of hubs enabling point-to-point operations	Next highest 50 percent of areas with composite score of priority factors
National Network	Nodes that provide ubiquitous availability, connecting corridors together or linking to national facilities	Next highest 33 percent of areas with composite score of priority factors

Figure 4 illustrates sites and potential site configurations that would be deployed within each launch area corresponding to the descriptions in Table 1 above; it also shows specific duty cycle and vehicle operation considerations enabled by infrastructure buildout within these areas.

Figure 4. Illustration of Site Configurations and Functions in Priority Launch Areas

In this projection, hubs are the highest priority areas, then corridors, and finally areas that constitute a national network, with hubs making up 75 percent of the total deployment, corridors 18 percent, and network nodes 7 percent. It was assumed that some investment will continue within more than one area across the analysis timeline.

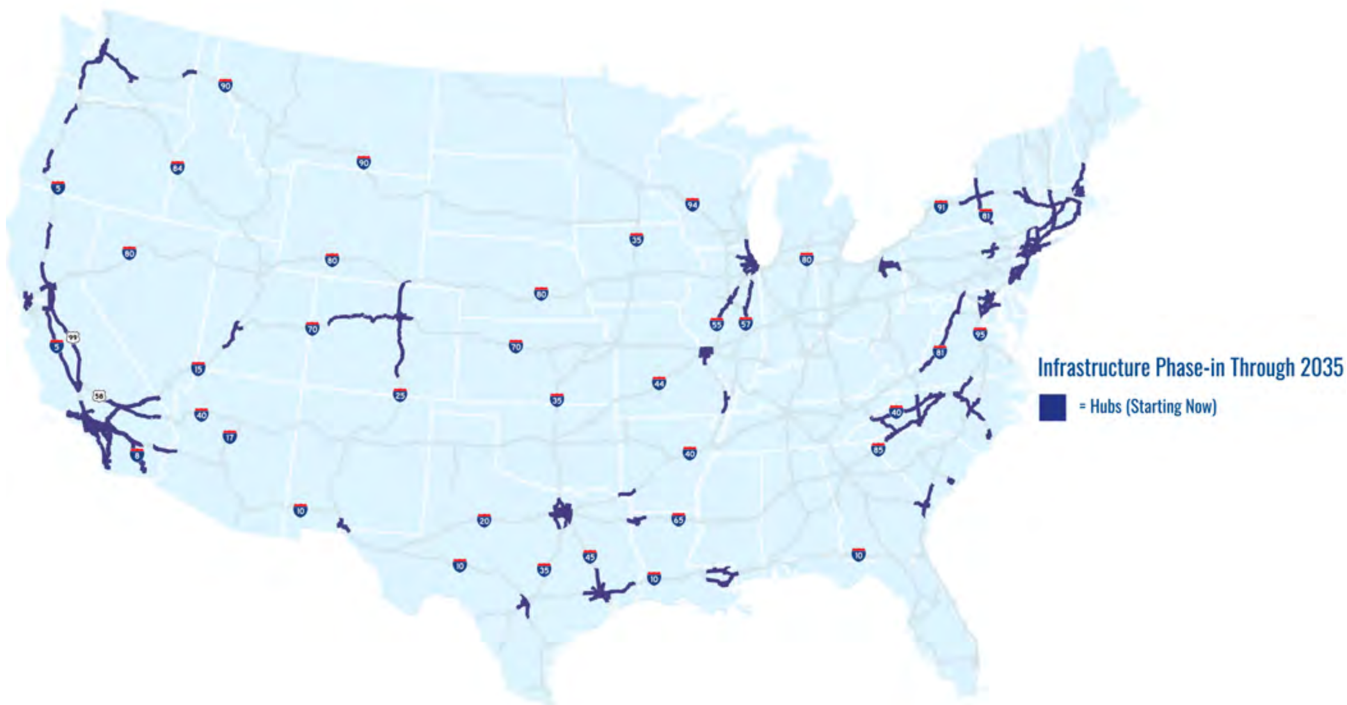
Deployment Phasing

The resulting national roadmap is one in which *phases* of infrastructure investment and deployment accommodate the scale of the ZE-MHDV transition. Below is a description of these results, which will be discussed in more detail throughout the rest of this working paper.

Phase 1 – Major Deployment in Competitive Clusters or Hubs

The first phase (Figure 5) sees investment and market-coordinated activity in and near MHDV-dependent industry clusters, supporting regional freight networks through 2027. This is estimated to be nearly 21 percent of all deployment and would include: 1) about 17 percent of projected infrastructure deployed within major freight industry clusters (composing 24 percent of all hub infrastructure), and 2) about 3 percent of projected infrastructure built on corridors with express industry support or support from federal and state incentive dollars (about 19 percent of all corridor infrastructure). Because investments are located in areas with high priority for overall long-term investment, infrastructure will have a clear relationship with future utilization and overall adoption.

Figure 5. CALSTART Phased Deployment, Present to 2027 – Phase 1



Each phase constitutes all infrastructure needed to support all vehicles as they are introduced over time, which is accomplished at the same adoption rate as an unoptimized scenario. The rate of adoption does not slow in a phased scenario—rather, the opposite occurs. Accordingly, phasing can be expressed as a cumulative share of the total amount of projected infrastructure (i.e., how much that has been built out compared to the total need) and the total number of vehicles supported by this phase (i.e., out of the total number of vehicles full buildout will support) (Table 2).

Table 2. Phase 1 Breakdown

Category	Share of Total
Share of Total Infrastructure Deployed in Phase 1	21 percent
Cumulative Share of Vehicles Supported Through Phase 1	16 percent

Phase 2 – Connecting Corridors

The next phase (Figure 6), from 2027 to 2030, will see investments covering 47 percent of total infrastructure needs. These investments center around reinforcing primary hubs, connecting these already identified clusters, and filling out identified corridors.

Figure 6. CALSTART Phased Deployment, 2027 to 2030 – Phase 2

About 53 percent of infrastructure investment in hubs occurs in this phase, the majority (58 percent) of investment in hubs overall (Table 3). At the same time, 9 percent of investment in corridors significantly expands the system, as 46 percent of all corridor development is built out in the Southwest, the Pacific Northwest, the Texas Triangle, and the mid-Atlantic.

Table 3. Phase 2 Breakdown

Category	Share of Total
Share of Total Infrastructure Deployed in Phase 2	53 percent
Cumulative Share of Vehicles Supported Through Phase 2	58 percent

Phase 3 – National Networks

The third phase (Figure 7), from 2030 to 2035, sees continuing investment in hubs and corridors but also in a supportive network for ubiquitous availability of infrastructure, all totaling 26 percent of remaining infrastructure needs (Table 4).

Figure 7. CALSTART Phased Deployment, 2030 to 2035 – Phase 3

Table 4. Phase 3 Breakdown

Category	Factor
Share of Total Infrastructure Deployed in Phase 3	26 percent
Cumulative Share of Vehicles Supported Through Phase 3	100 percent

This phase sees investments making up 3 percent of all total infrastructure in a chain of supportive stops for long-haul trips. Fifty-seven percent of all infrastructure is built in this phase, likely leveraging federal funds, while 7 percent of infrastructure is built out on corridors. The remaining 13 percent of infrastructure continues to be deployed in hubs.

Takeaways

This phase-in scenario meets the ZE-MHDV recharging needs projected in the energy needs analysis. It is, of course, only one possible scenario, but in contrast to other high-level projections, these needs were modeled on plausible considerations of ZE-MHDV market evolution and the recharging infrastructure support required. This analysis was also carried out at a finer resolution than other projections and is consequently able to attend to industry, economic, and other factors that closely integrate deployment with locational and competitive advantages.

The infrastructure deployment necessary to support vehicle adoption no longer appears as an undifferentiated block of investment and energy needs. Instead, it is more like a set of needs that can be approached in steps or chunks and is the outputs of detailed models and simulations that consider actual deployment siting and take into consideration local and regional coordination—such as the California Energy Commission's (CEC's) statewide infrastructure needs assessment, for instance, and also assessments from the National Renewable Energy Laboratory (NREL), the Pacific Northwest National Laboratory (PNNL), the Electric Power Research Institute, and others (CEC, 2021a). In these assessments, some of which CALSTART contributed to or was a project partner on, deployment needs respond to vehicle travel patterns and land uses, as well as the availability of the grid. Rarely does deployment increase across a territory everywhere at once in a straightforward, linear fashion.

In sum, the total phase-in deployment scenario developed differs greatly from a scenario that assumes ZE-MHDV adoption will occur uniformly based on a rate of adoption alone, indifferent to where and how need arises. In an unphased scenario, needs would have to be met identically everywhere at once. Potentially underutilized infrastructure would meet continually increasing energy needs in an unmanaged manner, which has the potential to mischaracterize the challenge of the transition and the nature of ZE-MHDVs; with respect to the distribution grid, both "represent a significant new load and a substantial new source of flexibility" (Pacific Northwest National Lab, 2022).

Figure 8 considers the percentage of ZE-MHDVs supported by a phase-in strategy against a straightforward, linear deployment assumption. The phase-in curve is pegged against an assumed linear vehicle adoption rate, which would total likely adoption population assumed by recent EPA regulations.

Figure 8. Rapid, Extensive Market Penetration Supported by Phased Buildout of Infrastructure

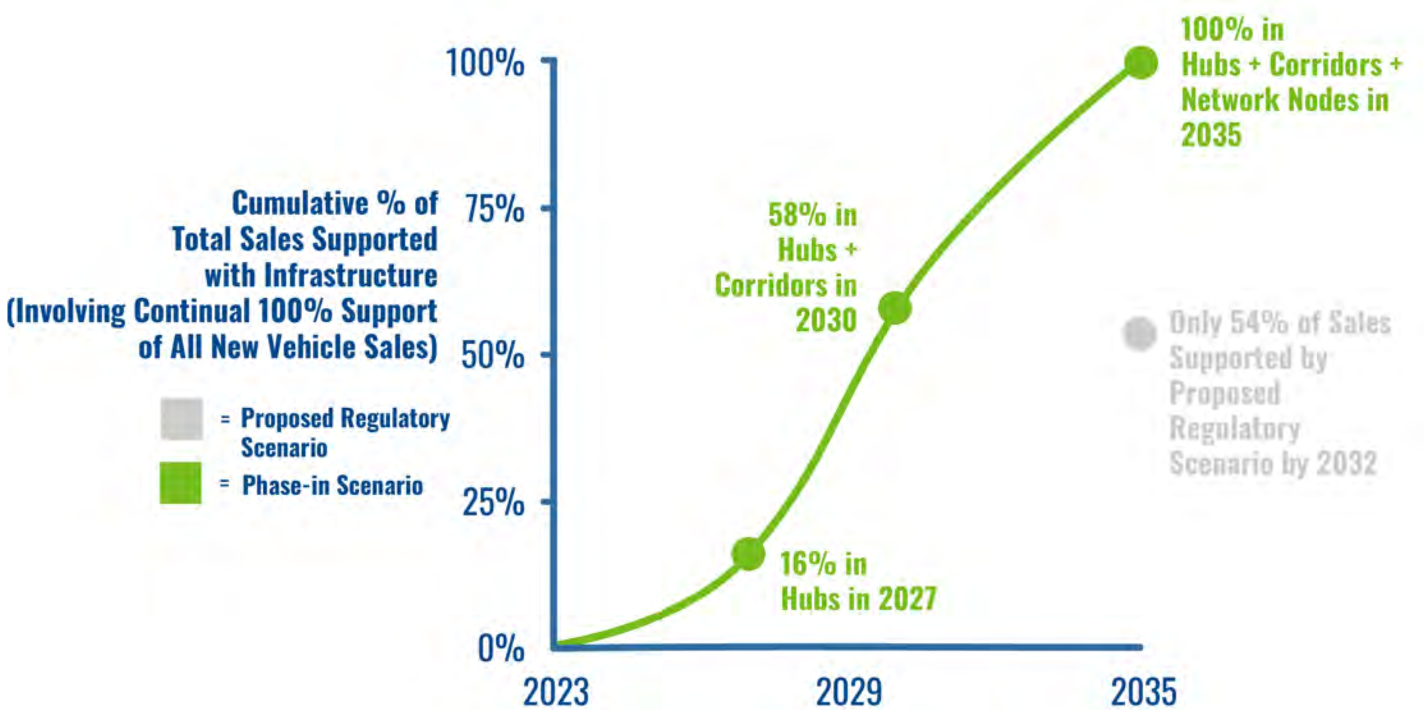


Figure 8 shows how, at all times, 100 percent of vehicles are supported by infrastructure but in very different ways. Initially, because buildout does not occur everywhere, deployment in the phased scenario is less than in a linear scenario; later, more deployments occur at a steeper rate, building off initial deployments. Even later, the curve smooths out, while still accommodating a higher overall percentage of the total number of Global MOU sales targets.

While the challenges involved in building out this scenario should not be underestimated, integrating spatial determinants of ZE-MHDV introduction along with timing priorities driving the use of infrastructure can support very sizable market penetration. The next sections discuss the deployment scenario results in depth and consider where industry assumptions were accounted for or where the scenario was limited in its considerations. In this way, this study shows how the phase-in scenario models one possible deployment pathway but contains a framework for supporting aggressive U.S. ZE-MHDV penetration rates generally. In sum:

- Energy demand will be geographically distributed where the transportation network will see deployment of ZE-MHDVs, and management of net demand can be met by a variety of energy system improvements.
- Deployment of infrastructure to meet this demand can be phased to target priority areas when and where infrastructure is needed first, while maintaining a rapid deployment rate that meets an aggressive demand.

II. When Buildout Will Happen: Prioritizing Areas

This analysis shows that phased deployment can manage timelines and maximize utilization, even at an aggressive ZE-MHDV penetration rate. New ZE-MHDV introductions will be served by targeted, rather than uniform, deployment. The following section discusses in more detail 1) how this important dimension of buildout is captured in this assessment, 2) how it reflects industry strategy, and 3) where other strategies involving prioritizing deployment areas for nearer-term vs. longer-term investments may also be at work in investment planning (though they may not be captured in this study).

Overcoming Barriers to Availability

Three central issues are often cited in discussion of infrastructure deployment barriers:

- Lead times for installation
- Energy capacity and volume concerns
- Unforeseen costs

This analysis does not underplay the importance of these barriers, which constitute considerations important to fleets (Electrification Coalition, 2020). At the same time, the last section's discussion of phasing shows that these barriers may not primarily arise *wherever* and *whenever* one fleet seeks to electrify. Rather, barriers appear *when* and *where* the maximum number of ZE-MHDVs are unable to maximize potential utilization of equipment.

In this sense, prioritizing areas for infrastructure buildout is a key strategy for overcoming barriers generally. In other words, deployment will not happen at first everywhere but "where it makes sense" with respect to maximizing infrastructure utilization (North American Council on Freight Efficiency, 2021).

Areas identified as priorities for rapid and concentrated deployments shift buildout ahead in time and away from areas where ZE-MHDV adoption rates are less important. They also concentrate utilization within geographies. First-mover-area infrastructure thus has the potential to be utilized more in the near term and possibly more efficiently over the life of its deployment. The pace of infrastructure deployment then precisely matches demand by shifting deployment to where there is the *most need*.

To establish priorities, this analysis used a spatial scoring of areas based on four factors with the potential to drive utilization, already mentioned above in the last section's discussion of priority areas for deployment. Table 5 below summarizes the factors and data sources used to understand the deployment geography in this manner. The following discussion will expand on and illustrate these priorities.

Table 5. Priority Factors

Factor	Description	Data Sources
Identified investment areas	Whether an area has already been indicated as a priority for investment by industry or by supportive federal money	CALSTART industry conversations; public announcements
Political, social, equity priorities	Whether an area will have adopted ACT, has signed on to or supported the Global MOU, is a major area for freight, or would benefit from investment in terms of air quality	Census data; industry data; North American Council on Freight Efficiency High Potential Regions Report
Economic clustering	Whether there is a concentration of sectoral activity (i.e., firm location and growth) in MHDV transportation services (such as warehouses, logistics, or other sectors)	U.S. Census NAICS codes and data
Energy	Whether likely grid improvements will be present in an area in the future	NREL Levelized Cost of Energy data

Examples in the Real World

Prioritization reflects real-world strategy and coordinated investment trends by major industries around high-potential areas.

Investment Priorities

Major fleets have service territories they will need to electrify in cooperation with infrastructure providers and energy services. Fleets are not, then, agnostic about the locations of investments both in their depots and along the larger transportation system.

Within depots, fleets are increasingly engaged in both coordinated charging between two sites and out-and-back operations, which would be primarily useful once opportunity charging is installed. In a striking role reversal, some charging site developers have made major investments in establishing their own fleets and have started deliveries. This reversal underscores the normal logic of fleet transition; as fleets consider the routes that could be electrified, they specifically begin to prioritize the coordination among their locations and the facilities they serve.

Accordingly, announcements in pull-through charging investments have targeted these key territories. BlackRock, Daimler, and NextEra have announced Greenlane, a $650 million joint venture to build out key corridors breaking ground this year; the three areas it identified publicly, which gesture to the West Coast, the South, and the East Coast, all specifically target service territories of major fleets operating in those areas (NextEra, 2022). TeraWatt announced that it would use $1 billion in seed funding to build charging stations from Los Angeles to Texas; this overlaps with the territory of major fleets moving goods specifically from the Ports of Los Angeles and Long Beach toward the Texas Triangle (TeraWatt, 2022). It also overlaps with the territory of fleets in Texas and which travel into Texas from Oklahoma, from Atlanta, or along the Gulf Coast.

Recent state and federal government funding has been influential for driving initial partnerships of investors and public agencies. Accordingly, states and charging site developers are working with fleets whose service territories are along these corridors to coordinate an infrastructure buildout strategy. These decisions, in short, are strategic and involve a major focus on making important geographies for fleets electrify first, rather than attempting to electrify the entire country at the same pace.

Political and Social Priorities

Political priorities are important factors. States adopting ACT regulations are often supporting them with incentive opportunities or coordinative activity to further leverage new federal funding for charging infrastructure. These constitute favorable environments for charging. The states themselves constitute priority geographies for fleets looking to reduce upfront costs of infrastructure in their larger deployment planning. States also determine priority areas to support via infrastructure investment and to align with other statewide strategy documents. Again, the roadmap to ZE-MHDV adoption is not uniform but instead tied to goals.

California in particular develops strategy documents to align infrastructure deployment to support key fleet territories within several public plans, such as CEC's Statewide Infrastructure Assessments, the California Public Utilities Commission's (CPUC's) Freight

Infrastructure Planning Process, and the California Transportation Commission's Priority Freight Corridor Designation process (CEC, 2018; CPUC, 2023). Each of these larger efforts prioritize specific areas and identify key measures, including energy rates and policies, which can assist deployment. Texas has adopted major public charging rate design legislation in a similar fashion, with key locations in mind and planned. New York is presently engaged in a similar commercial vehicle infrastructure proceeding. Another excellent example is Colorado, which has just adopted ACT. Colorado developed a robust set of climate and utilities policies in 2019, captured in its Electric Vehicle Plan, which worked to support goals of the electrification of key areas for commercial vehicles (Colorado Energy Office, 2020).

The number and pacing of these sites are directly tied to larger state agency initiatives to realize certain statewide climate plans, transportation efficiency improvements, and other broad statewide goals. Prioritization also features prominently in regional plans for goods movement, with the location of key areas for initial deployment captured in supporting studies.

Economic Clustering

This analysis reflects how commercial fleets are often located in clusters of similar firms within their industry, or in key locations that effectively integrate with the land uses and economy of the area (Delgado et al., 2014). Many fleets are increasingly engaged in efforts to electrify not just their own depot but a larger economic cluster. Fleets next to ports, for instance, will be engaged in many complicated collaborative planning and coordination exercises in order to identify and direct investments in their facilities and into the surrounding area, which will be important for their electrification efforts. Some of these plans—such as in coordinative efforts led by the Port of San Diego—involve discussion of the placement of shared charging resources or public facility deployments, which would assist the development of this cluster as a whole.

Fleet deployments are often integrated within comprehensive and long-term facility development plans, which afford a managed and phased-in approach to interconnection issues and close coordination with utilities. They also allow fleets to integrate electrification within larger sustainability planning efforts in cooperation with demand aggregative capabilities of utilities. In particular, vehicle-to-grid technologies offer methods for integrating fleet, facilities, and the grid directly, as well as managing demand in real-time and even in advance with utilities through demand response technologies and charging-discharging scheduling. Sites with these sorts of capabilities, or the potential to grow into such capabilities, serve as a major priority for electrification over others.

In addition, supportive public sustainability strategy frameworks and regional emissions regulations increasingly anticipate specific land use- or facility-based integration measures as a means for fleet compliance with emissions reduction targets. The California Sustainable Goods Movement Action Plan, California's ACF rule regarding drayage vehicles and their traffic near ports, and the South Coast Air Quality Management District's (SCAQMD's) Warehouse Indirect Source Rule all focus on the phase-in of new infrastructure from a holistic facility approach to manage emissions (CARB, 2016; CARB, 2022; SCAQMD, 2021). All these strategies and regulatory approaches, many of which are currently being replicated or will likely be replicated in ACT states, involve the prioritization of areas to ensure the success of fleet transition, rather than leaving the general location of infrastructure up to chance.

Energy Markets

This analysis reflects how fleets and infrastructure developers also prioritize areas based on energy market considerations. One factor generally is utility strategies for investments to support charging infrastructure. While seeking out areas for prioritization will drive more need for grid upgrades into certain areas—particularly the installation of new transformers—the coordination around the nature of these upgrades in such areas will be more robust and more efficient. The upgrades themselves will be utilized in a more efficient manner and provide an opportunity for new transactive service capabilities that will allow users to talk to each other (PNNL, 2022a).

Regional cost of energy is a potential driver of area prioritization for fleets that this analysis seeks to capture. The price of energy has been considered a major factor in investment decisions in fleet transition and larger charger deployment coordination efforts in which CALSTART has participated, and is acknowledged to be one of the major factors in maximizing utilization of charging (Phadke et al., 2021). Current statewide holidays on peak charging—such as those instituted by major California utilities—and innovations in rate structure attest to the importance of this factor. However, cheaper energy in general will also be a factor in lowering cost of the energy delivery systems.

In conversations with utilities as part of its planning activities for corridor development and in working groups on interconnection, CALSTART has witnessed utilities taking a variety of new strategies to speed up interconnection that involve the prioritization of particular areas. Many utilities look forward to utilizing energy infrastructure in key locations where already existing assets can be identified by a developer; they also look forward to a development in a wide array of energy services between their distribution network and customers, as well as planning upgrades and working more proactively.

In both cases, interconnection queues are managed not just through overcoming physical barriers in capacity and reliability but by developing new business models that are tailored to the market for mobile distributed loads that ZE-MHDVs compose. Fleets will be able to prioritize their transition to ZE-MHDVs where fleets, utilities, and energy service providers are all working toward this goal and where the market is particularly well developed to witness this sort of innovation.

Across all of these examples, the prioritization of key areas because of particular locational advantages either to a fleet's operational needs, to the sector, or to others in the space drives investments into those areas. These examples show that investment can create the potential for regional synergies in deployment, further signifying an area as a priority.

Examples in Analysis

In the optimized scenario modeled, some of these factors are reflected in the general distribution and extent of first-mover clusters and the key supportive corridors, which are identified in this section. Areas with clear industry interest from public statements have a high connection with the annual growth rate in ZE-MHDVs as projected in this analysis and serve as an important prioritization factor. These areas are:

- West Coast (I-5 in California, Washington, Oregon)
- East Coast (I-95 in New Jersey, New York)
- The Texas Triangle (I-10, I-35, I-45)
- Southwest (I-10 in Arizona, New Mexico)
- Rocky Mountains (I-70, I-25 in Colorado, Wyoming, Utah)
- The Midwest (I-80 from Ohio through Illinois)

These areas are supported by the recent Department of Energy Zero-Emission Freight Corridors (U.S. Department of Energy, 2023).

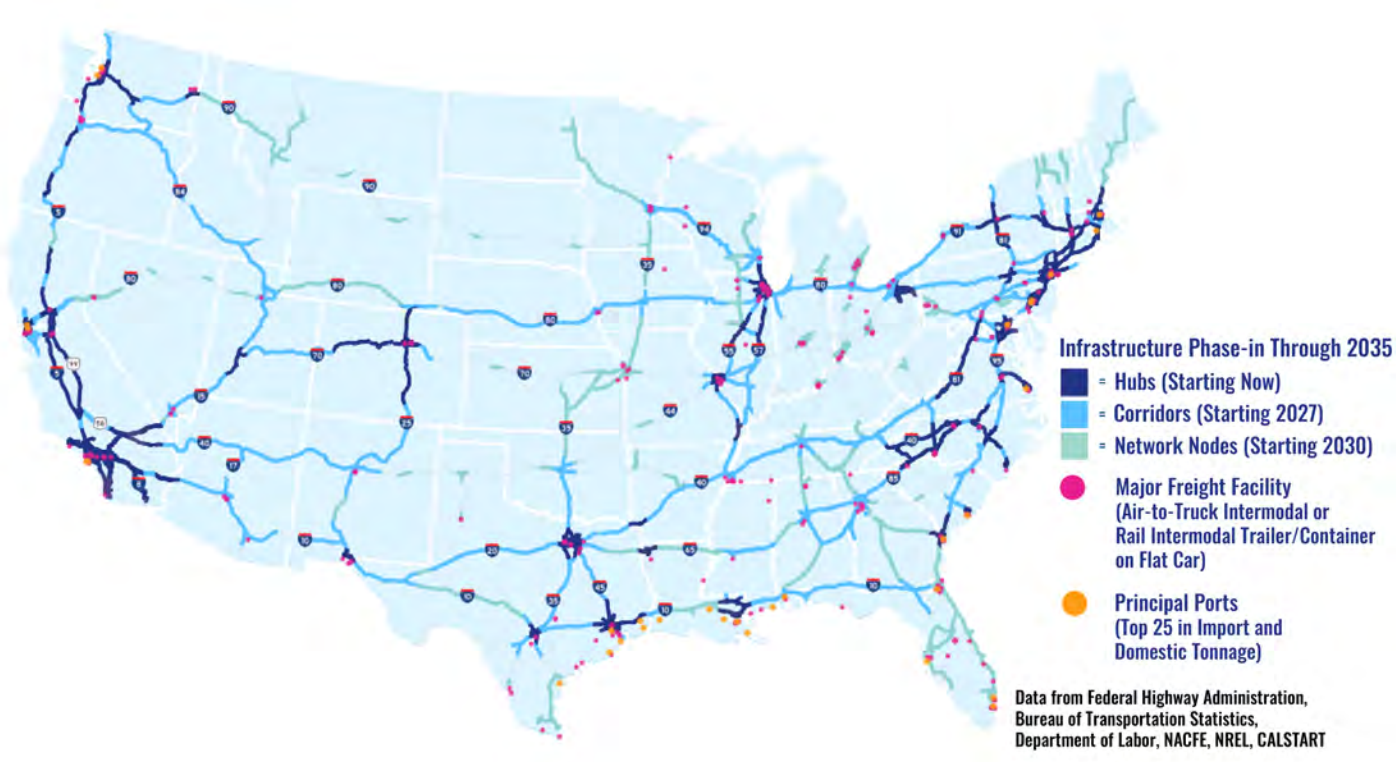
High policy priority areas include all of the signatories to ACT and those considering. In fact, this analysis highlights a very high connection between planned deployment volumes and areas with projected ZE-MHDV sales introductions.

Industry clusters in logistics and warehousing are centers in which annual growth in ZE-MHDV on-road travel concentrates. These include transportation and logistics and warehousing centers, such as the San Bernardino Valley in California, but also areas outside of major ports, including those in Oakland, the Puget Sound, and major East Coast ports such as those in Georgia, Virginia, New Jersey, and New York. Major logistics centers and hubs supported by intermodal travel appear as well in this analysis, particularly Chicago and Atlanta.

Levelized cost of energy of renewables and distributed energy resources were used to establish priority areas where energy distribution upgrades supportive of ZE-MHDVs will be likely, and thus be a priority to fleets seeking to electrify. This data found that a larger share of growth in distributed energy will fall generally across the Southwest and in the West, as well as certain areas of the Gulf Coast and Midwest through 2040.

To illustrate the combined prioritization of key areas and how it arises from the factors outlined in Table 5 above, Figure 9 shows the regional variation with contextualizing data concerning major freight facilities and ports.

Figure 9. Phase-in Priority Areas and Context



Considering the map above, priority factors can help explain regional specifics that arise from phasing in infrastructure, as well as the overall plausible roadmap for transformation for each region.

Mid-Atlantic / I-95

A high concentration of states adopting the ACT rule and federal money for a corridor (I-95), plus industry clusters of warehousing and connection to ports allowing closer coordination around I-95, make policy and industry clusters the focus of infrastructure buildout planning in this area. Many deployments centering in clusters and hubs may arise at first, where little open-road charging infrastructure envisioned for a national network is necessary to connect major hubs and key facilities like ports. Instead, investments will be utilized to connect key depots together, share demand, and accelerate investment.

Southwest / I-10

Huge advantages in a greater share of distribution grid infrastructure from solar and distributed energy resource growth onsite make this region a priority area; freight travel connected to high energy demand hubs also make it likely that development occurs to connect major areas along a potential corridor. The low concentration of supporting industries except at either the Los Angeles or Texas ends of I-10 makes heavy buildout along corridors necessary to support the needs of ZE-MHDVs.

Midwest / I-80

This is an important corridor for the last phase of investments: the national network. Filling in federal connectors to airports and the hubs coming off of West Coast freight travel does not just happen but forms a targeted effort in the later part of this projected timeline. While it may not score high in terms of certain future distribution system growth advantages, investments in key facilities of national importance, together with the efforts to build out national charging, benefit the region.

Takeaways

The major takeaways from the prioritization of areas are threefold:

- By shifting investment into priority regions, more ZE-MHDVs can be supported in less time and for less overall investment.
- Key priority launch areas will form around areas where industry can leverage investments, where political and social priorities create a favorable policy atmosphere, where industry clusters form, and where energy is cheap and has a high potential for distributed grid investments to take off.
- By prioritizing key areas and regions, those areas become integrated and can realize connected utilization efficiencies.

III. How Buildout Will Be Efficient: Site Configurations

The following section discusses how this study integrated strategies to reduce delays in deployment and manage specific risks associated with infrastructure availability by considering deployment configurations.

Overcoming Barriers to Utilization

Lacking infrastructure where and when it is needed is not the only barrier to deployment but fits within the larger picture of an operational shift that fleets are planning for and negotiating (RMI, 2021). This analysis addresses three potential difficulties that fleets are negotiating:

- Energy availability potentially lagging behind vehicle introductions
- Reliability of energy infrastructure
- Uncertain utilization forecasts for shared infrastructure

For the purposes of this analysis, these difficulties were translated into problems that capture how a site can be configured for maximum utilization.

While low utilization in terms of shared infrastructure is a well-understood concern of public charging deployment, the problem should be expanded and understood to encompass many of the issues generally regarding sites. The energy delivery system necessary to support the introduction of ZE-MHDVs is similarly out of balance if a site is not able to deliver power to them or if it is doing so unreliably. Additional components of the energy delivery system besides the charger itself—such as operational or technology factors that manage the site's power—should be integrated into assumptions about how the charger is used and is able to be used more over time.

Accordingly, this analysis considered deployment *configuration* within an analysis area, which introduces potential effects of optimizing charger power ratings for utilization or reaching a certain amount of throughput per charger necessary to optimize the overall relationship of vehicle to charging infrastructure. This analysis assumed that there is a constant industry pressure to optimize configurations in three ways.

First, to address how fleet management services within depots are increasingly used to negotiate infrastructure deployment barriers, this analysis assumed that charging preferences will not be uniformly tailored to vehicle routes but instead will trend toward efficient charging ratings to accommodate the introduction of ZE-MHDVs. Fleets use a mix of higher power and low-power chargers and optimize based on the site's flexibility to drive up utilization.

Accordingly, this analysis also assumed that, especially in priority areas, potential for throughputs per charger can be higher or lower than one vehicle per day. Infrastructure can be shared through a depot-shared system or a depot Charging-as-a-Service (CaaS) system; additionally redundant infrastructure can be built to increase reliability without necessarily creating a higher load on the grid if the charge is managed. The specific assumption used in this analysis was that, except in the case of dedicated public chargers, most chargers are dedicated chargers for one vehicle but can, especially if they are at a higher power rating, charge other vehicles as well.[5]

Third, this analysis assumed that onsite battery storage constitutes a real feature of many future deployments, and that this makes available additional deployments or increased utilization through more flexible site-level management. More volume available to chargers to utilize and manage can lead to higher utilization rates per site.

Examples in the Real World

These assumptions account for the real-world practice of building out infrastructure such that it can be managed by control systems or by site-level management adjustments. The overall energy needs of the energy delivery system can be adjusted so that vehicles can be introduced but not necessarily create an unsustainably high load. This allows the introduction of new vehicles over a predictable timeline while distribution infrastructure comes to meet the site.

Managed charging is a major strategy in feasibly deploying sites while the grid is built out. This can involve 1) improving utilization rates per deployed vehicle through software and operations, and 2) the improvement of overall energy load to allow for a deployment strategy. Current providers of managed charging systems provide services to fleets, which actively manage the energy needs involved in building out a fleet's site.

Four real-world components of this solution were included in this assessment. Active load management services, onsite storage, mobile and temporary infrastructure, and shared infrastructure can be combined—and coordinated—into a site operations regime that takes advantage of charge management software to keep energy demand within acceptable limits of capacity while the latter is expanded or built out. A fifth related

[5] The difficult problem of queuing is not factored in this analysis; rather this analysis assumes conservative throughputs and confines these mostly to shared public chargers.

component is high-power charger integration on sites, which will provide increasing options within sites that need higher throughput in general.

Load Management Services

Load management services can manage the introduction of new loads at facilities while grid capacity is built out. A combination of charge management software and a broader analytic services suite can be actively integrated into facility expansion planning so that recharging infrastructure to support a fleet can be continually installed while staying underneath grid capacity as the latter expands and is upgraded.

One interesting example of successful load management service comes from EO Charging, a UK company that is expanding its presence in North America. EO currently manages the charging operations for several large fleets, including more than 5,000 Amazon commercial electric vehicles in Europe, primarily delivery vans but including medium-duty trucks. Their site design and operation enable accelerated truck deployments and manage utility capacity delays via smart managed charging and a mix of flexible charging rates to meet fleet operational requirements, site capacity limits, energy storage, and pricing considerations. In conversations, the group noted the system has been delivering consistent 99+ percent reliability/uptime (EO Charging, 2023).

Onsite Storage

Sometimes coupled with onsite generation, onsite storage allows a more flexible load to be managed by the control system or utilized as redundancy. Charging infrastructure is now often dispatched together with battery packs. New announcements in charging storage tailored for commercial vehicles are happening apace, and some are positioning themselves as useful for not only depot but also corridor charging (ChargePoint, 2023).

Another solution is battery swapping, which places batteries in a bank and allows charging to take place at low speeds throughout the day.

Mobile and Temporary Infrastructure

CALSTART recently performed an inventory of temporary infrastructure solutions that could assist in the deployment of vehicles and which some vehicle manufacturers are coupling with sales of new ZE-MHDVs to bridge the gap between when energy delivery system upgrades and the actual infrastructure are deployed. Because temporary infrastructure is assumed to effectively deliver energy without creating a permanent need, it was not factored into this deployment assessment. Nevertheless, it can remain a pathway to react to the introduction of ZE-MHDVs or bolster reliability. Temporary and mobile charging solutions can usually be installed and inspected in less than one month and currently cost under $200,000, while saving fleets permitting and installation costs in the short term. FreeWire, DANNAR, Eaton, BP Pulse, Proterra, Veloce Energy, Beam, GM, Lightning, and Voltera all manufacture systems, some for under $100,000.[6]

Shared Infrastructure

The final strategy is the sharing of charging infrastructure, whether at the depot or in a public charging site. At the depot level, several efforts are underway to aggregate demand among multiple fleets at a co-located site, or to coordinate one fleet across multiple locations. CaaS strategies are now the basis of many planned depot charging projects within depots; vendors have adopted reservation systems or per-charge solutions which can be built out to charge a co-located set of fleets and in many ways can be integrated into new facility design and construction, especially in the logistics and warehousing space, shortening timelines and giving predictable coordination to utilities (CALSTART, 2021c). This is a companion, outgrowth, and driver of clustering, as explored in Section II above.

Shared accessible infrastructure is also a supportive system, which is accounted for both at the depot level (as mentioned above) and in public charging. Major investments on corridor-level pull-through charging by companies show that this is a model with viability and that at scale could produce real effects. In this analysis, it was not necessarily considered a factor that removes a need for return-to-base charger deployment at the depot level to support vehicles. However, it does introduce a play between the charging needs for vehicles continually and the chargers continually within a depot, and if present in areas, may allow depot charger utilization to increase.

Higher Charging Power

Higher charging power is quickly becoming a reality. CALSTART is engaged with the Electric Power Research Institute on a project to deploy higher-power charging approaching megawatt levels, and manufacturers such as ABB and Siemens are both testing and nearly ready to offer potential solutions on the market. Charging utilization rates jump extremely high with the introduction of higher power charging. A 15- to 30-minute charge of a major Class 8 truck is theoretically possible at these rates, as well as throughputs which dramatically increase the availability of a charger to potential vehicles.

The effects of higher power charging in this study were not considered beyond a higher assumed utilization rate among public chargers and a total assumed share of deployment configuration, which is very consistent with the high use of high-power charging. However,

[6] Many of these systems can be rented or leased for short periods of time to minimize costs for the fleet (allowing them to be utilized only until permanent solutions can be deployed and then transferred to a new site, where another fleet can take advantage of the same unit).

innovative deployments to handle energy needs should also be noted, including the potential of connecting directly to sub-transmission level medium-voltage lines and reducing the need for step-downs.

Examples in Analysis

This study forecasts that battery packs will be used in some form on many sites (i.e., 50 percent) in both hubs and clusters and along corridor sites. On other sites on the national network, they will be widely used (i.e., 50 percent of deployments). This analysis did not assume that battery packs will be used as part of microgrids or distributed energy generation, which may offset peak loads; however, the assumption was made that in any case they will be deployed as an add-on that forms part of a site's energy demand management system and unlocks the availability of one additional charger per vehicle per site by creating utilization flexibilities. This was built in as a cost increase per deployment according to the share allocated to each specific geography. A long duration (> 2 hour) battery storage system of 650 kilowatts (kW) was assumed, and this analysis used both standard deployment configurations for charging rows of commercial vehicles and industry costs on storage derived from recent cost assessments (Energy Information Administration, 2021; PNNL, 2022b; NREL, 2021). While this increases the costs of an individual deployment in this scenario, it enables many charging strategies and deployment configuration optimizations. This analysis did not consider potential cost savings on energy peak demand, but these are also likely significant.

Accordingly, this analysis also assumed that shared charging will be prominent in priority hubs and clusters and somewhat on corridors; nearly 50 percent of chargers will be as shared in those areas in some way—if only by using two ports—while on sites along corridors a similar percentage of chargers will be shared in some way. This analysis did not assume that sites composing the national network will utilize shared charging. Instead, it was assumed that sharing will add additional utilization to the charger of 50 percent, which ultimately reduced the total costs over the maximum scenario.

Furthermore, it was assumed that public charging will become widely available, especially in areas along corridors and the national network. Utilization of chargers in public sites is very high, and this analysis assumed that they effectively double or triple the utilization of a charger per day. This is a conservative estimate, as calculations involving public chargers can, depending on the need, yield a utilization rate of twelve or even sixteen vehicles per day. These estimations follow Lawrence Berkeley National Lab at this time, but future iterations will make room for high-power charging, which will have even higher utilization rates (Lawrence Berkeley National Lab, 2021). Though most public sites have a more delayed deployment phase-in in this assessment, and assuming only 10 percent of hubs and 10 percent of sites on corridors are public, and that half of sites along the national network are public, this approach produces additional total cost reductions.

Takeaways

The major takeaways from this discussion of site configuration are threefold:

- Utilization is the primary factor in establishing optimal site configurations, and different priority launch areas have optimized site profiles that maximize utilization.
- Phasing in strategies will focus on maximizing charger utilization to manage energy demand increases.
- If utilization is optimized, the costs of infrastructure per vehicle can be lower and the buildout rate can still proceed rapidly.

IV. Conclusions

The previous sections discuss a market-driven, overlapping, and concurrent growth of a supportive ZE-MHDV ecosystem in a *phased transition*. This final section summarizes conclusions and suggestions for how this analysis can support a framework for future infrastructure deployment.

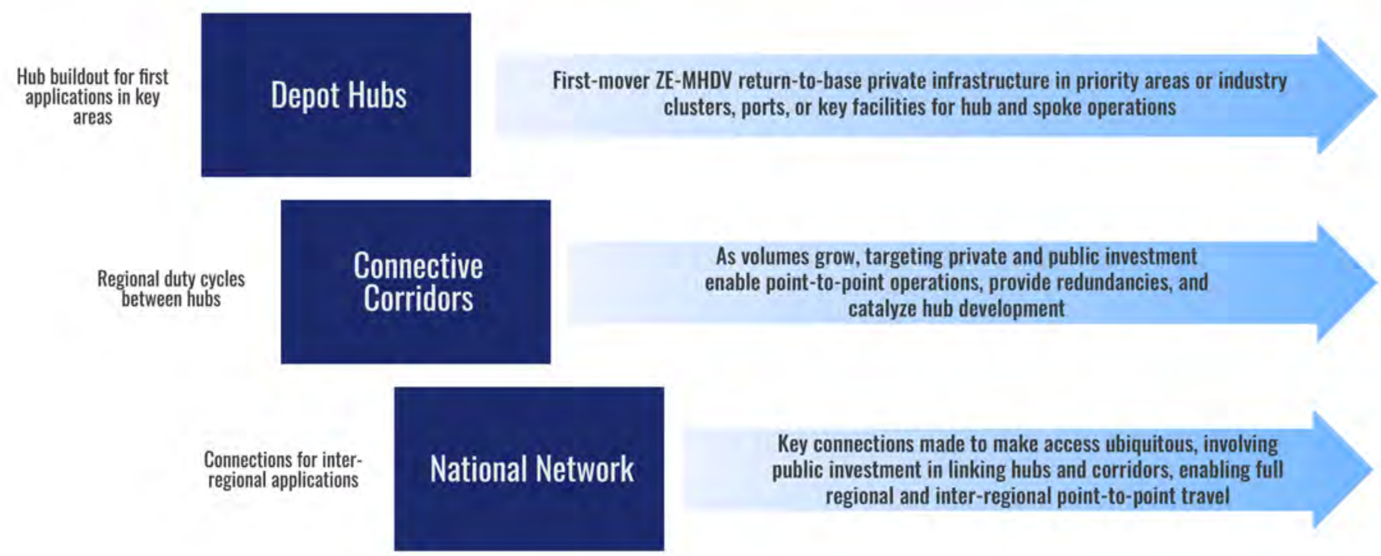
Discussion: Network Effects and Further Research

Network Effects

Many existing models project infrastructure needs by scaling up infrastructure needs analyses that utilities and fleet transition specialists are now performing on individual fleets within their depots. By contrast, this analysis represents a systems approach to energy transitions. It is oriented toward capturing effects that these depot-focused models mostly aggregate or ignore, and which arise as soon as a fleet is considered within a larger combined travel and energy market.

Some of these effects have been described by CALSTART in previous papers as arising within the "market gradient" for new and advanced technologies, and still apply even as all ZE-MHDVs are now mature and ready for adoption in all applications (CALSTART, 2021b). As deployment progresses through the phases described in this study, the market will continue to involve innovations and learnings, and the investment of capital in infrastructure will seek high leverage and benefit opportunities. Progression through the phased transition can be summarized in Figure 10.

Figure 10. Infrastructure Phase-In Progression



This figure updates previous versions of CALSTART's assumptions regarding the deployment of vehicles in light of the findings of this working paper (CALSTART, 2022b). It brings together several axes of change seen in Figure 2 above, including vehicle technology, duty cycles, and fleet management scenarios. But it also summarizes how the findings from this study compose a dynamic picture of the future of the infrastructure and vehicle markets, involving coordination, learning, and overall technology cost reductions.

Coordination and Learnings

This analysis makes room for implementation efficiencies characteristic of a dynamic technoeconomic shift. These efficiencies—which are already happening—are assumed to be a key driver of prioritization and maximized utilization from site configurations. Commercial vehicle deployments are being served by make-ready programs within specific utility territories and exhibiting a geographic prioritization, showing that this prioritization of first-mover regions is both possible and occurring. In general, this analysis was framed to capture this effect, which can increase and streamline infrastructure delivery processes, as well as drive overall distribution system modernization and resiliency. Where similar needs are catered to, more refinements will emerge.

Capturing these dynamics is also important to understand that risk reduction will cascade across an increasingly energized transportation system. Many of the utilization efficiencies in prioritizing areas and establishing high-utilization configurations outlined in Section III above will involve advance planning and the management of both net demand and any grid impacts. But again, prioritization can assist. In key areas, services are now provided by a suite of well-established service providers and consultants, which can dramatically reduce the potential of a new deployment triggering unforeseen major upgrades. Microgrid Labs, for instance, provides advanced simulation of grid needs for medium-duty fleets as well as many other commercial vehicle applications; in the course of their analyses, they identify and flag grid reliability needs and grid upgrades necessary for a fleet's electrification well ahead of time, reducing the potential for surprises. Comparable services are now being offered by major firms like Arup, Edison Energy, ICF, GNA, and Parsons, to name a few.

In addition, in conversations with CaaS providers and site developers, CALSTART has learned that these evaluations are regularly developed as a way to assess site potential as well. The growth of a transportation-energy integration industry—which features some site developers with data-center development experience—and the increasing sophistication of this planning for fleets make coordination with utilities easier and open up a window of multiple options for interconnection. Transitions can then pace at the rate responsive to the grid's upgrade timelines and needs.

The extensively studied and generally predictable dynamics of travel markets will allow for advance planning for upgrades. To prioritize areas generally is to extend from the fleet's operating territory to both the travel market and the grid.

Technology Diffusion

These efficiencies will lead to decreases in technology costs, which lower the levelized cost of charging infrastructure (Borlaug et al., 2020). While many factors involved in manufacturing and in technology diffusion and market acceleration in infrastructure can lead to cost reductions, these assumptions were mainly based on dramatic cost reductions in comparable industries and in the distribution system. For instance, analyses show that capital costs across energy delivery infrastructure have been subject to great changes, such as in solar technology, and not to major increases except through extreme market changes.

CALSTART has tracked both market growth in energy infrastructure solutions and infrastructure costs in this space, both within research targeting market acceleration and within projects involving the administration of state incentive programs for EVSE. A reasonable technology reduction cost was considered between 4 percent and 7 percent over the course of this analysis within the priority areas. In this way, the analysis accounted for how industry will be creating shared solutions together, especially in priority areas. Over the timeline of this analysis, total capital costs were reduced 11 percent in the resulting scenarios.

Overall Cost Reductions

Overall costs are included in Table 6 below.

Table 6. Costs ($ billions)

Area	Phase 1	Phase 2	Phase 3	Total
Cluster	$10.0	$37.2	$11.7	**$58.9**
Corridor	$1.9	$7.2	$5.6	**$14.7**
Network	-	$0.5	$5.2	**$5.7**
Total	**$11.9**	**$44.9**	**$22.5**	**$79.3**

These costs are similar to those projected by other studies (ICCT, 2023). Note that these figures could be significantly reduced, however, if 80 percent of costs are be borne by private investment, especially along key clusters and corridors where federal funding currently exists. For this reason, potential funding leverage was factored into prioritization in Table 5 above.

Several important network effects can result from these costs. First, costs are shifted into areas where the highest priorities in the overall deployment are located. Second, they increase when corridors connect to those areas and where national nodes are added on to support them. It is likely that these costs can be optimized further through the adequate establishment of the interaction of sites within each priority launch area. That is, by growing smartly in key areas, and then managing the distribution of travel within these areas between sites, further buildout of sites will be able to take place more or less cheaply as the market grows and ZE-MHDVs penetrate more deeply into that market.

In short, fully managed clusters and integrated, intelligent travel corridors that maximize site level utilization even further could reduce costs overall through a flywheel-like effect. This effect, which is truly visible when a systems approach is taken and costs are not accounted for by simple aggregation, will be explored along with the other network effects mentioned above in future versions of this working paper.

Recommendations

Based on this assessment, aggressive ZE-MHDV penetration rates can be accommodated by a buildout of energy delivery infrastructure if a phase-in method and strategy is taken seriously for this deployment. Previous CALSTART discussions on infrastructure recommended major coordinative actions necessary among stakeholders in the transition to support ZE-MHDV infrastructure buildout (CALSTART, 2020):

- Conduct road mapping and anticipate emerging demand.
- Develop competitive utility rate structures.
- Create favorable utility investment regulatory frameworks.

On the basis of the above analysis, this list can be extended to include the following:

- Forecast high-level energy needs using a phase-in approach sensitive to the anticipated distribution of energy needs in specific priority launch areas.
- Coordinate investments around priority launch areas that will accommodate vehicles first, designating them with specific prioritization factors including industry clustering, investment leverage potential, supportive policy, and energy system development potential and costs, as in Table 5.
- Encourage practices and policies to support coordination around higher charger utilization.
- Plan rapidly for grid modernization around transportation and energy system integration.

Future Work

CALSTART is engaged in work to bring together and advance ideas related to address energy demand issues in this scenario for probable demand growth. Further investigation of flexible interconnection, bring-your-own-device strategies, time value rates, performance-based regulations—which are critical to some of the concerns developed here—will be the subject of future research to be integrated into this paper and other related efforts to show how phased infrastructure buildout could meet demand for ZE-MHDVs.

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Appendix

Data Sources

For this study, CALSTART generally used publicly available data. For this reason, some of the estimates and derivations made are limited by the granularity of data available.

Energy Needs

Vehicle data was taken from the U.S. Highway Performance Management System (HPMS), using a base year of 2018 for projections. Additional contextual information was provided by the NHFN designation dataset. As noted above, areas outside the continental United States (including Puerto Rico, Hawaii, and Alaska, as well as other territories) were excluded from this analysis (Table A-1).

Table A-1. Travel Data Sources

Data	Specific Data	Source	Year
Travel data per segment	AADT, Operational Classifications, Segment Length	FHWA, 2018	2018
NHFN	Freight System Classifications	FHWA, 2023a	2023
EPA MOVES Categories	EPA Vehicle Categories	EPA, 2023c; EPA, 2023d	2023
Administrative Boundaries	Census TIGRIS Shapefiles	Census Bureau, 2023b	2022

Data included deriving travel per road segment in the form of annual average daily traffic for specific categories of vehicles within the HPMS dataset. These were cleaned with reference to both existing operational classifications relevant to the dataset and by validating against NHFN designations (allowing for differences within the designation process between 2018 and 2021). Vehicle classifications for MHDVs were crosswalked with vehicle categories in EPA MOVES. Administrative boundaries were taken from the most recent TIGRIS shapefiles.

Phasing

To determine how buildout phases would be split up (between Phases 1 through 3), the following datasets were used (Table A-2).

Table A-2. Prioritization Data

Category	Data	Source	Year
Industry infrastructure investments	Location of Deployment	Public announcements by NextEra, 2022; Terawatt, 2022; Voltera, 2022	2023
Federal investment areas	Federal FY 21-22 awards for U.S. Department of Energy corridor planning grant funds; Title 23 and NEVI Guidelines	Department of Energy, 2023; FHWA, 2023b	2023
ZE-MHDV potential	Priority Freight Regions (States)	North American Council for Freight Efficiency 2021	2020
Economic clustering	County NAICS Code Data	Census Bureau, 2023a Delgado et al., 2014	2022
Energy cost and grid improvement potential	NREL projected Levelized Cost of Energy data from 2020 to 2040 for solar and wind (commercial applications)	NREL, 2023	2022

Industry investment area data and federal investment areas were both developed into datasets by projecting assumptions of key locations onto the road network.

Industry Investment Area Data

Data on industry announcements has been tracked by CALSTART and was derived from public announcements. Five-mile buffer areas around the road network in the areas covered by the announcements were developed and reprojected to intersect with the grid and flag an area as a particular industry priority with the appropriate weighting.

Federal Investment Area Data

Federal investment areas were also taken from announcements. Major federal corridor planning projects to use Infrastructure Investment and Jobs Act funding were selected. A 5-mile buffer was placed around these corridor areas, and these areas were flagged as federal corridor investment priority areas and given the appropriate weighting (U.S. Department of Energy, 2023).

In addition, the National Electric Vehicle Infrastructure (NEVI) Formula Program enables states to designate sites eligible for public funding roughly every 50 miles (FHWA, 2023b). Fifty-mile sites were projected across the nation near the network in this study and designated as a priority with the appropriate weight.

Assumptions Data

Table A-3. Cost Data

Data Source	Specific Data	Source	Year
EVSE	Average per-vehicle EVSE costs	Borlaug et al., 2020 EPA, 2023a; 2023b Muratori, 2021	2020-2023
Onsite storage	Average onsite battery storage cost per vehicle	NREL, 2021; Energy Information Administration, 2021	2021

Approach

Energy Needs

HPMS 2018 vehicle activity data was used where the vehicle activity is available for both single and combination vehicle classes. These categories were aligned with EPA MOVES vehicle categories in a crosswalk. Data was prepared and validated against existing vehicle activity data and filtered for segments on the National Highway System Network, specifically the Primary Highway Freight System. The vehicle activity data was parsed as follows:

1. Vehicle activity data (i.e., annual average daily traffic), which is the number of vehicles at any given point (temporally and spatially) across the road network, was parsed at a 10-mile resolution across the network.
2. Vehicle count was summed within segments. VMT appropriate to the commercial vehicle classes was calculated by multiplying vehicle count by segment length for each segment. The result was aggregated to the 10-mile interval area. Because VMT calculated from HPMS data is liable to undercount actual VMT on the network, validation proceeded to scale up VMT to match statewide estimates for the relevant classes.
    - In order to transpose this vehicle activity across the United States to new ZE-MHDVs that will enter the market, a scaling factor for each segment was derived. This was calculated as *ZE-MHDV VMT in each segment/Total ZE-MHDV VMT across the United States*.
    - To determine the ZE-MHDV activity distribution across the United States, the total VMT based on sales estimates for single and combination ZE-MHDV was calculated. It was then multiplied by the scaling factor for each segment across the United States to derive the share of ZE-MHDV VMT at each segment.
3. Energy intensities were used to calculate the energy demand at each segment.
    - A population-based weighting factor was associated for deriving energy intensity for single vehicles composed of vehicles between Class 3 through 7.

This was calculated as 1.525 brake horsepower-hour per mile (bhp-hr/mile) for single vehicles and 0.94606 bhp-hr/mile for combination vehicles using MOVES factors and vehicle populations for corresponding vehicle weight classes. Energy demand per segment was then calculated by multiplying ZE-MHDV VMT per segment by the respective energy intensities.[7]

[7] While the above approach is applicable for calculating energy demand for all in-use vehicles on the corridor, in this study only the energy demand to cater to ZE-MHDVs that are expected to be electrified were of primary importance.

CALSTART's Drive to Zero program published expected zero-emission vehicle penetration pathways in various vehicle weight classes through 2050 (CALSTART, 2020b). This study used the 2030 and 2035 penetration percentages for single vehicles by summing the expected number of ZE-MHDVs in Classes 3–7 by 2030 and Class 8 ZE-MHDVs for combination vehicles. In this way, while ZE-MHDVs introduced across the United States are expected to be spatially dynamic and will appear depending on the phasing carried out, the total eventual distribution of ZE-MHDVs across the national surface transportation network ultimately is derived from the vehicle activity characteristics that constitute VMT distribution.

Deployment Prioritization

Having determined where vehicles would need to be introduced, the analysis then phased these areas by ranking their priority and determined deployment on the basis of that priority ranking. The timing and pace were validated against the timeline and pace of the original projected vehicle introduction.

The datasets associated with the priorities are listed above, but a summary of priorities and how they were weighted is below (Table A-4).

Table A-4. Priority Data

Category	Data	Weight
Identified investment areas	Industry investment areas (as identified spatial extents)	High
Identified investment areas	Federal investment areas	Medium
Political, social, equity priorities	State support for Global MOU	High
Political, social, equity priorities	State ACT adoption	High
Political, social, equity priorities	Statewide “high potential regions” identified by North American Council on Freight Efficiency and re-scored to include updated above political and social commitments	Low
Economic clustering	County NAICS code categories of “Transportation and Logistics,” “Distribution and Electronic Commerce,” and “Local Logistical Services"	Medium
Energy cost and grid improvement potential	NREL projected Levelized Cost of Energy data from 2020 to 2040 for solar and wind (commercial applications)	Low

The total scoring of the areas in terms of priority was developed by ranking each of the metrics for each area against the rest of the areas within the national network under consideration and normalizing them via min-max rescaling. They then were assigned due weights (of 1-5) and combined to produce a prioritization score. For example, Maricopa County, Arizona, scored nationally very high in terms of the share of solar and wind applications which would increase the potential that the distribution grid would be robust in the area. This was normalized and, after weighting, combined together with its ranks in terms of economic clustering and political and social priorities, as well as its priority as an identified investment area for industry or for the federal government. This calculation produced a composite score for Maricopa County.[8]

Phasing

From here, composite scores were cut into separate bins; the top ones, comprising one-third of areas, were considered Phase 1, the next half constituted Phase 2, and the remaining bins constituted Phase 3 (Table A-5).

Table A-5. Phase Definition

Type	Description
Phase 1	Begins currently; highest priority ranking areas; takes on percentage of future deployment
Phase 2	Begins 2027; middle ranking in terms of priority; takes on percentage of future deployment
Phase 3	Begins 2030; bottom ranking in terms of priority; shifted furthest back; does not take on percentage of future deployment

Finally, deployment was shifted to affect the phasing of buildout. Areas in Phase 1 would deploy starting presently through 2027, Phase 2 starting only after 2027. Both, however, could shift forward subsequent deployment to take on about 75 percent of its deployments, while areas within Phase 3 were shifted back in time to deploy 100 percent of their chargers between 2030 and 2035. In this way, a phasing of investment was carried out.

Following this step, validation of initial energy needs as forecasted against the phasing scenario was performed to ensure total deployment responded in a clear relationship to initial forecasts of energy demand.

Assumptions

Energy Needs Assumptions

The model involved several key assumptions:

- The vehicle activity data used from any week was representative of most weekly operations and adjusted for seasonality.

[8] Transformation of datasets at different resolutions was necessary. Where county-level data was necessary to transform to the more granular grid-level, county data once ranked was assigned equally to analysis grid areas within the county.

- Single vehicles were assumed to be comprised of vehicle Classes 3 through 7 and combination vehicles comprised of Class 8 vehicles.
- New ZE-MHDV introductions in the United States followed current vehicle activity/usage across the country.

These assumptions will be explored in future work.

Utilization Factors

Charging Power

The actual deployment of infrastructure was allowed flexibility with respect to what vehicles were required, reflecting two related tendencies assumed in other major studies and corroborated by industry experience: 1) operational considerations shift charger choices downward in many contexts for charging that would be overnight, but 2) the general trend for all charger selection is to increase utilization, yielding a continual preference for higher power charging through 2032. This was assumed to yield a shift from an initial distribution of chargers, which skews lower, toward Level 2 chargers and away from a larger share of higher power chargers to a U-shaped distribution in the charging power categories in deployment over the lifetime of this analysis. Table A-6 shows the assumed change in the share of chargers used by vehicle class through the study.

Table A-6. Deployment Distributions

Power Rating	Vehicle Class	Share of Chargers (present)	Share of Chargers (2032)
Level 2	Class 3-7	30 percent	30 percent
Level 2	Class 8	50 percent	10 percent
DCFC 50 kW	Class 3-7	30 percent	20 percent
DCFC 50 kW	Class 8	30 percent	10 percent
DCFC 150 kW	Class 3-7	30 percent	40 percent
DCFC 150 kW	Class 8	10 percent	20 percent
DCFC 350 kW	Class 3-7	10 percent	30 percent
DCFC 350 kW	Class 8	10 percent	60 percent

Sharing

Sharing in some form (by sharing a charger or an arrangement) was assumed to be prevalent within Phase 1 (hubs/clusters) at 75 percent of deployments and less prominent in other areas, where it was considered equally 50 percent of deployments.

Public Charging

Public charging was assumed to be prevalent within 30 percent of hub/cluster deployment areas, 50 percent of corridor deployment areas, and 90 percent of national network locations.

Costs

Unless otherwise indicated, costs were calculated per vehicle based on assumed costs derived from several sources (Table A-3).

Overall Costs

Overall costs were calculated after phasing of deployment and after validation of initial assessments of energy needs against deployment was performed. Costs presented in Table A-7 utilize the assumptions indicated in the following discussion.

Table A-7. Costs of Phased Scenario by Phase and Area ($ billions)

Area	Phase 1	Phase 2	Phase 3	Total
Cluster	$10.0	$37.2	$11.7	**$58.9**
Corridor	$1.9	$7.2	$5.6	**$14.7**
Network	-	$0.5	$5.2	**$5.7**
Total	**$11.9**	**$44.9**	**$22.5**	**$79.3**

The following were not factored into Table A-7: 1) incentives for public charging, which significantly reduce the upfront costs of deployment, and 2) federal and state investments in charging infrastructure, which will reduce the overall costs of deployment. Initial exploration of these costs, which will be developed in subsequent work, shows that the total costs can fall significantly with those two factors.

EVSE

For the purposes of this analysis, EVSE costs were derived from what EPA used per vehicle for its Proposed Phase 3 ruling (EPA 2023a; EPA 2023b). These assumptions were checked against academic studies on the subject and considered as a starting point for a baseline cost estimate (Muratori et al., 2021). CALSTART will, in future analyses, derive cost data from a wider array of both academic literature, industry data, and collected deployment data. A summary of costs per port (as per-vehicle) is below (Table A-8).

Table A-8. EVSE Base Costs

Power Rating	Costs per Port
Level 2	$10,541
DCFC 50 kW	$31,623
DCFC 150 kW	$99,066
DCFC 350 kW	$162,333

Assignment of Costs per Deployment

Costs were assigned to areas according to the distribution of chargers in different scenario phases (Table A-6).

Onsite Storage

Onsite storage costs were based on CALSTART internal data on project costs involving onsite storage. These were added to vehicle costs. Additional average costs per vehicle were estimated at a fraction of total charger cost based on industry data and project information available to CALSTART. This was determined based on data involving major deployments of onsite storage at nearly 600 kW with > 2-hour charge, to support deployments of 15 vehicles or more. Per-vehicle cost was calculated using cost estimations from NREL and Energy Information Administration (Table A-3) and added these as additional assumed costs to half of deployments of 150-kW chargers or higher.

Technology Diffusion

Analyses show that capital costs across energy delivery infrastructure have significant reductions due to technology learning rates, such as in solar technology. This analysis considered a technology reduction cost between 4 percent and 7 percent annually, similar to those historically seen over similar periods in wind and solar energy, as reasonable. These were applied to all deployments.

National Zero-Emission Freight Corridor Strategy

Prioritizing investments, planning, and deployment for medium- and heavy-duty vehicle fueling infrastructure to advance zero-emission freight along our nation's corridors.

Kang-Ching (Jean) Chu, Kevin George Miller, Alex Schroeder
(Joint Office of Energy and Transportation)
Alycia Gilde, Michael Laughlin (U.S. Department of Energy)

March 2024 (updated September 2024)

DOE/EE-2816 2024

List of Acronyms

DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
EV	electric vehicle
MHDV	medium- and heavy-duty vehicle
NHFN	National Highway Freight Network
ZEF	zero-emission freight
ZE-MHDV	zero-emission medium- and heavy-duty vehicle
ZEV	zero-emission vehicle

Executive Summary

A National Vision

The United States has committed to decarbonizing freight transportation by advancing the deployment of commercial zero-emission medium- and heavy-duty vehicles (ZE-MHDVs) and infrastructure. It is pursuing this goal by leveraging historic federal and private investments, policies, and partnerships. Through the U.S. National Blueprint for Transportation Decarbonization[1] and the Global Memorandum of Understanding for Zero-Emission Medium- and Heavy-Duty Vehicles,[2] the United States has committed to identifying viable pathways and implementation actions that promote at least 30% ZE-MHDV sales by 2030, with a goal of 100% by 2040. These actions, along with the investments laid out in the Bipartisan Infrastructure Law and Inflation Reduction Act, put the nation on a path to advancing transportation and infrastructure solutions that are better for freight movement, our communities, the environment, and the economy.

Providing ubiquitous and convenient access to electric vehicle (EV) charging and hydrogen refueling along our nation's freight corridors, and at truck depots within freight hubs, is key to successfully deploying ZE-MHDVs. Consistent with its charge in the Bipartisan Infrastructure Law,[3] the Joint Office of Energy and Transportation (Joint Office), in collaboration with the U.S. Department of Energy (DOE), Department of Transportation, and the Environmental Protection Agency, has developed the *National Zero-Emission Freight Corridor Strategy* (Strategy). The Strategy guides infrastructure deployment to meet growing market demands; catalyze public and private investment; and support utility and regulatory planning and action at local, state, and regional levels. This Strategy lays out an all-of-government approach to aligning investments and accelerating sustainable and scalable deployment of reliable ZE-MHDV infrastructure.

Starting with First Success Regions

A core objective of the Strategy is to meet freight truck and technology markets where they are today, determine where they are likely to develop next, and set an ambitious pathway that mobilizes actions to achieve decarbonization. The Strategy identifies the greatest opportunities to support early introduction of ZE-MHDVs, promoting cost savings for commercial fleets, cleaner air for communities, and strategic investments for infrastructure companies and electric utilities. This comprehensive approach is intended to support the commercial ZE-MHDV market, both where it is growing and where it can succeed first. The Strategy includes zero-emission fuels and diverse truck applications

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[1] The U.S. National Blueprint for Transportation Decarbonization: A Joint Strategy to Transform Transportation | Department of Energy

[2] U.S. Secretary of Energy Advances America's Commitment to Reaching Net Zero Global Emissions and Combatting Climate Change at COP27 | Department of Energy

[3] Title VIII of division J of the Bipartisan Infrastructure Law (enacted as the Infrastructure Investment and Jobs Act) (Pub. L. 117-58) (Nov. 15, 2021)

representing Classes 4 through 6 (e.g., first- to last-mile delivery trucks, local work and service trucks, and school buses) and Classes 7 and 8 (e.g., refuse, transit, coach bus, port drayage, regional haul, and eventually long-haul transportation). As infrastructure availability increases within freight hubs and connecting corridors, the opportunity for longer-range transportation to occur between these locations is more likely, catalyzing market expansion and transformation.

Applying Key Deployment Factors

To prioritize the buildout of ZE-MHDV infrastructure nationwide, the Strategy evaluates critical deployment factors that target favorable investment areas along the National Highway Freight Network[4] (NHFN) and within supporting freight ecosystems. The Strategy moves through four progressive phases to promote zero-emission truck adoption from 2024 to 2027, 2027 to 2030, 2030 to 2035, and 2035 to 2040. The analysis applied the following deployment factors to determine infrastructure phasing over time:

1) The highest percentage of freight volume over the NHFN.[5]

2) The highest percentage of ports by annual tonnage, all intermodal freight facilities, and key truck service facility locations.[6]

3) Projected ZE-MHDV volumes that demonstrate better total cost of ownership compared to internal combustion engine trucks (e.g., early markets with first- and last-mile delivery, local and regional haul, and moving toward long-haul transportation).[7]

4) Areas that bear disproportionate environmental and air quality burden from MHDV emissions.[8]

5) States with policies that enable zero-emission vehicle deployment.[9]

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[4] National Highway Freight Network | Federal Highway Administration Freight Management and Operations | U.S. Department of Transportation

[5] Highway Performance Monitoring System 2022; Freight Analysis Framework 2050 Base Line Scenario.

[6] See Appendices for lists of key facilities included in each phase of the Strategy, which were triaged based on the U.S. Army Corps of Engineers Ports Commodity Tonnage (2022).

[7] Ledna, C., Muratori, M., Yip, A., Jadun, P., Hoehne, C., and Podkaminer, K. 2024. Assessing Total Cost of Driving Competitiveness of Zero-Emission Trucks. *iScience*. https://doi.org/10.1016/j.isci.2024.109385.

[8] Nonattainment Areas for Criteria Pollutants (Green Book) | U.S. Environmental Protection Agency

[9] Specifically, states that have adopted Advanced Clean Trucks | California Air Resources Board

6) “On-the-ground” planning for ZE-MHDVs through Department of Energy commercial zero-emission vehicle corridor planning grants.[10]

Sequencing Market-Driven Actions

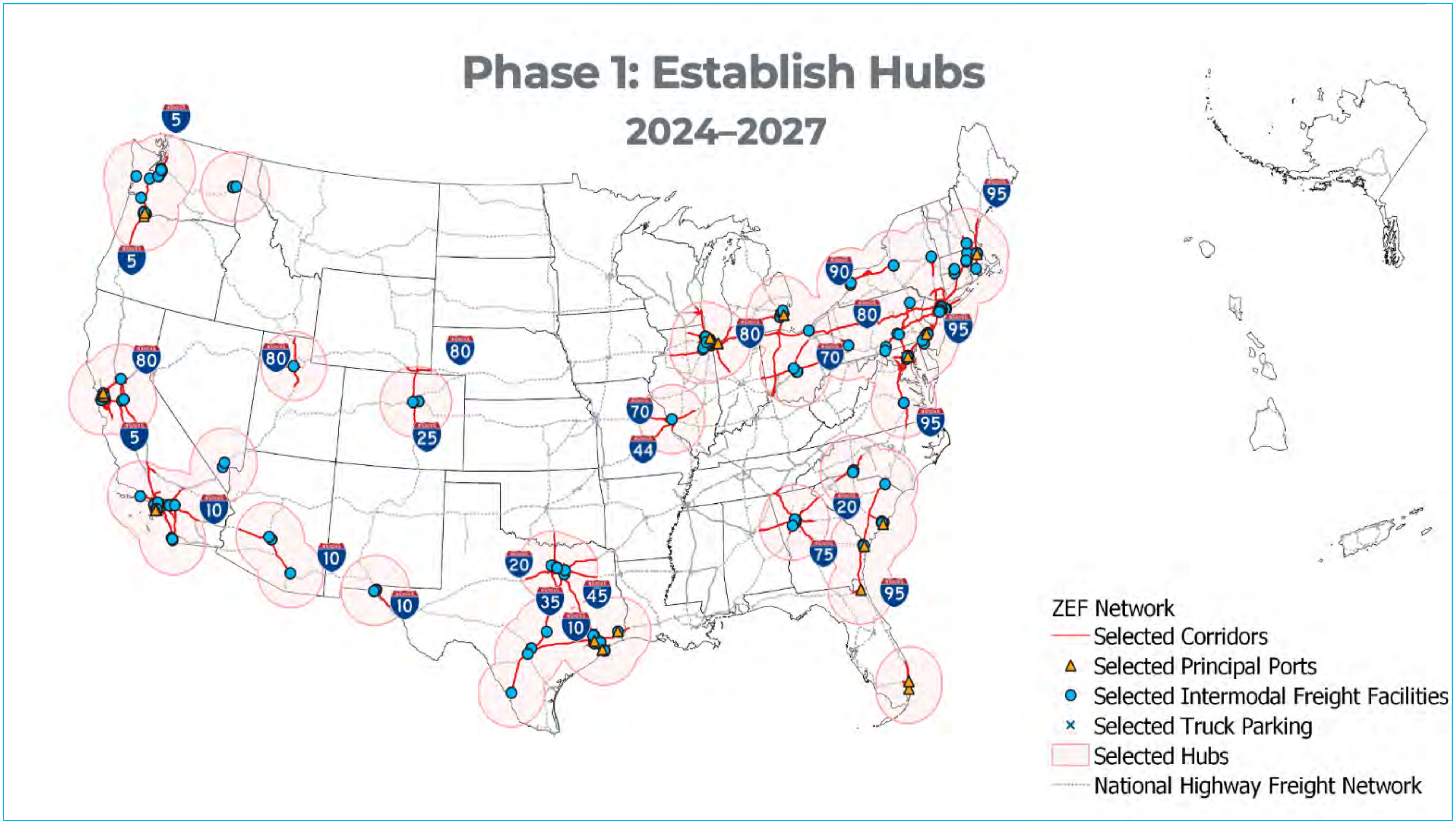
The Strategy demonstrates how infrastructure can be phased in around favorable launch areas in priority regions. This considers where ZE-MHDVs are more cost-effective[11] and targets investments, planning, utility upgrades, and deployment resulting in the rapid adoption of zero-emission trucks and infrastructure. By phasing infrastructure deployment over time, the Strategy helps sequence market-driven actions that promote a fully integrated transportation energy system. The Strategy complements the goals set by the Global Memorandum of Understanding on ZE-MHDVs, the Environmental Protection Agency’s proposed greenhouse gas rule for heavy-duty vehicles (2027 to 2032), and the implementation of state regulation and policies related to the deployment of ZE-MHDVs (e.g., states that have adopted California’s Advanced Clean Truck rule and statutory targets for transportation decarbonization).

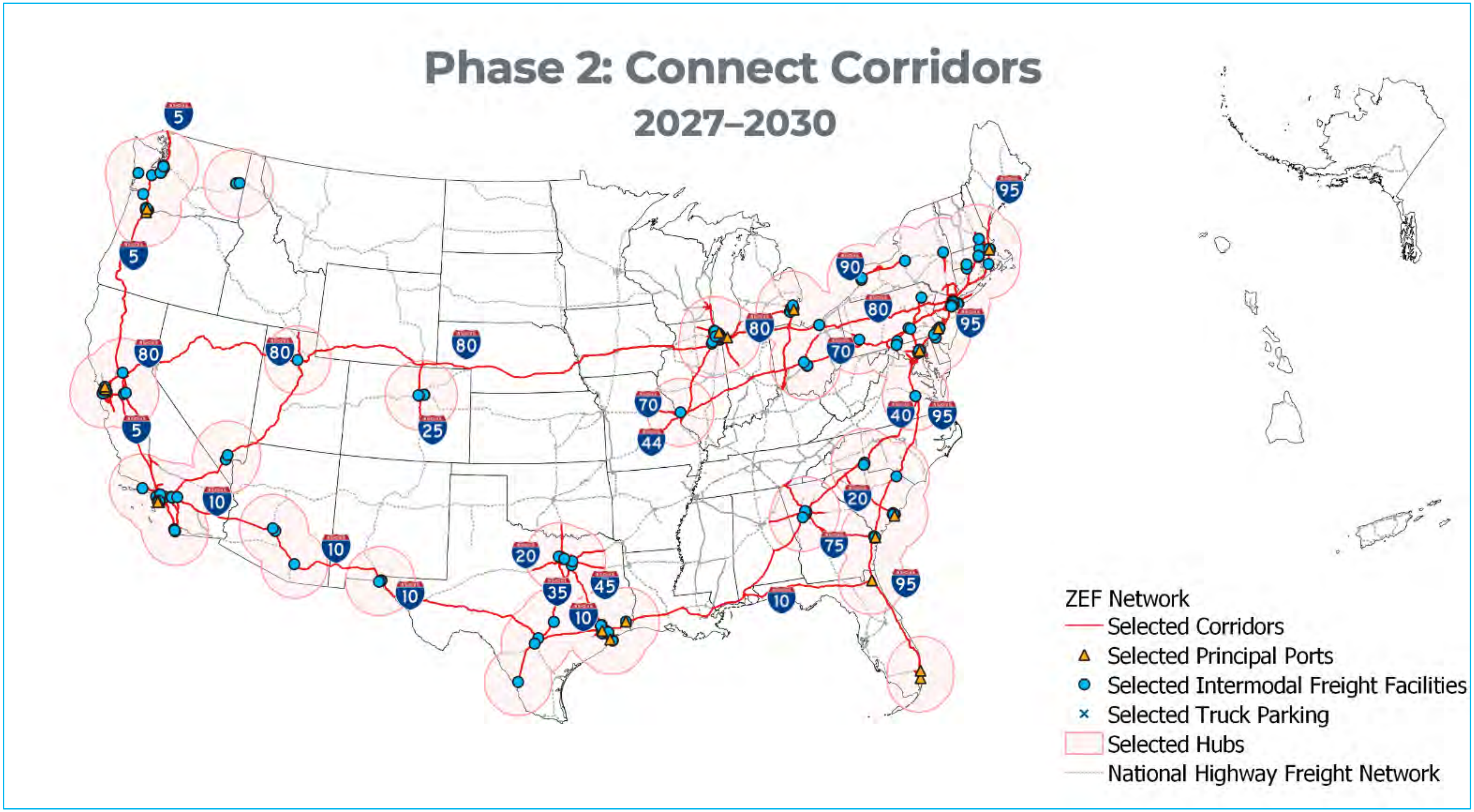
Phasing In ZE-MHDV Infrastructure

The Strategy seeks to prioritize and sequence the deployment of ZE-MHDV infrastructure in and around key freight hubs and along freight corridors over four phases to accelerate adoption of ZE-MHDVs and ultimately achieve a national zero-emission freight (ZEF) network. The following maps present phasing based on the described deployment factors.

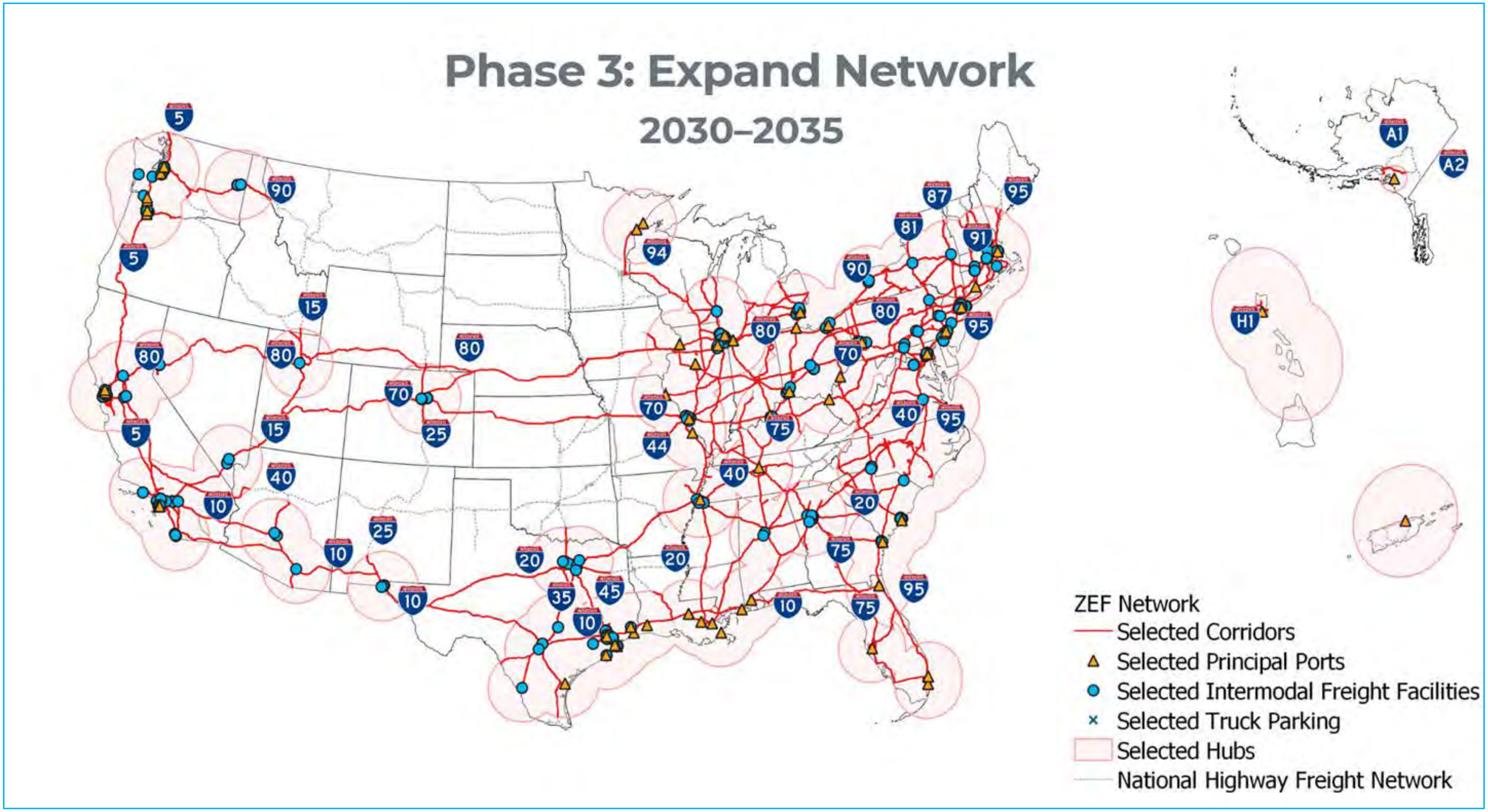
[10] Biden-Harris Administration Announces Funding for Zero-Emission Medium- and Heavy-Duty Vehicle Corridors, Expansion of EV Charging in Underserved Communities | Department of Energy

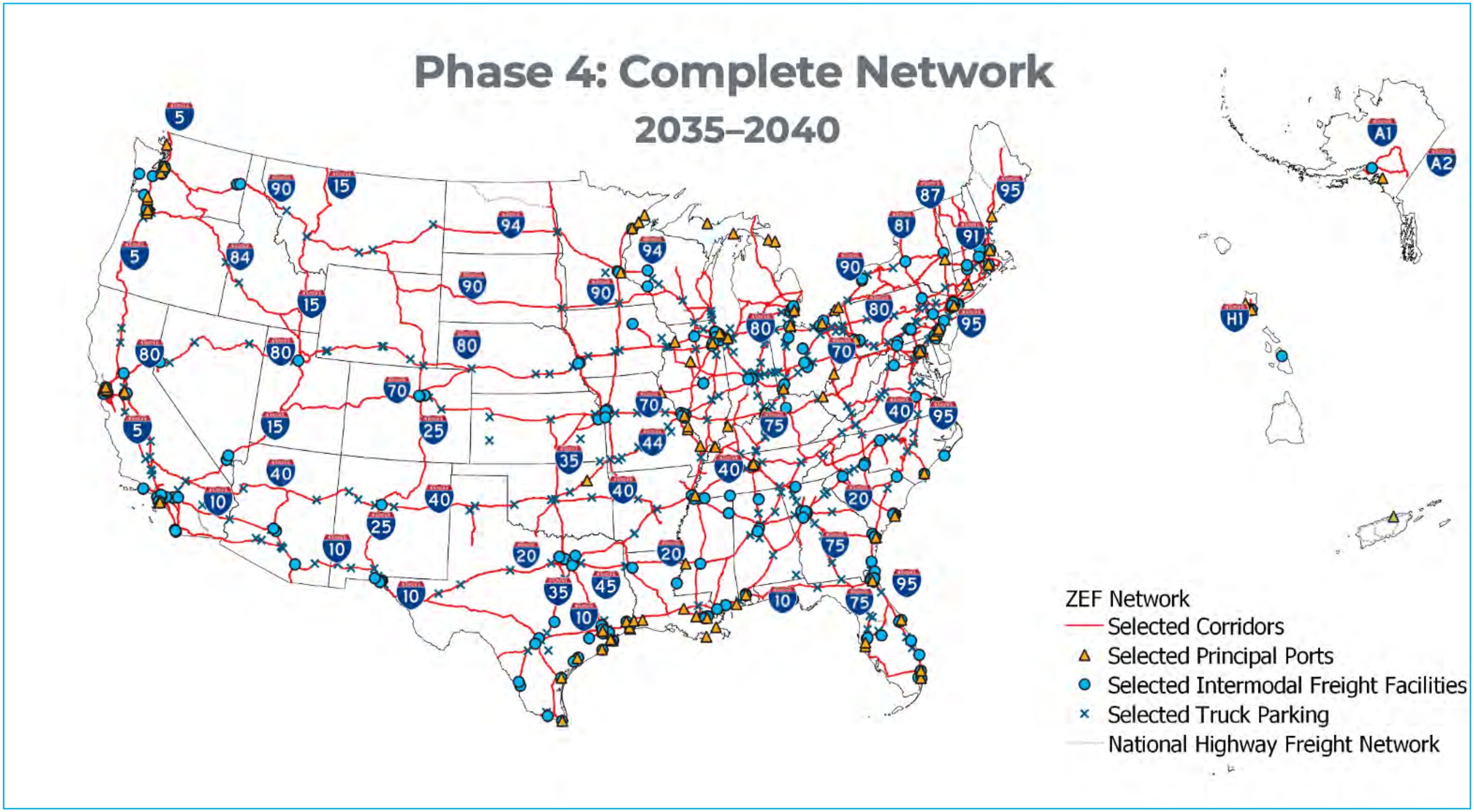
[11] Ledna, C., Muratori, M., Yip, A., Jadun, P., Hoehne, C., and Podkaminer, K. 2024. Assessing Total Cost of Driving Competitiveness of Zero-Emission Trucks. *iScience*. https://doi.org/10.1016/j.isci.2024.109385.


Phase 1: Establish Hubs
2024–2027
5
5
80
5
80
80
25
10
10
10
20
35
45
10
70
44
80
90
80
70
95
95
95
20
75
95
ZEF Network
Selected Corridors
Selected Principal Ports
Selected Intermodal Freight Facilities
Selected Truck Parking
Selected Hubs
National Highway Freight Network



Phase 2: Connect Corridors
2027–2030
ZEF Network
Selected Corridors
Selected Principal Ports
Selected Intermodal Freight Facilities
Selected Truck Parking
Selected Hubs
National Highway Freight Network
5
80
10
25
70
44
35
20
45
90
40
95
75


Phase 3: Expand Network
2030–2035
ZEF Network
Selected Corridors
Selected Principal Ports
Selected Intermodal Freight Facilities
Selected Truck Parking
Selected Hubs
National Highway Freight Network


Phase 4: Complete Network
2035–2040
ZEF Network
Selected Corridors
Selected Principal Ports
Selected Intermodal Freight Facilities
Selected Truck Parking
National Highway Freight Network

The Strategy intends to accelerate the adoption of ZE-MHDVs by initially focusing on key freight hubs with a 100-mile radius in Phase 1, moving toward building out a complete ZEF network in Phase 4.

Download the GIS files used to create the maps for each phase. Please note the linked file is 40 MB.

Cross-Sector Collaboration

The Strategy is designed to facilitate and expand the cross-sector collaboration needed to realize a national ZEF network. One of the outcomes of this Strategy is to help stakeholders including commercial truck fleets, industry, zero-emission fuel providers, grid and pipeline operators, energy and environmental regulators, and communities to evaluate where new electricity load and hydrogen needs are likely to develop.

For electricity, systems-level analysis on how freight volumes at commercial fueling locations will impact distribution and transmission needs can support planning and investment at the local, state, and regional levels. By evaluating existing energy capacity, potential grid constraints, and innovative strategies to scale power, the Strategy can support critical transmission planning to support prioritized corridor phasing.

For hydrogen, fuel producers and vehicle manufacturers can use the Strategy to align planning for production, fuel delivery, and market development in favorable launch areas. With DOE's $7 billion investment in seven regional clean hydrogen hubs throughout the U.S.,[12] the Strategy complements the expected increased production capacity to serve key freight corridors.

Another example of cross-sector collaboration is DOE's seven commercial ZE-MHDV corridor planning grants.[13] These grants involve public, private, and community partners working together to evaluate energy needs; identify locations for charging and hydrogen refueling infrastructure; and develop deployment plans to catalyze public and private investments for ZEF corridors.

Mobilizing Outcomes

The Strategy is designed to mobilize market activity around ZE-MHDVs across multiple sectors. For example, federal and state government can use the Strategy to prioritize and align public infrastructure grants, loans, and other investments. The energy sector can incorporate the Strategy into systems-level planning to align grid development and fuel production with ZE-MHDV needs. Industry can have greater transparency on infrastructure priorities to inform planning and ZE-MHDV investments in communities that

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[12] Regional Clean Hydrogen Hubs | Department of Energy

[13] Biden-Harris Administration Announces Funding for Zero-Emission Medium- and Heavy-Duty Vehicle Corridors, Expansion of EV Charging in Underserved Communities | Department of Energy

they serve around the nation. Communities can use the Strategy to inform advocacy, partnerships, and project development to promote cleaner transportation solutions.

Figure 1 highlights opportunities for Strategy implementation across key stakeholder groups.

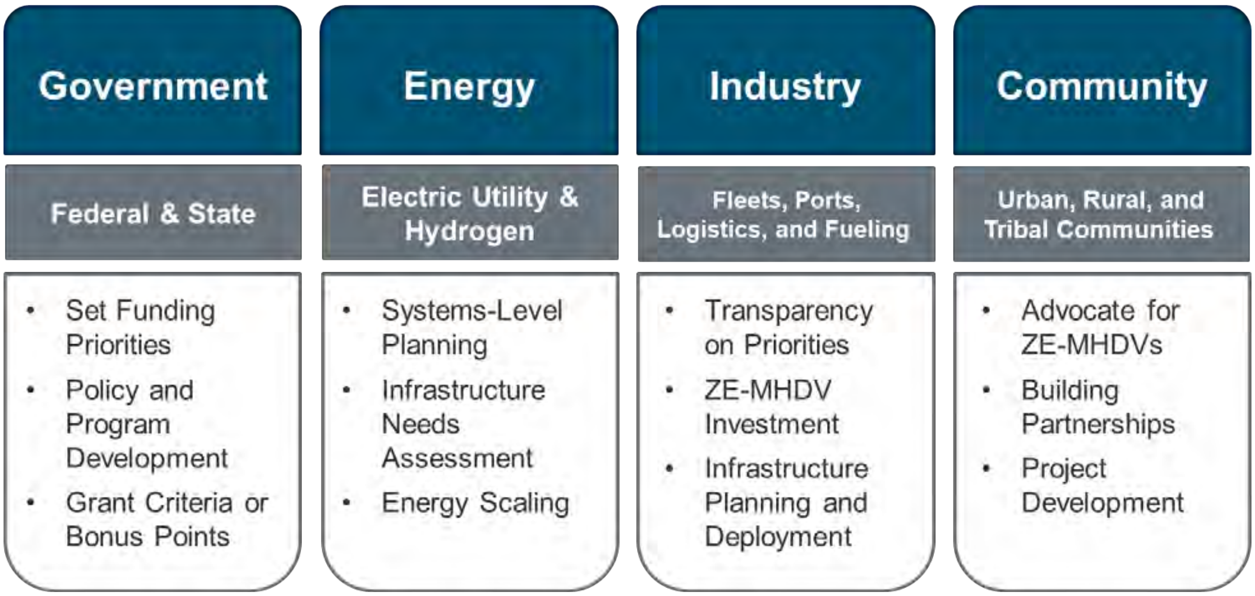

Figure 1. National Zero-Emission Freight Corridor Strategy stakeholder groups and implementation

Adapting to Market Needs

The *National Zero-Emission Freight Corridor Strategy* is intended to catalyze scalable and sustainable investment in ZE-MHDVs around the country. The Strategy will be reevaluated periodically to effectively accelerate rapid growth in the adoption of ZE-MHDVs and ensure that its goals and methodology reflect real-world economics, technological capabilities, market development, and community interests. This Strategy maintains the flexibility to adjust expected timing and to reflect the significant private investment to decarbonize freight that is already underway around the nation. The Joint Office intends to revise the Strategy at least annually through engagement with the Joint Office's Electric Vehicle Working Group, requests for information, public-private efforts such as DOE's 21st Century Truck Partnership, and other opportunities for public engagement.

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Introduction

The Joint Office of Energy and Transportation (Joint Office) partnered with the U.S. Department of Energy (DOE), the Department of Transportation (DOT), and the Environmental Protection Agency (EPA) to develop the *National Zero-Emission Freight Corridor Strategy* (Strategy). The Strategy is a coordinated, all-of-government approach that supports national clean energy and transportation goals and will help catalyze already increasing levels of private investment to decarbonize the movement of freight and goods around the nation.

Figure 2. National clean energy goals

In addition, the Strategy is a framework to prioritize federal investments in commercial zero-emission medium- and heavy-duty vehicles (ZE-MHDVs) and infrastructure to ensure the best outcomes for communities, fleet and fueling operators, and the economy. The Strategy provides agencies with a consistent tool to develop criteria or award additional consideration (e.g., priority weighting in a grant program evaluation) for projects that align with the identified priority zero-emission freight (ZEF) hubs and corridors during each of the Strategy's four phases between 2024 and 2040.

The Strategy is intended to address key national priorities. As shown in **Figure 2**, the Strategy will support key national clean energy goals related to climate change, technical innovation in clean energy, economic growth, workforce development, environmental justice, national security, and U.S. climate leadership. The Strategy also supports scalable and sustainable private market growth in ZEF technologies by sending clear market signals; supporting grid transformation and resiliency; maximizing the efficient use of resources such as federal deployment funds; accelerating technology innovation and adoption; and enhancing stakeholder collaboration and engagement across jurisdictions.

Finally, the Strategy responds to Congressional direction. It is a combined and coordinated effort, building on Congressional authorization for Federal Highway Administration to designate freight electric vehicle (EV) corridors and for the Joint Office to develop a national study on zero-emission vehicle (ZEV) charging and refueling infrastructure needs for ZE-MHDVs.

Title VIII of division J of the Bipartisan Infrastructure Law requires the Secretary of Transportation to "designate national electric vehicle charging corridors that identify the near- and long-term need for, and the location of, electric vehicle charging infrastructure to support freight and goods movement at strategic locations along major national highways, the National Highway Freight Network established under section 167 of title 23, United States Code, and goods movement locations including ports, intermodal centers, and warehousing locations."[14] The Federal Highway Administration's intent to designate freight EV corridors was first identified on May 18, 2023 through its Round 7 Request for Nominations for Alternative Fuel Corridor designations.[15]

The publication of the Strategy by the Joint Office is consistent with the Congressional direction under BIL to develop "a national and regionalized study of zero-emission vehicle charging and refueling infrastructure needs."[16]

[14] United States Code, Title 23, Section 167, "National highway freight program," subsections (c)-(f), https://uscode.house.gov/

[15] Request for Nominations – Alternative Fuel Corridors (May 18, 2023) | Department of Transportation

[16] 135 Stat. 1425.

National Zero-Emission Freight Corridor Strategy

Goal and Objectives

The goal of the Strategy is to align public policy and investments by prioritizing infrastructure deployment along the National Highway Freight Network (NHFN) and complementary roadways through a progression of phases to accelerate the adoption of commercial ZE-MHDVs. This all-of-government approach intends to catalyze public and private investment, accelerate industry activity, and signal electricity and hydrogen markets to plan and deploy necessary generation, transmission, and distribution projects. These activities serve the timely and sustainable infrastructure buildout for a complete ZEF network.

Methodology

The methodology used to inform the Strategy evaluated critical deployment factors that prioritize favorable investment areas along the NHFN (e.g., freight corridor segments), as well as key origin-destination points and surrounding freight hubs. The methodology started by identifying hubs, which the Strategy defines as a 100-mile to a 150-mile radius zone or geographic area centered around a point with a significant concentration of freight volume (e.g., ports, intermodal facilities, and truck parking), that supports a broader ecosystem of freight activity throughout that zone.

The Strategy analysis considered deployment factors including:

1) The most **heavily used freight corridor segments by freight volume** on the NHFN (top 25% in Phases 1–3 and top 50% in Phase 4).[17]

2) The most **heavily used ports by annual freight tonnage** (top 20% in Phases 1–2, top 40% in Phase 3, and top 60% in Phase 4), intermodal freight facilities, and key truck service facility locations.[18]

3) **Projected ZE-MHDV volumes that demonstrate optimal total cost of ownership** compared to internal combustion engine trucks (e.g., early markets with first- to last-mile delivery, local and regional haul, and moving toward long-haul transportation). [19]

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[17] Highway Performance Monitoring System 2022; Freight Analysis Framework 2050 Base Line Scenario.

[18] See Appendices for lists of key facilities included in each phase of the Strategy, which were triaged based on the U.S. Army Corps of Engineers Ports Commodity Tonnage (2022).

[19] Ledna, C., Muratori, M., Yip, A., Jadun, P., Hoehne, C., and Podkaminer, K. 2024. Assessing Total Cost of Driving Competitiveness of Zero-Emission Trucks. *iScience*. https://doi.org/10.1016/j.isci.2024.109385.

4) **Locations that bear disproportionate environmental and air quality burden** from MHDV transportation and are in nonattainment for criteria air pollutants.[20]

5) States with **policies that enable ZEV deployment.**[21]

6) "On-the-ground" planning for ZE-MHDVs through DOE's **commercial ZEV corridor planning** grants.[22]

By applying these deployment factors, the Strategy presents a progression of infrastructure deployment along the NHFN over four phases. Each phase demonstrates increased growth over time and helps the nation meet critical commercial ZE-MHDV adoption rates by 2027, 2030, 2035, and 2040.

Phased Outcomes for Infrastructure Buildout

The Strategy prioritizes, sequences, and accelerates infrastructure buildout along key freight corridors and hubs in four phases. The Strategy's key outcomes, as referenced in Figure 3, include establishing priority hubs based on freight volumes in Phase 1, connecting hubs along critical freight corridors in Phase 2, expanding corridor connections and initiating network development in Phase 3, and achieving a national network by linking regional corridors for ubiquitous access to ZE-MHDV infrastructure in Phase 4.

It is important to note that the Strategy does not assume that investment in ZE-MHDVs will only take place within the hubs and corridors identified in each phase. The Strategy intends to catalyze and accelerate widespread private investment in ZE-MHDVs around the nation through this targeted, phased approach. Agencies should consider best practices in community engagement[23] and opportunities to leverage, optimize, and decarbonize existing freight, grid, and hydrogen infrastructure. Expanding the availability of ZE-MHDV infrastructure will also require a widespread effort to overlay projected freight volumes and fueling locations with systems-level analysis of electricity and hydrogen generation, transmission, and distribution capacity. This kind of systems-level analysis, which is already underway in some jurisdictions[24] will be essential to maintaining sustainable and scalable growth in the deployment of ZE-MHDV infrastructure.

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[20] Nonattainment Areas for Criteria Pollutants (Green Book) | US EPA

[21] Specifically, states that have adopted Advanced Clean Trucks | California Air Resources Board

[22] Biden-Harris Administration Announces Funding for Zero-Emission Medium- and Heavy-Duty Vehicle Corridors, Expansion of EV Charging in Underserved Communities | Department of Energy

[23] https://driveelectric.gov/files/just-community-engagement.pdf

[24] See, e.g., New York PSC Case No. 23-E-0070 – *Proceeding on Motion of the Commission to Address Barriers to Medium- and Heavy-Duty Electric Vehicle Charging Infrastructure*; California PUC Freight Infrastructure Planning.

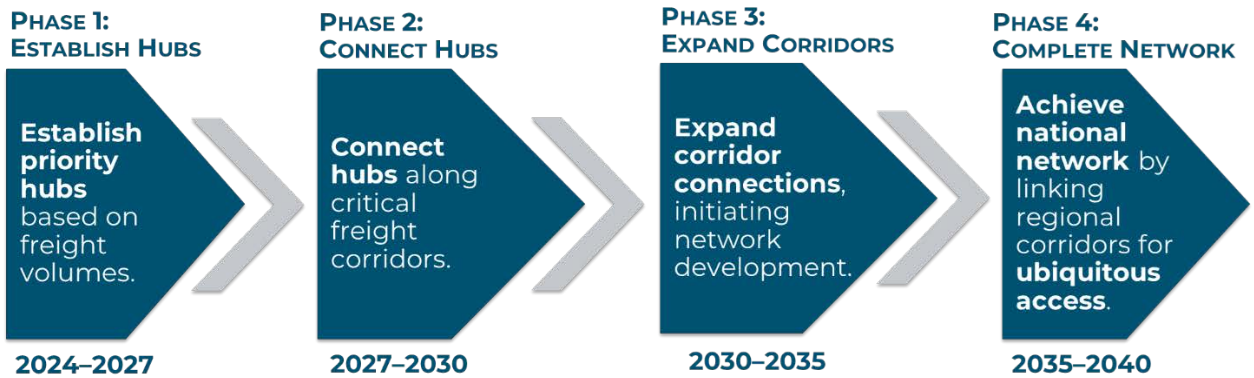


Figure 3. Phased approach for advancing zero-emission freight corridors.

Table 1 identifies the percentage of the NHFN that would be prioritized during each phase, enabling reliable access to ZE-MHDV infrastructure (ZE-MHDV miles), the area of the ZEF hub (square miles), and the percentage of benefits from prioritizing the development of the identified ZEF ecosystems anticipated to flow to disadvantaged communities.

Table 1. Infrastructure Phases and Timeline of Progress

Infrastructure Phase	Phase 1	Phase 2	Phase 3	Phase 4
Timeline	2024–2027	2027–2030	2030–2035	2035–2040
Outcome	Establish Hubs	Connect Hubs	Expand Corridors	Complete Network
ZE-MHDV Miles	12,000 mi	19,000 mi	37,000 mi	49,000 mi
NHFN % Complete	23%	36%	72%	94%
Area of ZEF Hubs	898,000 sq mi		1.28M sq mi	3.12M sq mi
% ZEF Hub Benefits to Disadvantaged Communities	40%	40%	43%	47%
Primary Vehicle Use Case	Class 3–7 Local and regional return-to-base operations, first-/last-mile delivery, drayage	Class 3–7 Local and increased regional freight movement with long haul initiating	Class 3–8 Local, regional, and point-to-point operations with long haul enabled	Class 3–8 Local, regional, and long-haul freight movement

The following section describes the Strategy's progression across four phases and the corresponding phase maps were developed based on deployment factors as described in the methodology.

Phase 1: Establish Hubs [2024–2027]

Key freight hubs are identified in areas that may be most immediately suited to early deployments of first-mover battery-electric MHDV fleets with predominantly return-to-base operations. In Phase 1, a higher concentration is expected of medium-duty vehicles serving purposes such as first- and last-mile delivery trucks. Initial focus on freight ecosystems within hubs will serve as foundational elements for zero-emission regional (e.g., port drayage) and long-haul use cases longer term.

Prioritization in Phase 1 also focuses on states with regulations and market structures that encourage deployment of ZEVs, areas with EPA nonattainment status to accelerate environmental mitigation for disproportionately impacted communities, and facilities along corridors identified by the DOE Vehicle Technologies Office's Fiscal Year 2022 MD/HD corridor planning projects.

In Phase 1, a total of 12,000 miles (23% of the NHFN) are prioritized as ZEF corridors, including I-5, I-10, I-25, I-75, I-80, I-95, and the Texas Triangle (I-10, I-45, and I-35). Additionally, ZEF hubs in Phase 1 include the 100-mile freight ecosystems centered around key ports, including but not limited to the Port Authority of New York and New Jersey, Ports of Long Beach and Los Angeles, Port of San Diego, Ports of Seattle and Tacoma, Port of Miami, Houston Port Authority, and Port of Savannah.

Forty percent of the benefits stemming from the 898,000 square miles of ZEF hubs in Phase 1, shown in Figure 4, are anticipated to flow to disadvantaged communities and represent the opportunity to decarbonize goods movement for more than 1 billion in total annual commodity tonnage.

Figure 4. Phase 1 map: Establish hubs [2024–2027]. ***[Download the GIS files](#) used to create the maps for each phase. Please note the linked file is 40 MB.***

Phase 2: Connect Hubs [2027–2030]

Phase 2 expands prioritization of ZEF corridor segments to connect key ZEF hubs from Phase 1, as shown in Figure 5. Prioritizing the connection of key ZEF hubs will support private market efforts to build out ZEF infrastructure along I-5, serving all ports along the West Coast, I-10 from California to Florida through the Southwest, major segments of I-95 on the East Coast, I-80 through the Midwest, and I-70 from Pittsburgh to St. Louis.

In Phase 2, infrastructure buildout begins to expand beyond states that have adopted California's Advanced Clean Truck rule or have already taken proactive steps to plan for ZE-MHDV corridors. Non-tractor-trailer truck (e.g., Class 4–6 straight delivery trucks) activity likely remains battery-EV-dominant, with early introduction of hydrogen fuel cell electric truck technology for longer-distance travel. Phase 2 also begins to see the construction and ramp-up of DOE's Regional Clean Hydrogen Hubs.[25] Operations expand with increased regional goods distribution (e.g., port drayage) and initial deployments of long-haul transportation.

Phase 2 prioritizes 19,000 miles (36% of the NHFN) of ZEF corridors.

Figure 5. Phase 2 map: Connect hubs [2027–2030]. ***[Download the GIS files](#) used to create the maps for each phase. Please note the linked file is 40 MB.***

[25] [Regional Clean Hydrogen Hubs | Department of Energy](#)

Phase 3: Expand Corridors [2030–2035]

In Phase 3, the facilities included as ZEF hubs are expanded to include a larger percentage of ports and freight facilities (by annual commodity tonnage), as shown in Figure 6. Corridor connections expand across the United States to reflect increased capacity to support point to point ZEF transportation along the entirety of I-80, I-95, I-10, and I-70, including access to charging and fueling to all coastal ports and their surrounding freight ecosystems for short-haul and regional operations. In Phase 3, both battery-electric and hydrogen fuel cell truck technology are prevalent, with increased access to hydrogen refueling along freight corridors. Phase 3 prioritizes a total of 37,000 miles (72% of the NHFN) of ZEF corridors. Forty-three percent of all benefits stemming from the 1.28 million square miles of ZEF hubs in Phase 3 are anticipated to flow to disadvantaged communities. ZEF hubs in Phase 3 represent the opportunity to decarbonize goods movement for more than 2 billion in total annual commodity tonnage.

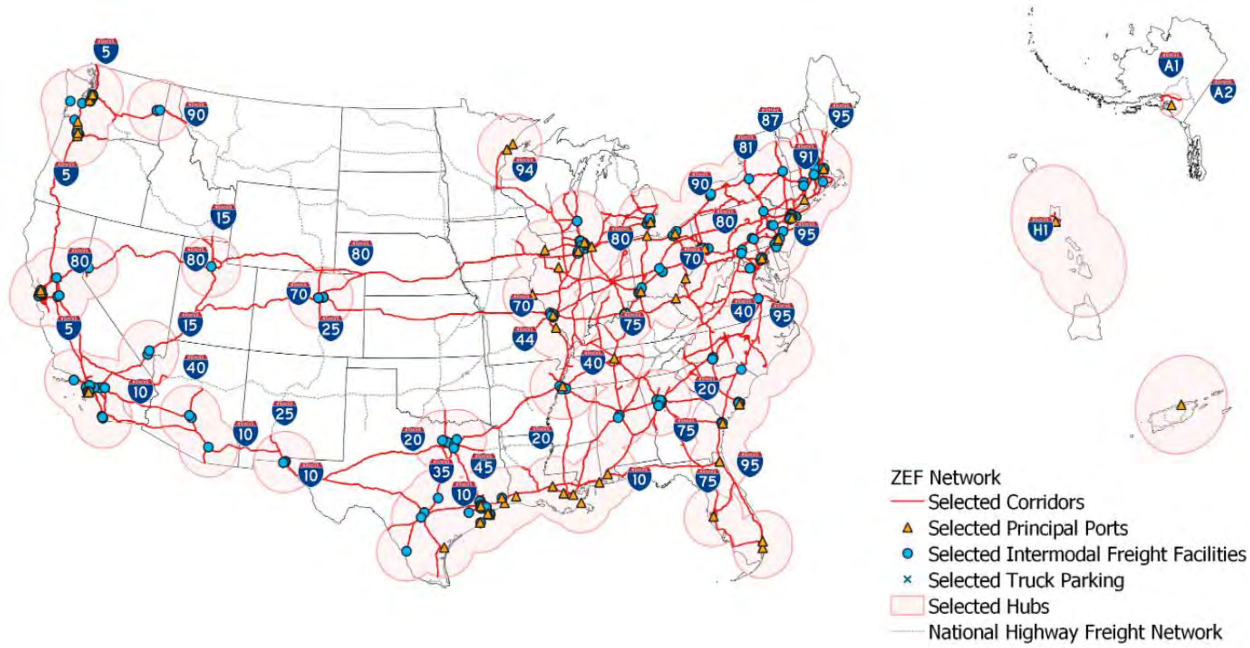


Figure 6. Phase 3 map: Expand corridors [2030–2035]. ***Download the GIS files used to create the maps for each phase. Please note the linked file is 40 MB.***

Phase 4: Complete Network [2035–2040]

In the final phase of the Strategy, as shown in Figure 7, the vast majority of the NHFN is prioritized to support expanded private investment that enables ubiquitous access to MHDV charging and hydrogen refueling along corridors east to west and north to south. Facilities reflected in ZEF hubs expand from intermodal freight and port facilities to also include truck parking facilities, which will increasingly service ZE-MHDVs across all use cases. A fully integrated transportation energy system will be essential to supporting use cases across all vehicle classes and duty cycles, allowing for local, regional, and long-haul transportation of goods and services. By 2035, DOE Regional Clean Hydrogen Hubs are in full production, serving critical regions with clean hydrogen transportation fuel.

Phase 4 prioritizes 49,000 miles (94% of the NHFN) of ZEF corridors. Forty-seven percent of all benefits stemming from the 3.12 million square miles of ZEF hubs in Phase 4 are anticipated to flow to disadvantaged communities. The ZEF hubs in Phase 4 represent the opportunity to decarbonize goods movement for more than 2.3 billion in annual commodity tonnage.

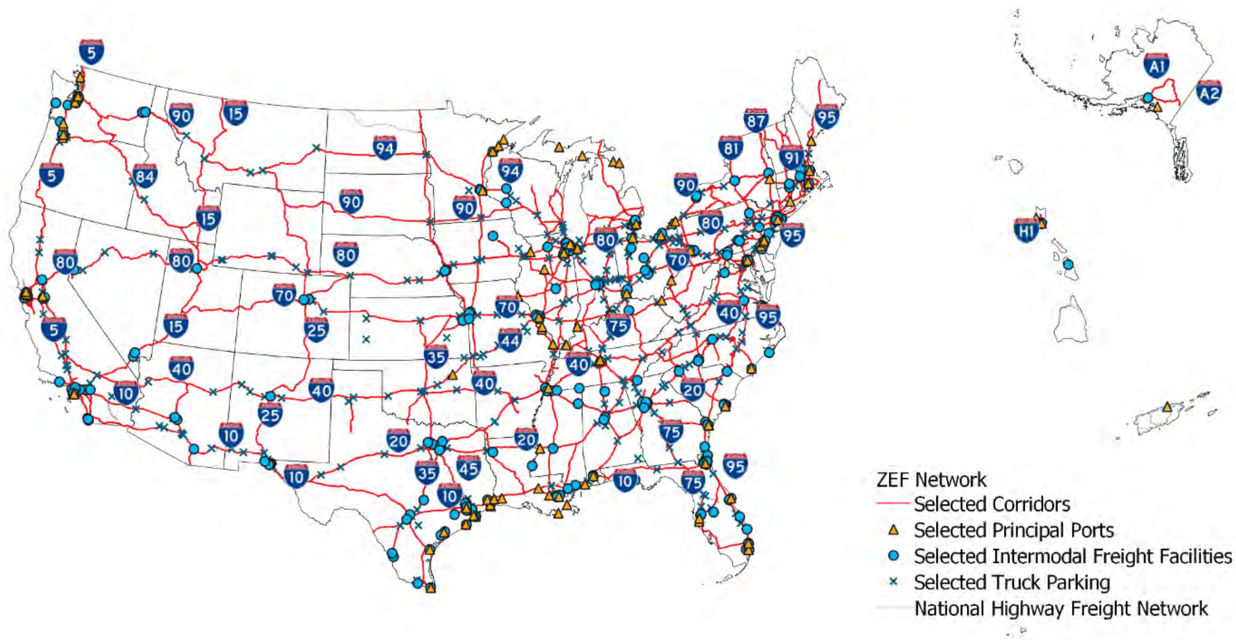


Figure 7. Phase 4 map: Complete network [2035 – 2040]. ***Download the GIS files* used to create the maps for each phase. Please note the linked file is 40 MB.**

Strategy Implementation

The *National Zero-Emission Freight Corridor Strategy* serves as a compass for public and private stakeholders to prioritize and guide investment, planning, and deployment of ZE-MHDV electric charging and hydrogen refueling infrastructure along the NHFN and complementary roadways. Starting first in favorable launch areas and with trucks that will have lower total cost of ownership than existing internal combustion engine vehicles, the phased approach strategically deploys infrastructure, enabling emerging markets to develop, expand, and fully transform by 2040. The Strategy can be effectively implemented by federal and state governments; utility and energy providers; fleets and technology providers; ports and freight logistics companies; and communities in the ways outlined below.

Target Public Investments

Government agencies will be able to incorporate the Strategy analysis into their own policy and program development. This “all-of-government” approach seeks to align federal and state investments by prioritizing funding decisions on projects that fall within the deployment areas defined in the Strategy. For example, agencies preparing to issue competitive grant programs related to ZE-MHDVs and infrastructure over the 2024 through 2027 timeline can reference the Strategy's Phase 1 map to reflect the geographical representation of prioritized locations, a list of Phase 1 facilities and corridors, and distance parameters, all of which could potentially be provided as guidance to applicants within the grant solicitation.[26]

Focus Energy Planning

Energy markets and regulators will also be able to incorporate the Strategy into their systems-level planning and infrastructure needs assessments for the generation, transmission, and distribution of ZE-MHDV transportation fuel. By referencing the prioritized areas in each phase, utility and energy providers can include another important data point in essential energy capacity planning efforts, which are inherently specific to local, state, and regional conditions. This planning will be vitally important to serve the anticipated load on electric charging and hydrogen refueling infrastructure for commercial ZE-MHDVs.

Align Industry Activity

On-road freight stakeholders, including MHDV original equipment manufacturers; fleet and depot operators; ports; logistics and warehouse industries; retail fuel providers; and charging and refueling manufacturers will benefit from greater transparency about national freight priorities and increased certainty in near-term, medium-term, and long-term investments, planning, and deployment.

Mobilize Communities for Clean Transportation

Communities seeking opportunities to promote ZEF transportation within their regions can use the Strategy to help advocate for the deployment of commercial ZE-MHDVs and infrastructure. For example, communities can engage with local governments, utilities, and private stakeholders to leverage available public investments that reference the Strategy within the respective grant program. Communities that appear in later phases can leverage the Strategy in local and regional efforts to highlight the urgent need to begin immediate long-term planning. Adequate planning will ensure the supply of zero-emission fuel needed to support ZE-MHDV adoption, as well as charging and fueling infrastructure deployment, as markets mature.

To request technical assistance on how to incorporate the Strategy maps into your program or planning efforts, please contact the Joint Office.

Opportunities for Federal Agencies

Federal agencies can implement the Strategy in a variety of ways. For example, an agency issuing grants to award funding for commercial ZE-MHDVs, or related

[26] For a list of ZEF hubs and corridors included in each phase, see appendices.

infrastructure, could include the Strategy's phased maps, lists of identified ZEF hubs, and location distance parameter information for the responding freight hub or corridor segment within the guidance of the grant or loan program solicitation.

The Joint Office is committed to providing technical support to public agencies that plan to implement the Strategy maps into policy, program, and regulatory development. To request technical assistance on how to incorporate the Strategy maps into your program, please contact the Joint Office.

Alignment With Existing Policy and Areas of Future Interest

This Strategy is part of an overall effort by the federal government to support industry, states, and communities as they transition to ZE-MHDVs nationwide. The Strategy complements existing work at DOE, DOT, EPA, and other federal agencies to support ZEV adoption, and it acknowledges the complexity and rapidly shifting nature of future zero-emission activities. In this way, the Strategy will evolve and remain relevant as an effective reference and resource for facilitating discussions around ZEF transportation.

Alignment with Existing Truck Initiatives

Concurrent research taking place across DOE and the national laboratories is developing new zero-emission truck technology for MHDV applications through the SuperTruck 3 initiative. Researchers are also exploring the potential for high-power fast charging and rapid hydrogen refueling for ZE-MHDVs. Close examination is also being given to vehicle-grid integration, which could help provide charging and hydrogen fueling to meet ZE-MHDV fleet needs in a manner that supports grid operations and resiliency, through efforts such as new county-level electric grid load forecasting tools for ZE-MHDVs. Additionally, DOE and its local partners, such as the network of Clean Cities and Communities coalitions, are providing technical assistance, education, and outreach support on zero-emission technologies to MHDV fleets and using tools through the Alternative Fuels Data Center.

Areas of Future Interest

Considerable thought and stakeholder engagement has gone into the development of the Strategy and serves as the beginning of ongoing discussions and updates to acknowledge the rapidly changing ZEF landscape. This allows the Joint Office and interagency partners the flexibility to proactively reflect changing needs, as well as track progress against each phase for industry, environment, and community benefits.

The Inflation Reduction Act has spurred changes to automotive, battery, charging, fuel cells, hydrogen infrastructure, and minerals manufacturing capabilities that will require continued proactive transportation and energy planning. Transportation and energy forecasts have not yet accounted for shifts in domestic markets.

The current surface transportation authorization is the Bipartisan Infrastructure Law, which provides $1.2 trillion over fiscal years 2022 through 2026 in federal investment in infrastructure, including in roads, bridges, transit, rail, ports, airports, water infrastructure, resilience, and broadband. Future revisions to Strategy should inform discussions related to how long-term infrastructure funding can complement private sector buildout of a national ZEF network.

The Joint Office intends to issue a request for information related to ZE-MHDV technology, supply chains, infrastructure, and connector standards.

Revisions to the Zero-Emission Freight Corridor Strategy

The Strategy is intended to be a living document that evolves periodically to align goals, methodology to reflect real-world economics, technological capabilities, market development, and community needs. The Joint Office intends to revise Strategy periodically, with input from the Joint Office's Electric Vehicle Working Group and requests for information. Furthermore, the Joint Office anticipates providing other informal opportunities for feedback from interested parties on an *ad hoc* basis.

Definitions and Assumptions

Definitions

1) **Zero-Emission Freight**
   The fuels included in the definition of "zero-emission freight" are electricity and hydrogen.

2) **Zero-Emission Freight Corridor**
   A zero-emission freight (ZEF) corridor is a subsystem of highways that facilitates movement of battery electric and hydrogen fuel cell electric MHDVs by providing adequate, convenient, and reliable access to electric charging and hydrogen refueling infrastructure at strategic locations along the NHFN.

3) **Zero-Emission Freight Hub**
   A zero-emission freight (ZEF) hub is a zone or geographic area centered on a location with a significant concentration of freight volume (e.g., port, intermodal freight facility) that supports a broader ecosystem of freight activity and is well suited to supporting short-haul and regional freight operations in transitioning to electric and hydrogen vehicles.

4) **Deployment factors**
   Deployment factors are characteristics describing locations that, when prioritized for ZEF investments, will be key to growing and catalyzing private investment in ZEF.

Assumptions

The pace and scale of commercial ZE-MHDV and infrastructure deployment will be informed by industry need, community benefits, economics, infrastructure requirements, commercial readiness, and signals from policymakers and regulators in these areas:

1) **Electric vehicle charging**

- Fleets of all sizes and vehicle classes have already begun to incorporate EVs into operations, and they will continue to do so at an increasing pace.

- EV fleet duty cycles will initially focus on return-to-base and regional haul operations and expand into long-haul applications, which is aligned with earlier total cost of ownership studies by DOE national laboratories.

- Industry adoption of electric drivetrains will grow as vehicle costs reduce, repair/maintenance cost savings rise, customer experiences expand, and MHDV charging infrastructure is increasingly deployed, particularly along high-volume freight segments.

- Initial investments in public-access electric freight charging infrastructure can support opportunity charging for local delivery and return-to-base use cases, as well as some vocational uses, such as school busing and waste collection. In later phases, these investments can establish the foundation for long-haul corridors.

2) Hydrogen refueling

- Hydrogen fueling infrastructure will initially be located near hydrogen production facilities, the expansion of which is being pursued by private developers and is also supported by programs like DOE's Regional Clean Hydrogen Hubs program.

- Hydrogen currently supports transit bus return-to-base operations and will likely lead to increased use in point-to-point operations and longer distance routes.

- The adoption of hydrogen fuel cell EVs by freight operators may be on a different timeline than EVs but can be similarly assumed to grow as conditions improve and as hydrogen refueling infrastructure is increasingly deployed along high-volume freight corridor segments.

For a full list of ZEF hubs, corridors, and key facilities in each phase, please see the Appendices Document.

Joint Office of
Energy and Transportation

National Zero-Emission Freight Corridor Strategy

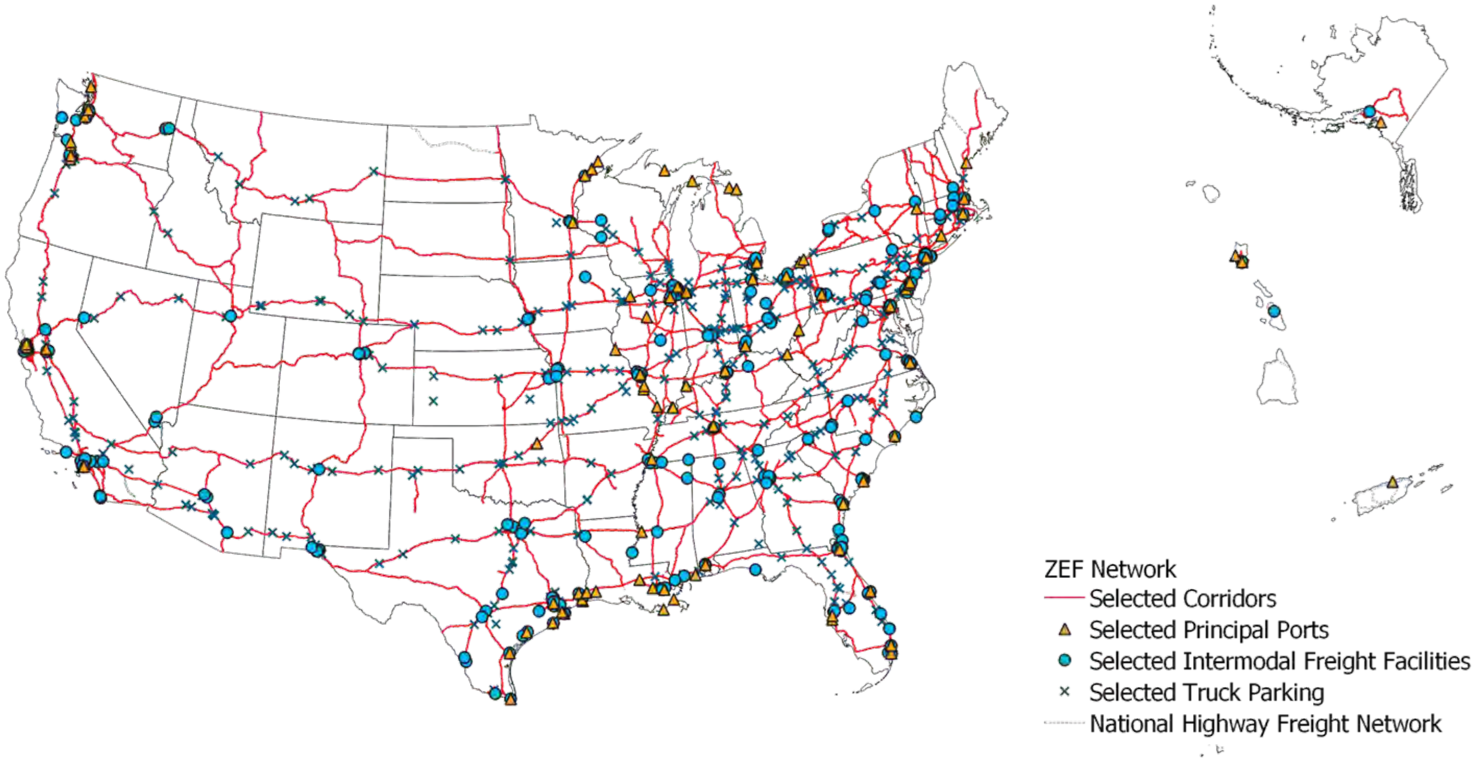
DOT Climate Change Center Webinar
Intermodal Freight Decarbonization

April 26, 2024

driveelectric.gov

Goal

The *National Zero-Emission Freight Corridor Strategy* seeks to **align and accelerate cross-sector investments** in zero-emission medium- and heavy-duty vehicle (ZE-MHDV) infrastructure and **clearly signal the need to bolster electric grid and hydrogen planning** to achieve a zero-emission freight network by 2040.



Background

An **interagency** initiative between the Joint Office of Energy and Transportation (JO), U.S. Department of Energy (DOE), U.S. Department of Transportation (DOT), and the Environmental Protection Agency (EPA) to **develop a national strategy for MHD freight corridors for electric and hydrogen vehicles** by:

1) Identifying **key characteristics** of a zero-emission freight corridor for electric charging and hydrogen fueling infrastructure

2) **Prioritizing and strategically sequencing** federal investments that will help achieve **a national zero-emission freight network by 2040.**

Joint Office of Energy and Transportation

Approach

To catalyze public and private investment in zero-emission freight (ZEF) and fully build out a ZEF corridor network by 2040, we will **prioritize** and **sequence** federal investments:

PRIORITIZE

APPROACH

- Determine deployment factors.
- Apply factors to map.
- Establish focus and cadence of a multi-phase corridor plan to scale growth along freight corridors by 2040 for a fully built out national network.

OUTCOMES

- Allows federal grant program administrators to prioritize applications by assigning criteria/bonus points to projects in priority locations.
- Enables utilities & regulators to plan and approve infrastructure investments.
- Aligns policy across jurisdictions, sequences public & private action, ensures hubs and corridors support environmental justice.

Analysis

Zero-Emission Freight Corridor Strategy

Deployment Factors to Identify Priority ZEF Corridors

1. Segments of the NHFN with highest freight volumes.
2. Highest percentage of ports by annual tonnage, all intermodal freight facilities, and key truck service & parking.
3. Areas that bear disproportionate environmental and air quality burden from MHDV emissions.
4. States with policies that enable zero-emission vehicle deployment.
5. Areas projected to demonstrate better total cost of ownership for ZE-MHDV compared to ICE.
6. “On-the-ground” planning through Department of Energy commercial zero-emission vehicle corridor planning grants.

Phases

Zero-Emission Freight Corridor Strategy

A Four-Phased Strategy for a National ZEF Network

The **ZEF Corridor Strategy will accelerate infrastructure deployment** along key corridors and hubs in four phases to achieve a **national ZEF network by 2040**.

PHASE 1: ESTABLISH HUBS

Establish priority hubs based on freight volumes.

2024 – 2027

PHASE 2: CONNECT HUBS

Connect hubs along critical freight corridors.

2027 – 2030

PHASE 3: EXPAND CORRIDORS

Expand corridor connections initiating network development.

2030 – 2035

PHASE 4: COMPLETE NETWORK

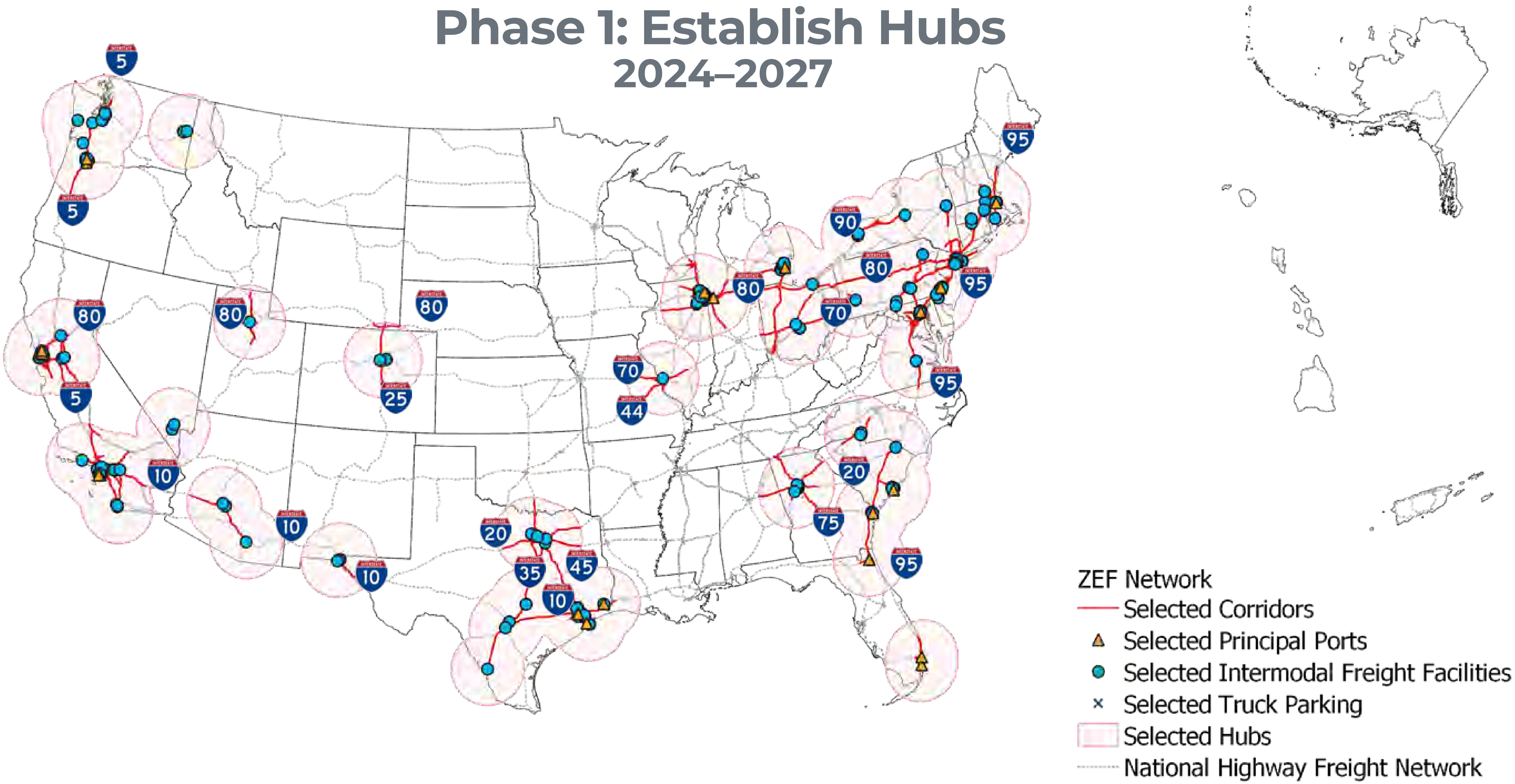
Achieve national network by linking regional corridors for **ubiquitous access**.

2035 – 2040

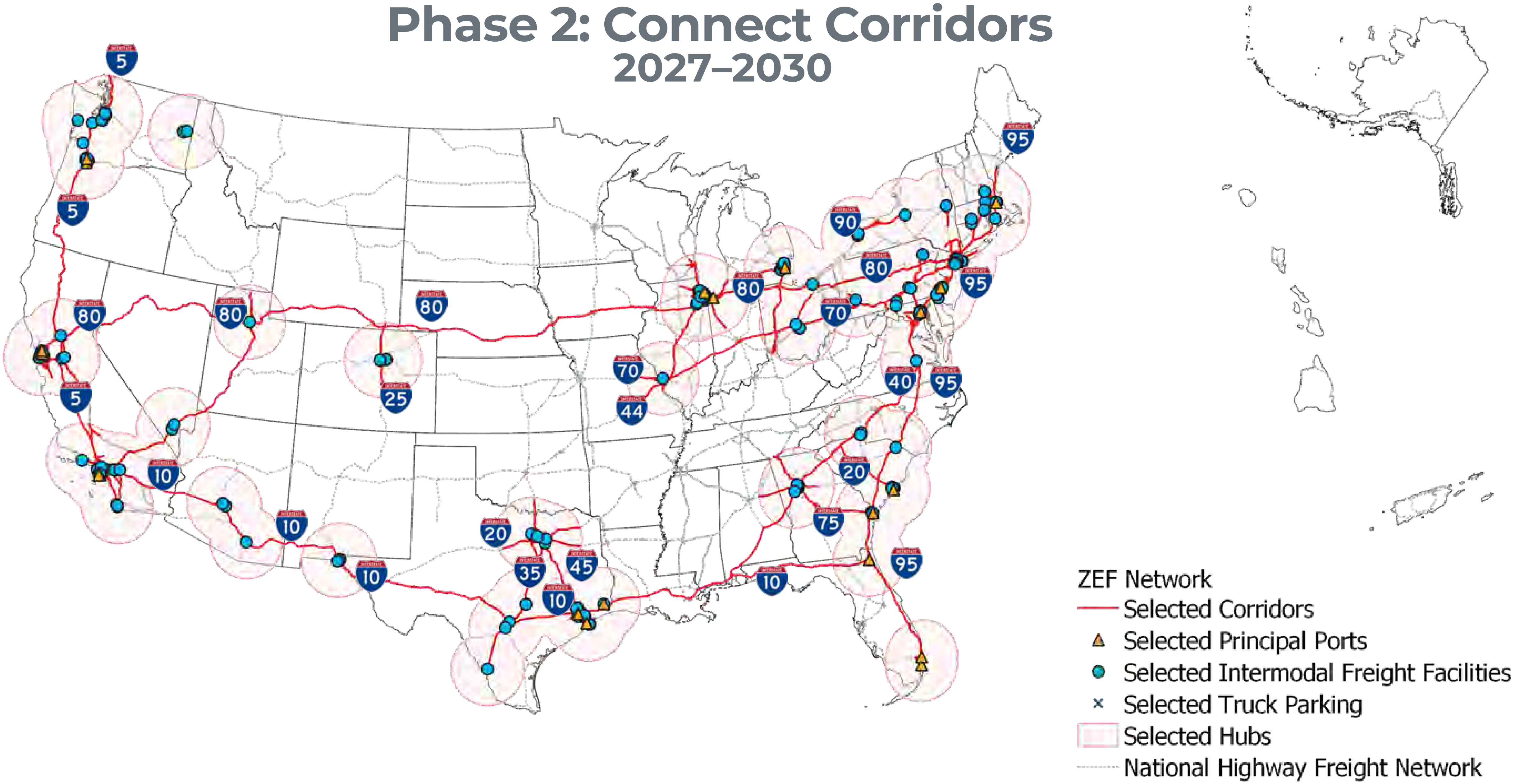
Maps

Zero-Emission Freight Corridor Strategy

Phase 1: Establish Hubs
2024–2027

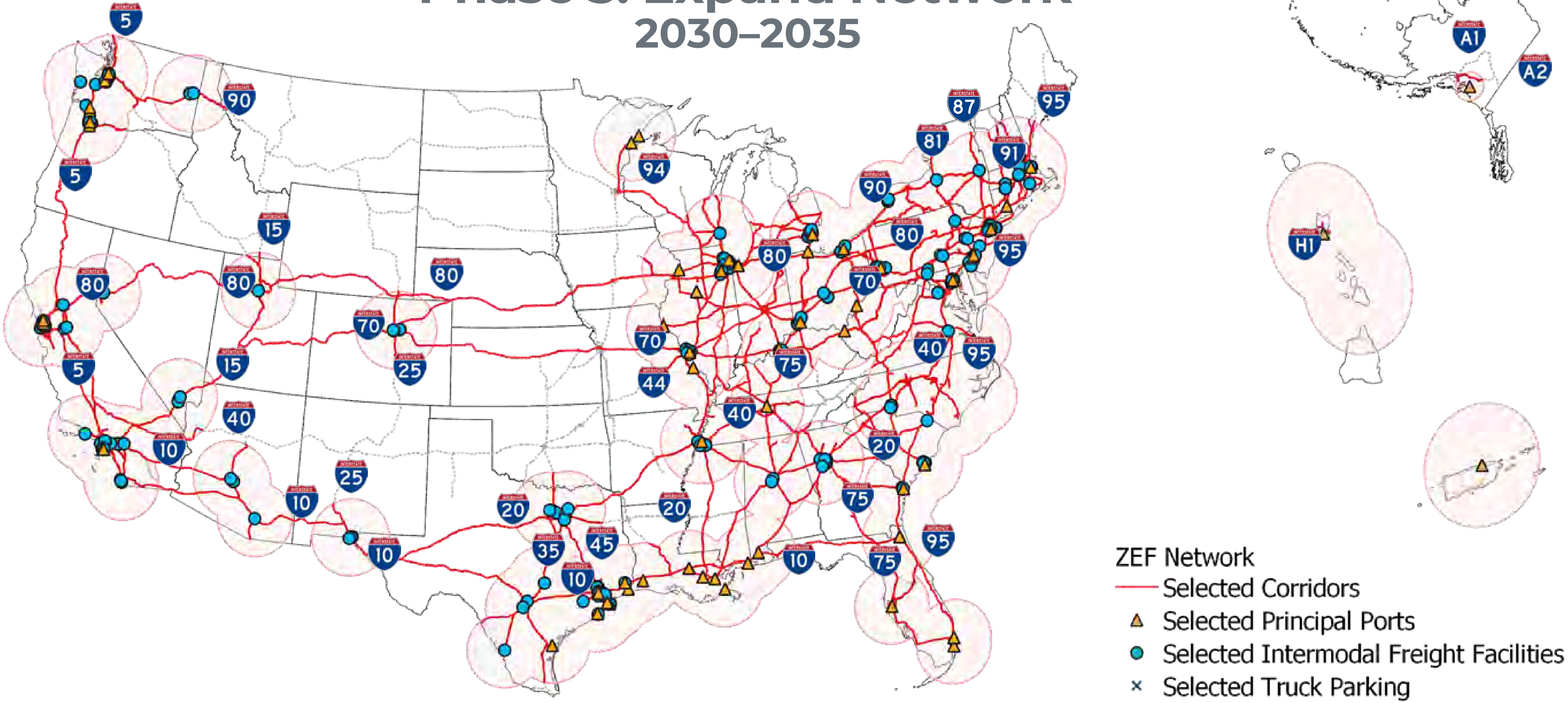


Phase 2: Connect Corridors
2027–2030

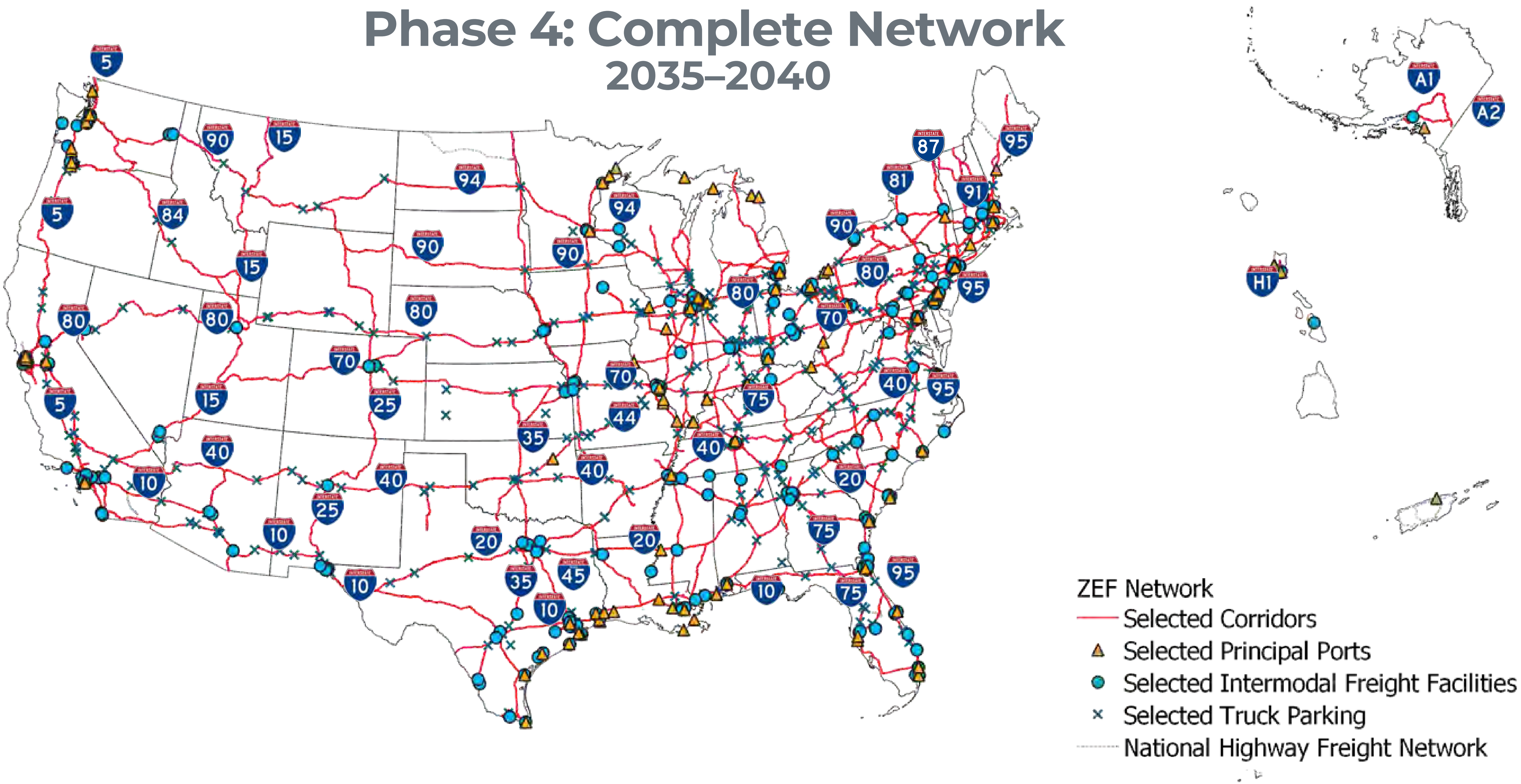


Phase 3: Expand Network

2030–2035



Phase 4: Complete Network
2035–2040



Joint Office of
Energy and Transportation

Thank You/Q&A

driveelectric.gov

National Zero-Emission Freight Corridor Strategy Appendices Document

Prioritizing investments, planning, and deployment for medium- and heavy-duty vehicle fueling infrastructure to advance zero-emission freight along our nation's corridors.

Kang-Ching (Jean) Chu, Kevin George Miller, Alex Schroeder
(Joint Office of Energy and Transportation)
Alycia Gilde, Michael Laughlin (U.S. Department of Energy)

DOE/EE-2816 | September 2024

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Appendix A: List of Facilities Included as Zero-Emission Freight Hubs in Phases 1 and 2

Facility Type	State	Airport Code/Port Name/Rail Terminal	City
Intermodal_Freight_Air-to-Truck	TX	AFW	Fort Worth
Intermodal_Freight_Air-to-Truck	GA	ATL	Atlanta
Intermodal_Freight_Air-to-Truck	TX	AUS	Austin
Intermodal_Freight_Air-to-Truck	CT	BDL	Windsor Locks
Intermodal_Freight_Air-to-Truck	WA	BFI	Seattle
Intermodal_Freight_Air-to-Truck	MA	BOS	East Boston
Intermodal_Freight_Air-to-Truck	MD	BWI	Baltimore
Intermodal_Freight_Air-to-Truck	OH	CLE	Cleveland
Intermodal_Freight_Air-to-Truck	NC	CLT	Charlotte
Intermodal_Freight_Air-to-Truck	CO	DEN	Denver
Intermodal_Freight_Air-to-Truck	TX	DFW	Grapevine, Irving, Euless, Coppell
Intermodal_Freight_Air-to-Truck	MI	DTW	Romulus
Intermodal_Freight_Air-to-Truck	TX	ELP	El Paso
Intermodal_Freight_Air-to-Truck	NJ	EWR	Newark, Elizabeth
Intermodal_Freight_Air-to-Truck	WA	GEG	Spokane
Intermodal_Freight_Air-to-Truck	TX	IAH	Houston
Intermodal_Freight_Air-to-Truck	NY	JFK	Queens
Intermodal_Freight_Air-to-Truck	NV	LAS	Las Vegas
Intermodal_Freight_Air-to-Truck	CA	LAX	Westchester, Los Angeles
Intermodal_Freight_Air-to-Truck	OH	LCK	Lockbourne
Intermodal_Freight_Air-to-Truck	NH	MHT	Manchester
Intermodal_Freight_Air-to-Truck	CA	OAK	Oakland
Intermodal_Freight_Air-to-Truck	CA	ONT	Ontario
Intermodal_Freight_Air-to-Truck	IL	ORD	Chicago
Intermodal_Freight_Air-to-Truck	OR	PDX	Portland
Intermodal_Freight_Air-to-Truck	PA	PHL	Philadelphia
Intermodal_Freight_Air-to-Truck	AZ	PHX	Phoenix
Intermodal_Freight_Air-to-Truck	CA	SAN	San Diego
Intermodal_Freight_Air-to-Truck	TX	SAT	San Antonio
Intermodal_Freight_Air-to-Truck	WA	SEA	SeaTac
Intermodal_Freight_Air-to-Truck	CA	SFO	San Francisco

Intermodal_Freight_Air-to-Truck	UT	SLC	Salt Lake City
Intermodal_Freight_Air-to-Truck	MO	STL	St. Louis
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	WA	Port of Grays Harbor	Aberdeen
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	MD	Port of Baltimore	Baltimore
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port of Beaumont	Beaumont
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	SC	Port of Charleston	Charleston
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	MA	Port of Boston	Charlestown
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port of Galveston	Galveston
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port of Houston	Houston
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	NJ	Port of New York and New Jersey	Jersey City
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port of Houston	La Porte
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of Long Beach	Long Beach
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of San Diego	National City
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	SC	Port of Charleston	North Charleston
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of Oakland	Oakland
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port of Houston	Pasadena
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	PA	Port of Philadelphia	Philadelphia
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of Hueneme	Port Hueneme
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	NJ	Port of New York and New Jersey	Port Newark
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	OR	Port of Portland, OR	Portland
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	RI	Port of Providence	Providence
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of Richmond, CA	Richmond
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	VA	Port of Virginia	Richmond
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	NJ	Camden Gloucester	Salam
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of San Diego	San Diego
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of San Francisco	San Francisco
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	GA	Port of Savannah	Savannah
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	WA	Port of Seattle	Seattle
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	NY	Port of New York and New Jersey	Staten Island
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	WA	Port of Tacoma	Tacoma
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	WA	Port of Vancouver, WA	Vancouver
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of Los Angeles	Wilmington
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	DE	Port of Wilmington, DE	Wilmington
Intermodal_Freight_Rail	GA	Atlanta, GA - Hulsey	Atlanta

Intermodal_Freight_Rail	GA	Atlanta, GA - Inman	Atlanta
Intermodal_Freight_Rail	MA	Ayer, MA	Ayer
Intermodal_Freight_Rail	MD	Baltimore, MD	Baltimore
Intermodal_Freight_Rail	MD	Baltimore, MD - Seagirt Marine Terminal	Baltimore
Intermodal_Freight_Rail	IL	Chicago, IL - Bedford Park	Bedford Park
Intermodal_Freight_Rail	NY	Buffalo, NY	Blasdell
Intermodal_Freight_Rail	IL	Blue Island, IL	Blue Island
Intermodal_Freight_Rail	NY	Red Hook Container Terminal	Brooklyn
Intermodal_Freight_Rail	NY	Buffalo, NY	Buffalo
Intermodal_Freight_Rail	NJ	Balzano Marine Terminal	Camden
Intermodal_Freight_Rail	PA	Chambersburg, PA	Chambersburg
Intermodal_Freight_Rail	NC	Charlotte Inland Port (CIP)	Charlotte
Intermodal_Freight_Rail	NC	Charlotte, NC	Charlotte
Intermodal_Freight_Rail	IL	Chicago, IL - 59th Street	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - 14th Street (Global I)	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - 47th Street	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - 63rd Street	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - Calumet	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - Corwith	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - Landers	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - Cicero	Cicero
Intermodal_Freight_Rail	CA	Los Angeles, CA - East Washington Blvd	City of Commerce
Intermodal_Freight_Rail	CA	Los Angeles, CA - City of Industry	City of Industry
Intermodal_Freight_Rail	OR	Port Westward Industrial Park	Clatskanie
Intermodal_Freight_Rail	OH	Columbus, OH - Buckeye Yard	Columbus
Intermodal_Freight_Rail	CA	Commerce, CA	Commerce
Intermodal_Freight_Rail	CO	Denver, CO	Denver
Intermodal_Freight_Rail	CO	Denver, CO - Irondale	Denver
Intermodal_Freight_Rail	MI	Detroit, MI	Detroit
Intermodal_Freight_Rail	MI	Detroit, MI - Delray	Detroit

Intermodal_Freight_Rail	MI	Detroit, MI - Detroit Intermodal Terminal	Detroit
Intermodal_Freight_Rail	MI	Detroit, MI - Livernois	Detroit
Intermodal_Freight_Rail	SC	Inland Port Dillon	Dillon
Intermodal_Freight_Rail	IL	Chicago, IL - Dolton (Yard Center)	Dolton
Intermodal_Freight_Rail	TX	El Paso, TX	El Paso
Intermodal_Freight_Rail	NJ	Erail, NJ	Elizabeth
Intermodal_Freight_Rail	GA	Fairburn, GA	Fairburn
Intermodal_Freight_Rail	MI	Detroit, MI - Moterm Intermodal Facility (MOT)	Ferndale
Intermodal_Freight_Rail	IL	Chicago, IL - Franklin Park (Bensenville Intermodal Terminal)	Franklin Park
Intermodal_Freight_Rail	CA	Lathrop, CA	French Camp
Intermodal_Freight_Rail	GA	Mason ICTF	Garden City
Intermodal_Freight_Rail	AZ	Phoenix, AZ - Glendale	Glendale
Intermodal_Freight_Rail	PA	Greencastle, PA - Franklin County Regional Intermodal Facility	Greencastle
Intermodal_Freight_Rail	PA	Harrisburg, PA	Harrisburg
Intermodal_Freight_Rail	PA	Rutherford, PA	Harrisburg
Intermodal_Freight_Rail	IL	Chicago, IL - Harvey (Gateway)	Harvey
Intermodal_Freight_Rail	TX	Alliance, TX	Haslet
Intermodal_Freight_Rail	IL	Chicago, IL - Willow Springs	Hodgkins
Intermodal_Freight_Rail	TX	Jacintoport Terminal	Houston
Intermodal_Freight_Rail	TX	Houston, TX - Englewood (Wallisville Rd)	Houston
Intermodal_Freight_Rail	TX	Houston, TX - Pearland	Houston
Intermodal_Freight_Rail	TX	Houston, TX - Settegast (Kirkpatrick, Blvd)	Houston
Intermodal_Freight_Rail	NJ	GCT Bayonne Terminal, NJ	Jersey City
Intermodal_Freight_Rail	NJ	Croxton, NJ	Jersey City
Intermodal_Freight_Rail	IL	Chicago, IL - Joliet (Global IV)	Joliet
Intermodal_Freight_Rail	IL	Joliet, IL	Joliet
Intermodal_Freight_Rail	NJ	Kearny, NJ	Kearny
Intermodal_Freight_Rail	TX	Barbours Cut Container Terminal	La Porte

Intermodal_Freight_Rail	TX	Laredo, TX	Laredo
Intermodal_Freight_Rail	NV	Las Vegas, NV	Las Vegas
Intermodal_Freight_Rail	CA	Long Beach, CA - ICTF	Long Beach
Intermodal_Freight_Rail	CA	Long Beach, CA - International Transportation Service (ITS/Pier G)	Long Beach
Intermodal_Freight_Rail	CA	Long Beach, CA - Long Beach Container Terminal (LBCT/Pier E)	Long Beach
Intermodal_Freight_Rail	CA	Long Beach, CA - Pacific Container Terminal (PCT/Pier J)	Long Beach
Intermodal_Freight_Rail	CA	Long Beach, CA - SSA Terminals (Pier A)	Long Beach
Intermodal_Freight_Rail	CA	Total Terminals International (TTI/Pier T)	Long Beach
Intermodal_Freight_Rail	CA	Los Angeles, CA - Hobart	Los Angeles
Intermodal_Freight_Rail	CA	Los Angeles, CA - Lamar St (LATC)	Los Angeles
Intermodal_Freight_Rail	NY	Albany, NY - Mechanicville	Mechanicville
Intermodal_Freight_Rail	TX	Dallas, TX - Mesquite	Mesquite
Intermodal_Freight_Rail	SC	Wando Welch Terminal	Mt. Pleasant
Intermodal_Freight_Rail	NJ	Port Newark Container Terminal, NJ - ExpressRail (Newark)	Newark
Intermodal_Freight_Rail	NJ	Little Ferry, NJ	North Bergen
Intermodal_Freight_Rail	NJ	North Bergen, NJ	North Bergen
Intermodal_Freight_Rail	SC	North Charleston Terminal, SC	North Charleston
Intermodal_Freight_Rail	SC	Hugh K. Leatherman Terminal	North Charleston
Intermodal_Freight_Rail	SC	Charleston, SC	North Charleston
Intermodal_Freight_Rail	IL	Chicago, IL - Northlake (Global II)	Northlake
Intermodal_Freight_Rail	CA	Matson Terminal	Oakland
Intermodal_Freight_Rail	CA	Charles P. Howard Terminal	Oakland
Intermodal_Freight_Rail	CA	TraPac Terminal	Oakland
Intermodal_Freight_Rail	CA	Ben E. Nutter Terminal	Oakland
Intermodal_Freight_Rail	CA	Oakland International Container Terminal (OICT)	Oakland

Intermodal_Freight_Rail	CA	Railport Oakland	Oakland
Intermodal_Freight_Rail	CA	Oakland International Gateway (OIG) - Joint Intermodal Terminal (JIT)	Oakland
Intermodal_Freight_Rail	WA	Seaport	Olympia
Intermodal_Freight_Rail	CA	Bayport Container Terminal	Pasadena
Intermodal_Freight_Rail	PA	Philadelphia, PA - Greenwhich	Philadelphia
Intermodal_Freight_Rail	NJ	Elizabeth Marine Terminal, NJ - ExpressRail (Port Elizabeth)	Port Elizabeth
Intermodal_Freight_Rail	TX	Terminal	Port Hueneme
Intermodal_Freight_Rail	OR	Portland, OR - Brooklyn	Portland
Intermodal_Freight_Rail	OR	Portland, OR - Terminal 2 (Guilds Lake)	Portland
Intermodal_Freight_Rail	OR	Portland, OR - Terminal 6	Portland
Intermodal_Freight_Rail	VA	Richmond Marine Terminal (RMT)	Richmond
Intermodal_Freight_Rail	NJ	Salem Marine Terminal (SMT)	Salem
Intermodal_Freight_Rail	UT	Salt Lake City, UT	Salt Lake City
Intermodal_Freight_Rail	CA	San Bernardino, CA	San Bernardino
Intermodal_Freight_Rail	CA	West Basin Container Terminal (WBCT) - China Shipping Holding (Berths 100-109)	San Pedro
Intermodal_Freight_Rail	CA	West Basin Container Terminal (WBCT) - Everglades Company Terminal (Berths 120-126)	San Pedro
Intermodal_Freight_Rail	GA	Ocean Terminal	Savannah
Intermodal_Freight_Rail	GA	Garden City Marine Terminal	Savannah
Intermodal_Freight_Rail	GA	Savannah, GA	Savannah
Intermodal_Freight_Rail	GA	Chatham ICTF	Savannah
Intermodal_Freight_Rail	IL	Chicago, IL - Schiller Park	Schiller Park
Intermodal_Freight_Rail	WA	Terminal 115 (T-115)	Seattle
Intermodal_Freight_Rail	WA	Terminal 18 (T-18)	Seattle
Intermodal_Freight_Rail	WA	Terminal 30 (T-30)	Seattle
Intermodal_Freight_Rail	WA	Terminal 5	Seattle
Intermodal_Freight_Rail	WA	ARGO Yard	Seattle

Intermodal_Freight_Rail	WA	Seattle International Gateway (SIG)	Seattle
Intermodal_Freight_Rail	WA	Seattle, WA - South Seattle	Seattle
Intermodal_Freight_Rail	WA	Spokane, WA	Spokane
Intermodal_Freight_Rail	NY	GCT New York, NY - ExpressRail (Staten Island)	Staten Island
Intermodal_Freight_Rail	CA	Stockton, CA	Stockton
Intermodal_Freight_Rail	NY	Syracuse, NY	Syracuse
Intermodal_Freight_Rail	WA	Washington United Terminals (WUT)	Tacoma
Intermodal_Freight_Rail	WA	Husky Terminal	Tacoma
Intermodal_Freight_Rail	WA	East Sitcum Terminal	Tacoma
Intermodal_Freight_Rail	WA	West Sitcum Terminal	Tacoma
Intermodal_Freight_Rail	WA	Pierce County Terminal (PCT)	Tacoma
Intermodal_Freight_Rail	WA	Tacoma, WA - North Yard	Tacoma
Intermodal_Freight_Rail	WA	Tacoma South Intermodal Yard (TacSIM)	Tacoma
Intermodal_Freight_Rail	PA	Taylor, PA	Taylor
Intermodal_Freight_Rail	CA	Yusen Terminals (Berths 212-225)	Terminal Island
Intermodal_Freight_Rail	CA	Everport Terminal Services (Berths 226-236)	Terminal Island
Intermodal_Freight_Rail	CA	Los Angeles, CA - Terminal Island Container Transfer Facility (TICTF)	Terminal Island
Intermodal_Freight_Rail	CA	Fenix Marine Services (Berths 302-305)	Terminal Island
Intermodal_Freight_Rail	CA	APM Terminals Pacific (Berths 400-406)	Terminal Island
Intermodal_Freight_Rail	AZ	Tucson, AZ	Tucson
Intermodal_Freight_Rail	TX	San Antonio, TX - SAIT	Von Ormy
Intermodal_Freight_Rail	PA	Pittsburgh, PA	Wall
Intermodal_Freight_Rail	MA	Springfield, MA	West Springfield
Intermodal_Freight_Rail	TX	Dallas, TX - Wilmer (Dallas Intermodal Terminal)	Wilmer
Intermodal_Freight_Rail	CA	Wilmington, CA - TraPac Intermodal Container Transfer Facility	Wilmington
Intermodal_Freight_Rail	DE	Marine Terminal	Wilmington

Intermodal_Freight_Rail	MA	Stackbridge, MA	Worcester
Intermodal_Freight_Rail	MA	Worcester, MA	Worcester
Principal Ports	CA	Port of Long Beach, CA	
Principal Ports	TX	Houston Port Authority, TX	
Principal Ports	TX	Texas City, TX	
Principal Ports	TX	Beaumont, TX	
Principal Ports	GA	Port of Savannah, GA	
Principal Ports	SC	Port of Charleston, SC	
Principal Ports	IN	Indiana (Northern District), IN	
Principal Ports	MD	Baltimore, MD	
Principal Ports	PA	Philadelphia Regional Port, PA	
Principal Ports	CA	Port of Los Angeles, CA	
Principal Ports	CA	Port of Oakland, CA	
Principal Ports	OR	Port of Portland, OR	
Principal Ports	FL	Port Miami, FL	
Principal Ports	IL	Illinois International Port, IL	
Principal Ports	MA	Boston, MA	
Principal Ports	CA	Richmond, CA	
Principal Ports	WA	Port of Vancouver USA, WA	
Principal Ports	FL	Port Everglades, FL	
Principal Ports	FL	Jacksonville, FL	
Principal Ports	MI	Detroit-Wayne County Port, MI	

Appendix B: List of Facilities Included as Zero-Emission Freight Hubs in Phase 3

Facility Type	State	Airport Code/Port Name/Rail Terminal	City
Intermodal_Freight_Air-to-Truck	PA	ABE	Allentown
Intermodal_Freight_Air-to-Truck	TX	AFW	Fort Worth
Intermodal_Freight_Air-to-Truck	GA	ATL	Atlanta
Intermodal_Freight_Air-to-Truck	CT	BDL	Windsor Locks
Intermodal_Freight_Air-to-Truck	WA	BFI	Seattle
Intermodal_Freight_Air-to-Truck	MD	BWI	Baltimore
Intermodal_Freight_Air-to-Truck	OH	CLE	Cleveland
Intermodal_Freight_Air-to-Truck	NC	CLT	Charlotte
Intermodal_Freight_Air-to-Truck	KY	CVG	Hebron
Intermodal_Freight_Air-to-Truck	CO	DEN	Denver
Intermodal_Freight_Air-to-Truck	TX	DFW	Grapevine, Irving, Euless, Coppell
Intermodal_Freight_Air-to-Truck	MI	DTW	Romulus
Intermodal_Freight_Air-to-Truck	TX	ELP	El Paso
Intermodal_Freight_Air-to-Truck	NJ	EWR	Newark, Elizabeth
Intermodal_Freight_Air-to-Truck	WA	GEG	Spokane
Intermodal_Freight_Air-to-Truck	VA	IAD	Dulles
Intermodal_Freight_Air-to-Truck	TX	IAH	Houston
Intermodal_Freight_Air-to-Truck	NY	JFK	New York
Intermodal_Freight_Air-to-Truck	NV	LAS	Las Vegas
Intermodal_Freight_Air-to-Truck	CA	LAX	Westchester, Los Angeles
Intermodal_Freight_Air-to-Truck	OH	LCK	Columbus
Intermodal_Freight_Air-to-Truck	TN	MEM	Memphis
Intermodal_Freight_Air-to-Truck	WI	MKE	Milwaukee
Intermodal_Freight_Air-to-Truck	CA	OAK	Oakland
Intermodal_Freight_Air-to-Truck	CA	ONT	Ontario
Intermodal_Freight_Air-to-Truck	IL	ORD	Chicago

Intermodal_Freight_Air-to-Truck	PA	PHL	Philadelphia
Intermodal_Freight_Air-to-Truck	AZ	PHX	Phoenix
Intermodal_Freight_Air-to-Truck	PA	PIT	Pittsburgh
Intermodal_Freight_Air-to-Truck	NV	RNO	Reno
Intermodal_Freight_Air-to-Truck	CA	SAN	San Diego
Intermodal_Freight_Air-to-Truck	TX	SAT	San Antonio
Intermodal_Freight_Air-to-Truck	KY	SDF	Louisville
Intermodal_Freight_Air-to-Truck	CA	SFO	San Francisco
Intermodal_Freight_Air-to-Truck	UT	SLC	Salt Lake City
Intermodal_Freight_Air-to-Truck	MO	STL	St Louis
Intermodal_Freight_Air-to-Truck	TX	AUS	Austin
Intermodal_Freight_Air-to-Truck	MA	BOS	East Boston
Intermodal_Freight_Air-to-Truck	NH	MHT	Manchester
Intermodal_Freight_Air-to-Truck	OR	PDX	Portland
Intermodal_Freight_Air-to-Truck	WA	SEA	SeaTac
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	NJ	Camden Gloucester	Salam
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port Freeport	Freeport
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	MD	Port of Baltimore	Baltimore
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port of Galveston	Galveston
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port of Houston	Houston
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port of Houston	La Porte
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port of Houston	Pasadena
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of Hueneme	Port Hueneme
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of Long Beach	Long Beach
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of Los Angeles	Wilmington

Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	NJ	Port of New York and New Jersey	Jersey City
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	NJ	Port of New York and New Jersey	Port Newark
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	NY	Port of New York and New Jersey	Staten Island
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of Oakland	Oakland
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	PA	Port of Philadelphia	Philadelphia
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of Richmond, CA	Richmond
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of San Diego	National City
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of San Diego	San Diego
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of San Francisco	San Francisco
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	WA	Port of Seattle	Seattle
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	WA	Port of Tacoma	Tacoma
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	DE	Port of Wilmington, DE	Wilmington
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	WA	Port of Grays Harbor	Aberdeen
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port of Beaumont	Beaumont
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	SC	Port of Charleston	Charleston
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	MA	Port of Boston	Charlestown
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	SC	Port of Charleston	North Charleston
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	OR	Port of Portland, OR	Portland
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	RI	Port of Providence	Providence
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	VA	Port of Virginia	Richmond

Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	GA	Port of Savannah	Savannah
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	WA	Port of Vancouver, WA	Vancouver
Intermodal_Freight_Rail	TX	Alliance, TX	Haslet
Intermodal_Freight_Rail	GA	Atlanta, GA - Austell	Austell
Intermodal_Freight_Rail	GA	Atlanta, GA - Hulsey	Atlanta
Intermodal_Freight_Rail	GA	Atlanta, GA - Inman	Atlanta
Intermodal_Freight_Rail	MD	Baltimore, MD	Baltimore
Intermodal_Freight_Rail	AL	Bessemer, AL - Central Alabama ICTF (CAICTF)	North Bessemer
Intermodal_Freight_Rail	PA	Bethlehem, PA	Bethlehem
Intermodal_Freight_Rail	AL	Birmingham, AL	McCalla
Intermodal_Freight_Rail	IL	Blue Island, IL	Blue Island
Intermodal_Freight_Rail	NJ	Camden Gloucester	Camden
Intermodal_Freight_Rail	NJ	Camden Gloucester	Salem
Intermodal_Freight_Rail	NC	Charlotte Inland Port (CIP)	Charlotte
Intermodal_Freight_Rail	NC	Charlotte, NC	Charlotte
Intermodal_Freight_Rail	IL	Chicago, IL - Dolton (Yard Center)	Dolton
Intermodal_Freight_Rail	IL	Chicago, IL - Northlake (Global II)	Northlake
Intermodal_Freight_Rail	IL	Chicago, IL - 59th Street	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - Bedford Park	Bedford Park
Intermodal_Freight_Rail	IL	Chicago, IL - 14th Street (Global I)	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - 47th Street	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - 63rd Street	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - Calumet	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - Cicero	Cicero
Intermodal_Freight_Rail	IL	Chicago, IL - Corwith	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - Franklin Park (Bensenville Intermodal Terminal)	Franklin Park

Intermodal_Freight_Rail	IL	Chicago, IL - Harvey (Gateway)	Harvey
Intermodal_Freight_Rail	IL	Chicago, IL - Joliet (Global IV)	Joliet
Intermodal_Freight_Rail	IL	Chicago, IL - Landers	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - Logistics Park Chicago (LPC)	Elwood
Intermodal_Freight_Rail	IL	Chicago, IL - Schiller Park	Schiller Park
Intermodal_Freight_Rail	IL	Chicago, IL - Willow Springs	Hodgkins
Intermodal_Freight_Rail	OH	Cincinnati, OH - Gest Street	Cincinnati
Intermodal_Freight_Rail	OH	Cincinnati, OH - Queensgate Yard	Cincinnati
Intermodal_Freight_Rail	OH	Cincinnati, OH - Sharonville	Sharonville
Intermodal_Freight_Rail	OH	Cleveland, OH - Collinwood Yard	Cleveland
Intermodal_Freight_Rail	OH	Columbus, OH - Buckeye Yard	Columbus
Intermodal_Freight_Rail	CA	Commerce, CA	Commerce
Intermodal_Freight_Rail	NJ	Croxton, NJ	Jersey City
Intermodal_Freight_Rail	TX	Dallas, TX - Mesquite	Mesquite
Intermodal_Freight_Rail	TX	Dallas, TX - Wilmer (Dallas Intermodal Terminal)	Wilmer
Intermodal_Freight_Rail	CO	Denver, CO	Denver
Intermodal_Freight_Rail	CO	Denver, CO - Irondale	Denver
Intermodal_Freight_Rail	MI	Detroit, MI	Detroit
Intermodal_Freight_Rail	MI	Detroit, MI - Delray	Detroit
Intermodal_Freight_Rail	MI	Detroit, MI - Detroit Intermodal Terminal	Detroit
Intermodal_Freight_Rail	MI	Detroit, MI - Livernois	Detroit
Intermodal_Freight_Rail	MI	Detroit, MI - Moterm Intermodal Facility (MOT)	Ferndale
Intermodal_Freight_Rail	IL	Dupo, IL - St. Louis	Dupo
Intermodal_Freight_Rail	IL	East St. Louis, IL	East St. Louis

Intermodal_Freight_Rail	TX	El Paso, TX	El Paso
Intermodal_Freight_Rail	NJ	Erail, NJ	Elizabeth
Intermodal_Freight_Rail	GA	Fairburn, GA	Fairburn
Intermodal_Freight_Rail	PA	Harrisburg, PA	Harrisburg
Intermodal_Freight_Rail	TX	Houston, TX - Englewood (Wallisville Rd)	Houston
Intermodal_Freight_Rail	TX	Houston, TX - Kendleton	Beasley
Intermodal_Freight_Rail	TX	Houston, TX - Pearland	Houston
Intermodal_Freight_Rail	TX	Houston, TX - Settegast (Kirkpatrick, Blvd)	Houston
Intermodal_Freight_Rail	IL	Joliet, IL	Joliet
Intermodal_Freight_Rail	NV	Las Vegas, NV	Las Vegas
Intermodal_Freight_Rail	CA	Lathrop, CA	French Camp
Intermodal_Freight_Rail	CA	Los Angeles, CA - City of Industry	City of Industry
Intermodal_Freight_Rail	CA	Los Angeles, CA - East Washington Blvd	City of Commerce
Intermodal_Freight_Rail	KY	Louisville, KY	Louisville
Intermodal_Freight_Rail	KY	Louisville, KY - Appliance Park	Louisville
Intermodal_Freight_Rail	KY	Louisville, KY - Buechel	Louisville
Intermodal_Freight_Rail	AR	Marion, AR	Marion
Intermodal_Freight_Rail	TN	Memphis, TN	Memphis
Intermodal_Freight_Rail	PA	Morrisville, PA	East Langhorne
Intermodal_Freight_Rail	AZ	Phoenix, AZ - Glendale	Glendale
Intermodal_Freight_Rail	PA	Pittsburgh, PA	Wall
Intermodal_Freight_Rail	PA	Pittsburgh, PA - McKees Rocks	McKees Rocks
Intermodal_Freight_Rail	MD	Port of Baltimore	Baltimore
Intermodal_Freight_Rail	TX	Port of Freeport	Freeport
Intermodal_Freight_Rail	TX	Port of Houston	Houston
Intermodal_Freight_Rail	TX	Port of Houston	La Porte
Intermodal_Freight_Rail	TX	Port of Houston	Pasadena
Intermodal_Freight_Rail	CA	Port of Hueneme	Port Hueneme

Intermodal_Freight_Rail	CA	Port of Long Beach	Long Beach
Intermodal_Freight_Rail	CA	Port of Los Angeles	San Pedro
Intermodal_Freight_Rail	CA	Port of Los Angeles	Terminal Island
Intermodal_Freight_Rail	CA	Port of Los Angeles	Wilmington
Intermodal_Freight_Rail	CA	Port of Los Angeles/Long Beach	Long Beach
Intermodal_Freight_Rail	CA	Port of Los Angeles/Long Beach	Los Angeles
Intermodal_Freight_Rail	NJ	Port of New York and New Jersey	Kearny
Intermodal_Freight_Rail	NJ	Port of New York and New Jersey	Newark
Intermodal_Freight_Rail	NJ	Port of New York and New Jersey	North Bergen
Intermodal_Freight_Rail	NJ	Port of New York and New Jersey	Port Elizabeth
Intermodal_Freight_Rail	NY	Port of New York and New Jersey	Staten Island
Intermodal_Freight_Rail	NJ	Port of NYNJ	Jersey City
Intermodal_Freight_Rail	NY	Port of NYNJ	Brooklyn
Intermodal_Freight_Rail	CA	Port of Oakland	Oakland
Intermodal_Freight_Rail	WA	Port of Olympia	Olympia
Intermodal_Freight_Rail	PA	Port of Philadelphia	Philadelphia
Intermodal_Freight_Rail	WA	Port of Seattle	Seattle
Intermodal_Freight_Rail	WA	Port of Tacoma	Tacoma
Intermodal_Freight_Rail	DE	Port of Wilmington, DE	Wilmington
Intermodal_Freight_Rail	PA	Rutherford, PA	Harrisburg
Intermodal_Freight_Rail	UT	Salt Lake City, UT	Salt Lake City
Intermodal_Freight_Rail	TX	San Antonio, TX - SAIT	Von Ormy
Intermodal_Freight_Rail	CA	San Bernardino, CA	San Bernardino
Intermodal_Freight_Rail	NV	Sparks, NV	Sparks
Intermodal_Freight_Rail	WA	Spokane, WA	Spokane
Intermodal_Freight_Rail	MO	St. Louis, MO	St. Louis
Intermodal_Freight_Rail	MO	St. Louis, MO - Lindenwood	St. Louis

Intermodal_Freight_Rail	CA	Stockton, CA	Stockton
Intermodal_Freight_Rail	TX	Wylie, TX	Wylie
Intermodal_Freight_Rail	MA	Ayer, MA	Ayer
Intermodal_Freight_Rail	MD	Baltimore, MD - Seagirt Marine Terminal	Baltimore
Intermodal_Freight_Rail	NY	Buffalo, NY	Blasdell
Intermodal_Freight_Rail	NY	Red Hook Container Terminal	Brooklyn
Intermodal_Freight_Rail	NY	Buffalo, NY	Buffalo
Intermodal_Freight_Rail	NJ	Balzano Marine Terminal	Camden
Intermodal_Freight_Rail	PA	Chambersburg, PA	Chambersburg
Intermodal_Freight_Rail	OR	Port Westward Industrial Park	Clatskanie
Intermodal_Freight_Rail	SC	Inland Port Dillon	Dillon
Intermodal_Freight_Rail	GA	Mason ICTF	Garden City
Intermodal_Freight_Rail	PA	Greencastle, PA - Franklin County Regional Intermodal Facility	Greencastle
Intermodal_Freight_Rail	TX	Jacintoport Terminal	Houston
Intermodal_Freight_Rail	NJ	GCT Bayonne Terminal, NJ	Jersey City
Intermodal_Freight_Rail	NJ	Kearny, NJ	Kearny
Intermodal_Freight_Rail	TX	Barbours Cut Container Terminal	La Porte
Intermodal_Freight_Rail	TX	Laredo, TX	Laredo
Intermodal_Freight_Rail	CA	Long Beach, CA - ICTF	Long Beach
Intermodal_Freight_Rail	CA	Long Beach, CA - International Transportation Service (ITS/Pier G)	Long Beach
Intermodal_Freight_Rail	CA	Long Beach, CA - Long Beach Container Terminal (LBCT/Pier E)	Long Beach
Intermodal_Freight_Rail	CA	Long Beach, CA - Pacific Container Terminal (PCT/Pier J)	Long Beach
Intermodal_Freight_Rail	CA	Long Beach, CA - SSA Terminals (Pier A)	Long Beach

Intermodal_Freight_Rail	CA	Total Terminals International (TTI/Pier T)	Long Beach
Intermodal_Freight_Rail	CA	Los Angeles, CA - Hobart	Los Angeles
Intermodal_Freight_Rail	CA	Los Angeles, CA - Lamar St (LATC)	Los Angeles
Intermodal_Freight_Rail	NY	Albany, NY - Mechanicville	Mechanicville
Intermodal_Freight_Rail	SC	Wando Welch Terminal	Mt. Pleasant
Intermodal_Freight_Rail	NJ	Port Newark Container Terminal, NJ - ExpressRail (Newark)	Newark
Intermodal_Freight_Rail	NJ	Little Ferry, NJ	North Bergen
Intermodal_Freight_Rail	NJ	North Bergen, NJ	North Bergen
Intermodal_Freight_Rail	SC	North Charleston Terminal, SC	North Charleston
Intermodal_Freight_Rail	SC	Hugh K. Leatherman Terminal	North Charleston
Intermodal_Freight_Rail	SC	Charleston, SC	North Charleston
Intermodal_Freight_Rail	CA	Matson Terminal	Oakland
Intermodal_Freight_Rail	CA	Charles P. Howard Terminal	Oakland
Intermodal_Freight_Rail	CA	TraPac Terminal	Oakland
Intermodal_Freight_Rail	CA	Ben E. Nutter Terminal	Oakland
Intermodal_Freight_Rail	CA	Oakland International Container Terminal (OICT)	Oakland
Intermodal_Freight_Rail	CA	Railport Oakland	Oakland
Intermodal_Freight_Rail	CA	Oakland International Gateway (OIG) - Joint Intermodal Terminal (JIT)	Oakland
Intermodal_Freight_Rail	WA	Seaport	Olympia
Intermodal_Freight_Rail	CA	Bayport Container Terminal	Pasadena
Intermodal_Freight_Rail	PA	Philadelphia, PA - Greenwhich	Philadelphia
Intermodal_Freight_Rail	NJ	Elizabeth Marine Terminal, NJ - ExpressRail (Port Elizabeth)	Port Elizabeth

Intermodal_Freight_Rail	OR	Portland, OR - Brooklyn	Portland
Intermodal_Freight_Rail	OR	Portland, OR - Terminal 2 (Guilds Lake)	Portland
Intermodal_Freight_Rail	OR	Portland, OR - Terminal 6	Portland
Intermodal_Freight_Rail	VA	Richmond Marine Terminal (RMT)	Richmond
Intermodal_Freight_Rail	NJ	Salem Marine Terminal (SMT)	Salem
Intermodal_Freight_Rail	CA	West Basin Container Terminal (WBCT) - China Shipping Holding (Berths 100-109)	San Pedro
Intermodal_Freight_Rail	CA	West Basin Container Terminal (WBCT) - Everglades Company Terminal (Berths 120-126)	San Pedro
Intermodal_Freight_Rail	GA	Ocean Terminal	Savannah
Intermodal_Freight_Rail	GA	Garden City Marine Terminal	Savannah
Intermodal_Freight_Rail	GA	Savannah, GA	Savannah
Intermodal_Freight_Rail	GA	Chatham ICTF	Savannah
Intermodal_Freight_Rail	WA	Terminal 115 (T-115)	Seattle
Intermodal_Freight_Rail	WA	Terminal 18 (T-18)	Seattle
Intermodal_Freight_Rail	WA	Terminal 30 (T-30)	Seattle
Intermodal_Freight_Rail	WA	Terminal 5	Seattle
Intermodal_Freight_Rail	WA	ARGO Yard	Seattle
Intermodal_Freight_Rail	WA	Seattle International Gateway (SIG)	Seattle
Intermodal_Freight_Rail	WA	Seattle, WA - South Seattle	Seattle
Intermodal_Freight_Rail	NY	GCT New York, NY - ExpressRail (Staten Island)	Staten Island
Intermodal_Freight_Rail	NY	Syracuse, NY	Syracuse
Intermodal_Freight_Rail	WA	Washington United Terminals (WUT)	Tacoma
Intermodal_Freight_Rail	WA	Husky Terminal	Tacoma

Intermodal_Freight_Rail	WA	East Sitcum Terminal	Tacoma
Intermodal_Freight_Rail	WA	West Sitcum Terminal	Tacoma
Intermodal_Freight_Rail	WA	Pierce County Terminal (PCT)	Tacoma
Intermodal_Freight_Rail	WA	Tacoma, WA - North Yard	Tacoma
Intermodal_Freight_Rail	WA	Tacoma South Intermodal Yard (TacSIM)	Tacoma
Intermodal_Freight_Rail	PA	Taylor, PA	Taylor
Intermodal_Freight_Rail	CA	Yusen Terminals (Berths 212-225)	Terminal Island
Intermodal_Freight_Rail	CA	Everport Terminal Services (Berths 226-236)	Terminal Island
Intermodal_Freight_Rail	CA	Los Angeles, CA - Terminal Island Container Transfer Facility (TICTF)	Terminal Island
Intermodal_Freight_Rail	CA	Fenix Marine Services (Berths 302-305)	Terminal Island
Intermodal_Freight_Rail	CA	APM Terminals Pacific (Berths 400-406)	Terminal Island
Intermodal_Freight_Rail	AZ	Tucson, AZ	Tucson
Intermodal_Freight_Rail	MA	Springfield, MA	West Springfield
Intermodal_Freight_Rail	CA	Wilmington, CA - TraPac Intermodal Container Transfer Facility	Wilmington
Intermodal_Freight_Rail	DE	Marine Terminal	Wilmington
Intermodal_Freight_Rail	MA	Stackbridge, MA	Worcester
Intermodal_Freight_Rail	MA	Worcester, MA	Worcester
Principal Port	MD	Baltimore, MD	Baltimore
Principal Port	TX	Beaumont, TX	Beaumont
Principal Port	MA	Boston, MA	Boston
Principal Port	OH	Cincinnati-Northern KY, Ports of	Cincinnati
Principal Port	OH	Cleveland-Cuyahoga Port, OH	Cleveland
Principal Port	TX	Corpus Christi, TX	Corpus Christi

Principal Port	MI	Detroit-Wayne County Port, MI	Detroit
Principal Port	MN	Duluth-Superior, MN and WI	Duluth
Principal Port	IL	E Iowa and W Illinois, IA IL	Rock Island
Principal Port	TX	Galveston, TX	Galveston
Principal Port	HI	Honolulu, O'ahu, HI	Honolulu
Principal Port	TX	Houston Port Authority, TX	Houston
Principal Port	WV	Huntington-Tristate, KY, OH, WV	Huntington
Principal Port	IL	Illinois International Port, IL	Chicago
Principal Port	IL	Illinois Waterway Ports, IL	Granite City
Principal Port	IN	Indiana (Northern District), IN	Burns Harbor
Principal Port	MS	Jackson County Port, MS	Pascagoula
Principal Port	FL	Jacksonville, FL	Jacksonville
Principal Port	IL	Joliet Regional Port, IL	Joliet
Principal Port	LA	Lake Charles Harbor District, LA	Lake Charles
Principal Port	KY	Louisville-Jefferson Port, KY	Louisville
Principal Port	TN	Memphis-Shelby County Port, TN	Memphis
Principal Port	IL	Mid-America Port, IA, IL, and MO	Quincy
Principal Port	OH	Mid-Ohio Valley Port, OH and WV	Marietta
Principal Port	AL	Mobile, AL	Mobile
Principal Port	TN	Nashville, TN	Nashville
Principal Port	MO	New Bourbon Port Authority, MO	Perryville
Principal Port	CT	New Haven, CT	New Haven
Principal Port	LA	New Orleans, LA	New Orleans

Principal Port	NY	New York, NY & NJ	New York
Principal Port	PA	Philadelphia Regional Port, PA	Philadelphia
Principal Port	PA	Pittsburgh, PA Port of	Pittsburgh
Principal Port	LA	Plaquemines Port District, LA	Belle Chasse
Principal Port	TX	Port Arthur, TX	Port Arthur
Principal Port	FL	Port Everglades, FL	Fort Lauderdale
Principal Port	TX	Port Freeport, TX	Freeport
Principal Port	SC	Port of Charleston, SC	Charleston
Principal Port	LA	Port of Greater Baton Rouge, LA	Baton Rouge
Principal Port	WA	Port of Kalama, WA	Kalama
Principal Port	CA	Port of Long Beach, CA	Long Beach
Principal Port	WA	Port of Longview, WA	Longview
Principal Port	CA	Port of Los Angeles, CA	Los Angeles
Principal Port	CA	Port of Oakland, CA	Oakland
Principal Port	OR	Port of Portland, OR	Portland
Principal Port	GA	Port of Savannah, GA	Savannah
Principal Port	WA	Port of Vancouver USA, WA	Vancouver
Principal Port	FL	PortMiami, FL	Miami
Principal Port	CA	Richmond, CA	Richmond
Principal Port	PR	San Juan, PR	San Juan
Principal Port	WA	Seattle, WA	Seattle
Principal Port	NJ	South Jersey Port District, NJ	Camden
Principal Port	LA	South Louisiana, LA, Port of	Reserve
Principal Port	MO	St. Louis Metro Port, IL, and MO	St Louis
Principal Port	WA	Tacoma, WA	Tacoma
Principal Port	FL	Tampa Port Authority, FL	Tampa
Principal Port	TX	Texas City, TX	Texas City

Principal Port	OH	Toledo-Lucas County Port, OH	Toledo
Principal Port	MN	Two Harbors, MN	Two Harbors
Principal Port	AK	Valdez, AK	Valdez
Principal Port	VA	Virginia, VA, Port of	Richmond

Appendix C: List of Facilities Included as Zero-Emission Freight Hubs in Phase 4

Facility Type	State	Airport Code/Port Name/Rail Terminal	City
Intermodal_Freight_Air-to-Truck	PA	ABE	Allentown
Intermodal_Freight_Air-to-Truck	NM	ABQ	Albuquerque
Intermodal_Freight_Air-to-Truck	TX	AFW	Fort Worth
Intermodal_Freight_Air-to-Truck	AK	ANC	Anchorage
Intermodal_Freight_Air-to-Truck	GA	ATL	Atlanta
Intermodal_Freight_Air-to-Truck	TX	AUS	Austin
Intermodal_Freight_Air-to-Truck	CT	BDL	Windsor Locks
Intermodal_Freight_Air-to-Truck	WA	BFI	Seattle
Intermodal_Freight_Air-to-Truck	MA	BOS	Boston
Intermodal_Freight_Air-to-Truck	MD	BWI	Baltimore
Intermodal_Freight_Air-to-Truck	OH	CLE	Cleveland
Intermodal_Freight_Air-to-Truck	NC	CLT	Charlotte
Intermodal_Freight_Air-to-Truck	KY	CVG	Hebron
Intermodal_Freight_Air-to-Truck	CO	DEN	Denver
Intermodal_Freight_Air-to-Truck	TX	DFW	Grapevine, Irving, Euless, Coppell
Intermodal_Freight_Air-to-Truck	MI	DTW	Romulus
Intermodal_Freight_Air-to-Truck	TX	ELP	El Paso
Intermodal_Freight_Air-to-Truck	NJ	EWR	Newark, Elizabeth
Intermodal_Freight_Air-to-Truck	FL	FLL	Fort Lauderdale
Intermodal_Freight_Air-to-Truck	WA	GEG	Spokane
Intermodal_Freight_Air-to-Truck	NC	GSO	Greensboro
Intermodal_Freight_Air-to-Truck	HI	HNL	Honolulu
Intermodal_Freight_Air-to-Truck	AL	HSV	Huntsville
Intermodal_Freight_Air-to-Truck	VA	IAD	Dulles
Intermodal_Freight_Air-to-Truck	TX	IAH	Houston
Intermodal_Freight_Air-to-Truck	IN	IND	Indianapolis

Intermodal_Freight_Air-to-Truck	FL	JAX	Jacksonville
Intermodal_Freight_Air-to-Truck	NY	JFK	New York
Intermodal_Freight_Air-to-Truck	NV	LAS	Las Vegas
Intermodal_Freight_Air-to-Truck	CA	LAX	Westchester, Los Angeles
Intermodal_Freight_Air-to-Truck	TX	LBB	Lubbock
Intermodal_Freight_Air-to-Truck	OH	LCK	Columbus
Intermodal_Freight_Air-to-Truck	MO	MCI	Kansas City
Intermodal_Freight_Air-to-Truck	FL	MCO	Orlando
Intermodal_Freight_Air-to-Truck	TN	MEM	Memphis
Intermodal_Freight_Air-to-Truck	NH	MHT	Manchester
Intermodal_Freight_Air-to-Truck	FL	MIA	Miami
Intermodal_Freight_Air-to-Truck	WI	MKE	Milwaukee
Intermodal_Freight_Air-to-Truck	MN	MSP	Minneapolis
Intermodal_Freight_Air-to-Truck	CA	OAK	Oakland
Intermodal_Freight_Air-to-Truck	CA	ONT	Ontario
Intermodal_Freight_Air-to-Truck	IL	ORD	Chicago
Intermodal_Freight_Air-to-Truck	OR	PDX	Portland
Intermodal_Freight_Air-to-Truck	PA	PHL	Philadelphia
Intermodal_Freight_Air-to-Truck	AZ	PHX	Phoenix
Intermodal_Freight_Air-to-Truck	PA	PIT	Pittsburgh
Intermodal_Freight_Air-to-Truck	NC	RDU	Raleigh
Intermodal_Freight_Air-to-Truck	IL	RFD	Rockford
Intermodal_Freight_Air-to-Truck	VA	RIC	Richmond
Intermodal_Freight_Air-to-Truck	NV	RNO	Reno
Intermodal_Freight_Air-to-Truck	CA	SAN	San Diego
Intermodal_Freight_Air-to-Truck	TX	SAT	San Antonio
Intermodal_Freight_Air-to-Truck	KY	SDF	Louisville
Intermodal_Freight_Air-to-Truck	WA	SEA	SeaTac
Intermodal_Freight_Air-to-Truck	CA	SFO	San Francisco
Intermodal_Freight_Air-to-Truck	PR	SJU	San Juan
Intermodal_Freight_Air-to-Truck	UT	SLC	Salt Lake City

Intermodal_Freight_Air-to-Truck	MO	STL	St Louis
Intermodal_Freight_Air-to-Truck	FL	TPA	Tampa
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	NJ	Camden Gloucester	Salam
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	LA	General Cargo Dock	Shreveport
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	MS	Natchez - Adams County Port	Natchez
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	FL	Port Canaveral	Port Canaveral
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	FL	Port Everglades	Fort Lauderdale
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port Freeport	Freeport
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	MS	Port Itawamba	Fulton
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port Lavaca-Port Comfort	Point Comfort
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	AK	Port of Alaska in Anchorage	Anchorage
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	MD	Port of Baltimore	Baltimore
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port of Beaumont	Beaumont
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	MA	Port of Boston	Charlestown
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	GA	Port of Brunswick	Brunswick
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	SC	Port of Charleston	North Charleston
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port of Corpus Christi	Corpus Christi
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	MN	Port of Duluth-Superior	Duluth
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port of Galveston	Galveston
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	WA	Port of Grays Harbor	Aberdeen

Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	MS	Port of Gulfport	Gulfport
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	HI	Port of Hawaii	Kahului
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port of Houston	Houston
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of Hueneme	Port Hueneme
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	FL	Port of Jacksonville	Jacksonville
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of Long Beach	Long Beach
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of Los Angeles	Wilmington
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	FL	Port of Miami	Miami
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	AL	Port of Mobile	Mobile
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	NC	Port of Morehead City (NC)	Morehead City
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	LA	Port of New Orleans	New Orleans
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	NJ	Port of New York and New Jersey	Jersey City
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	NY	Port of New York and New Jersey	Staten Island
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of Oakland	Oakland
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	FL	Port of Palm Beach	Riviera Beach
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	PA	Port of Philadelphia	Philadelphia
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port of Port Arthur	Port Arthur
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	OR	Port of Portland, OR	Portland
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	RI	Port of Providence	Providence
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of Richmond, CA	Richmond

Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of San Diego	National City
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of San Francisco	San Francisco
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	GA	Port of Savannah	Savannah
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	WA	Port of Seattle	Seattle
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	WA	Port of Tacoma	Tacoma
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	WA	Port of Vancouver, WA	Vancouver
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	VA	Port of Virginia	Newport News
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	VA	Port of Virginia	Portsmouth
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	VA	Port of Virginia	Richmond
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	DE	Port of Wilmington, DE	Wilmington
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	NC	Port of Wilmington, NC	Wilmington
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	FL	Port Tampa Bay	Tampa
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port of Houston	La Porte
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	TX	Port of Houston	Pasadena
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	NJ	Port of New York and New Jersey	Port Newark
Intermodal_Freight_Facilities_Marine_Roll-on_Roll-off	CA	Port of San Diego	San Diego
Intermodal_Freight_Rail	NY	Albany, NY - Mechanicville	Mechanicville
Intermodal_Freight_Rail	NM	Albuquerque, NM	Albuquerque
Intermodal_Freight_Rail	TX	Alliance, TX	Haslet
Intermodal_Freight_Rail	GA	Appalachian Regional Port (Inland Port)	Crandall
Intermodal_Freight_Rail	WI	Arcadia, WI	Arcadia

Intermodal_Freight_Rail	GA	Atlanta, GA - Austell	Austell
Intermodal_Freight_Rail	GA	Atlanta, GA - Hulsey	Atlanta
Intermodal_Freight_Rail	GA	Atlanta, GA - Inman	Atlanta
Intermodal_Freight_Rail	MA	Ayer, MA	Ayer
Intermodal_Freight_Rail	MD	Baltimore, MD	Baltimore
Intermodal_Freight_Rail	AL	Bessemer, AL - Central Alabama ICTF (CAICTF)	North Bessemer
Intermodal_Freight_Rail	PA	Bethlehem, PA	Bethlehem
Intermodal_Freight_Rail	AL	Birmingham, AL	McCalla
Intermodal_Freight_Rail	IL	Blue Island, IL	Blue Island
Intermodal_Freight_Rail	NY	Brooklyn	
Intermodal_Freight_Rail	NY	Buffalo, NY	Blasdell
Intermodal_Freight_Rail	NY	Buffalo, NY	Buffalo
Intermodal_Freight_Rail	IA	Butler Intermodal Terminal	Shell Rock
Intermodal_Freight_Rail	NJ	Camden Gloucester	Camden
Intermodal_Freight_Rail	NJ	Camden Gloucester	Salem
Intermodal_Freight_Rail	PA	Chambersburg, PA	Chambersburg
Intermodal_Freight_Rail	NC	Charlotte Inland Port (CIP)	Charlotte
Intermodal_Freight_Rail	NC	Charlotte, NC	Charlotte
Intermodal_Freight_Rail	IL	Chicago, IL - Dolton (Yard Center)	Dolton
Intermodal_Freight_Rail	IL	Chicago, IL - Northlake (Global II)	Northlake
Intermodal_Freight_Rail	IL	Chicago, IL - 59th Street	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - Bedford Park	Bedford Park
Intermodal_Freight_Rail	IL	Chicago, IL - 14th Street (Global I)	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - 47th Street	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - 63rd Street	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - Calumet	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - Cicero	Cicero

Intermodal_Freight_Rail	IL	Chicago, IL - Corwith	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - Franklin Park (Bensenville Intermodal Terminal)	Franklin Park
Intermodal_Freight_Rail	IL	Chicago, IL - Harvey (Gateway)	Harvey
Intermodal_Freight_Rail	IL	Chicago, IL - Joliet (Global IV)	Joliet
Intermodal_Freight_Rail	IL	Chicago, IL - Landers	Chicago
Intermodal_Freight_Rail	IL	Chicago, IL - Logistics Park Chicago (LPC)	Elwood
Intermodal_Freight_Rail	IL	Chicago, IL - Rochelle (Global III)	Rochelle
Intermodal_Freight_Rail	IL	Chicago, IL - Schiller Park	Schiller Park
Intermodal_Freight_Rail	IL	Chicago, IL - Willow Springs	Hodgkins
Intermodal_Freight_Rail	WI	Chippewa Falls, WI	Chippewa Falls
Intermodal_Freight_Rail	OH	Cincinnati, OH - Gest Street	Cincinnati
Intermodal_Freight_Rail	OH	Cincinnati, OH - Queensgate Yard	Cincinnati
Intermodal_Freight_Rail	OH	Cincinnati, OH - Sharonville	Sharonville
Intermodal_Freight_Rail	OH	Cleveland, OH - Collinwood Yard	Cleveland
Intermodal_Freight_Rail	FL	Cocoa, FL	Cocoa
Intermodal_Freight_Rail	OH	Columbus, OH	Columbus
Intermodal_Freight_Rail	OH	Columbus, OH - Buckeye Yard	Columbus
Intermodal_Freight_Rail	CA	Commerce, CA	Commerce
Intermodal_Freight_Rail	IA	Council Bluffs, IA	Council Bluffs
Intermodal_Freight_Rail	NJ	Croxton, NJ	Jersey City
Intermodal_Freight_Rail	TX	Dallas, TX - Mesquite	Mesquite
Intermodal_Freight_Rail	TX	Dallas, TX - Wilmer (Dallas Intermodal Terminal)	Wilmer

Intermodal_Freight_Rail	IL	Decatur, IL - ADM Intermodal Ramp (Midwest Inland Port)	Decatur
Intermodal_Freight_Rail	CO	Denver, CO	Denver
Intermodal_Freight_Rail	CO	Denver, CO - Irondale	Denver
Intermodal_Freight_Rail	MI	Detroit, MI	Detroit
Intermodal_Freight_Rail	MI	Detroit, MI - Delray	Detroit
Intermodal_Freight_Rail	MI	Detroit, MI - Detroit Intermodal Terminal	Detroit
Intermodal_Freight_Rail	MI	Detroit, MI - Livernois	Detroit
Intermodal_Freight_Rail	MI	Detroit, MI - Moterm Intermodal Facility (MOT)	Ferndale
Intermodal_Freight_Rail	TX	Donna, TX - Rio Valley	Donna
Intermodal_Freight_Rail	IL	Dupo, IL - St. Louis	Dupo
Intermodal_Freight_Rail	IL	East St. Louis, IL	East St. Louis
Intermodal_Freight_Rail	TX	El Paso, TX	El Paso
Intermodal_Freight_Rail	NJ	Erail, NJ	Elizabeth
Intermodal_Freight_Rail	GA	Fairburn, GA	Fairburn
Intermodal_Freight_Rail	FL	Fort Pierce, FL	Ft. Pierce
Intermodal_Freight_Rail	KY	Georgetown, KY	Georgetown
Intermodal_Freight_Rail	PA	Greencastle, PA - Franklin County Regional Intermodal Facility	Greencastle
Intermodal_Freight_Rail	NC	Greensboro, NC	Greensboro
Intermodal_Freight_Rail	PA	Harrisburg, PA	Harrisburg
Intermodal_Freight_Rail	TX	Houston, TX - Englewood (Wallisville Rd)	Houston
Intermodal_Freight_Rail	TX	Houston, TX - Kendleton	Beasley
Intermodal_Freight_Rail	TX	Houston, TX - Pearland	Houston
Intermodal_Freight_Rail	TX	Houston, TX - Settegast (Kirkpatrick, Blvd)	Houston
Intermodal_Freight_Rail	AL	Huntsville, AL	Huntsville
Intermodal_Freight_Rail	IN	Indianapolis, IN	Indianapolis
Intermodal_Freight_Rail	IN	Indianapolis, IN - Plainfield Intermodal Terminal	Avon

Intermodal_Freight_Rail	SC	Inland Port Dillon	Dillon
Intermodal_Freight_Rail	MS	Jackson, MS	Richland
Intermodal_Freight_Rail	FL	Jacksonville, FL	Jacksonville
Intermodal_Freight_Rail	FL	Jacksonville, FL - Fowden Intermodal Terminal	Jacksonville
Intermodal_Freight_Rail	IL	Joliet, IL	Joliet
Intermodal_Freight_Rail	KS	Kansas City - Logistics Park Kansas City (LPKC)	Edgerton
Intermodal_Freight_Rail	MO	Kansas City, MO	Kansas City
Intermodal_Freight_Rail	MO	Kansas City, MO - International Freight Gateway (IFG)	Kansas City
Intermodal_Freight_Rail	TX	Laredo, TX	Laredo
Intermodal_Freight_Rail	NV	Las Vegas, NV	Las Vegas
Intermodal_Freight_Rail	CA	Lathrop, CA	French Camp
Intermodal_Freight_Rail	CA	Los Angeles, CA - City of Industry	City of Industry
Intermodal_Freight_Rail	CA	Los Angeles, CA - East Washington Blvd	City of Commerce
Intermodal_Freight_Rail	KY	Louisville, KY	Louisville
Intermodal_Freight_Rail	KY	Louisville, KY - Appliance Park	Louisville
Intermodal_Freight_Rail	KY	Louisville, KY - Buechel	Louisville
Intermodal_Freight_Rail	AR	Marion, AR	Marion
Intermodal_Freight_Rail	OH	Marion, OH - Ohio Valley Intermodal Facility	Marion
Intermodal_Freight_Rail	TN	Memphis, TN	Memphis
Intermodal_Freight_Rail	TN	Memphis, TN - Rossville	Rossville
Intermodal_Freight_Rail	FL	Miami, FL	Miami Springs
Intermodal_Freight_Rail	MN	Minneapolis, MN - Shoreham Yard	Minneapolis
Intermodal_Freight_Rail	PA	Morrisville, PA	East Langhorne
Intermodal_Freight_Rail	SC	Mt. Pleasant	North Charleston
Intermodal_Freight_Rail	TN	Nashville, TN	Nashville
Intermodal_Freight_Rail	MS	Natchez - Adams County Port	Natchez

Intermodal_Freight_Rail	LA	New Orleans	Westwego
Intermodal_Freight_Rail	LA	New Orleans, LA	Avondale
Intermodal_Freight_Rail	VA	Norfolk, VA - Portlock	Chesapeake
Intermodal_Freight_Rail	OH	North Baltimore, OH - Northwest Ohio ICTF	North Baltimore
Intermodal_Freight_Rail	NE	Omaha, NE	Omaha
Intermodal_Freight_Rail	AZ	Phoenix, AZ - Glendale	Glendale
Intermodal_Freight_Rail	PA	Pittsburgh, PA	Wall
Intermodal_Freight_Rail	PA	Pittsburgh, PA - McKees Rocks	McKees Rocks
Intermodal_Freight_Rail	MS	Port Bienville	Bay St Louis
Intermodal_Freight_Rail	FL	Port Everglades	Fort Lauderdale
Intermodal_Freight_Rail	MS	Port Itawamba	Fulton
Intermodal_Freight_Rail	TX	Port Lavaca-Port Comfort	Point Comfort
Intermodal_Freight_Rail	AK	Port of Alaska in Anchorage	Anchorage
Intermodal_Freight_Rail	MD	Port of Baltimore	Baltimore
Intermodal_Freight_Rail	TX	Port of Brownsville	Brownsville
Intermodal_Freight_Rail	LA	Port of Caddo-Bossier	Shreveport
Intermodal_Freight_Rail	SC	Port of Charleston	Greer
Intermodal_Freight_Rail	MN	Port of Duluth-Superior	Duluth
Intermodal_Freight_Rail	FL	Port of Fernandina	Fernandina Beach
Intermodal_Freight_Rail	TX	Port of Freeport	Freeport
Intermodal_Freight_Rail	MS	Port of Gulfport	Gulfport
Intermodal_Freight_Rail	TX	Port of Houston	Houston
Intermodal_Freight_Rail	TX	Port of Houston	La Porte
Intermodal_Freight_Rail	TX	Port of Houston	Pasadena
Intermodal_Freight_Rail	CA	Port of Hueneme	Port Hueneme
Intermodal_Freight_Rail	FL	Port of Jacksonville	Jacksonville
Intermodal_Freight_Rail	CA	Port of Long Beach	Long Beach
Intermodal_Freight_Rail	CA	Port of Los Angeles	San Pedro
Intermodal_Freight_Rail	CA	Port of Los Angeles	Terminal Island
Intermodal_Freight_Rail	CA	Port of Los Angeles	Wilmington

Intermodal_Freight_Rail	CA	Port of Los Angeles/Long Beach	Long Beach
Intermodal_Freight_Rail	CA	Port of Los Angeles/Long Beach	Los Angeles
Intermodal_Freight_Rail	FL	Port of Miami	Miami
Intermodal_Freight_Rail	AL	Port of Mobile	Mobile
Intermodal_Freight_Rail	LA	Port of New Orleans	Harahan
Intermodal_Freight_Rail	NJ	Port of New York and New Jersey	Kearny
Intermodal_Freight_Rail	NJ	Port of New York and New Jersey	Newark
Intermodal_Freight_Rail	NJ	Port of New York and New Jersey	North Bergen
Intermodal_Freight_Rail	NJ	Port of New York and New Jersey	Port Elizabeth
Intermodal_Freight_Rail	NY	Port of New York and New Jersey	Staten Island
Intermodal_Freight_Rail	NJ	Port of NYNJ	Jersey City
Intermodal_Freight_Rail	NY	Port of NYNJ	Brooklyn
Intermodal_Freight_Rail	CA	Port of Oakland	Oakland
Intermodal_Freight_Rail	WA	Port of Olympia	Olympia
Intermodal_Freight_Rail	FL	Port of Palm Beach	Riviera Beach
Intermodal_Freight_Rail	PA	Port of Philadelphia	Philadelphia
Intermodal_Freight_Rail	OR	Port of Portland	Portland
Intermodal_Freight_Rail	GA	Port of Savannah	Garden City
Intermodal_Freight_Rail	WA	Port of Seattle	Seattle
Intermodal_Freight_Rail	WA	Port of Tacoma	Tacoma
Intermodal_Freight_Rail	VA	Port of Virginia	Front Royal
Intermodal_Freight_Rail	VA	Port of Virginia	Norfolk
Intermodal_Freight_Rail	VA	Port of Virginia	Portsmouth
Intermodal_Freight_Rail	VA	Port of Virginia	Richmond
Intermodal_Freight_Rail	TX	Port of West Calhoun	Long Mott
Intermodal_Freight_Rail	NC	Port of Wilmington	Wilmington
Intermodal_Freight_Rail	DE	Port of Wilmington, DE	Wilmington

Intermodal_Freight_Rail	FL	Port Panama City	Panama City
Intermodal_Freight_Rail	FL	Port Tampa Bay	Tampa
Intermodal_Freight_Rail	OR	Port Westward Industrial Park	Clatskanie
Intermodal_Freight_Rail	VA	Portsmouth, VA	Portsmouth
Intermodal_Freight_Rail	GA	Post of Savannah	Savannah
Intermodal_Freight_Rail	PA	Rutherford, PA	Harrisburg
Intermodal_Freight_Rail	UT	Salt Lake City, UT	Salt Lake City
Intermodal_Freight_Rail	TX	San Antonio, TX - SAIT	Von Ormy
Intermodal_Freight_Rail	CA	San Bernardino, CA	San Bernardino
Intermodal_Freight_Rail	NM	Santa Teresa	
Intermodal_Freight_Rail	NM	Santa Teresa, NM	Santa Teresa
Intermodal_Freight_Rail	GA	Savannah Gateway Industrial Hub	Rincon
Intermodal_Freight_Rail	GA	Savannah, GA	Savannah
Intermodal_Freight_Rail	OH	Sharonville	
Intermodal_Freight_Rail	NV	Sparks	
Intermodal_Freight_Rail	NV	Sparks, NV	Sparks
Intermodal_Freight_Rail	WA	Spokane, WA	Spokane
Intermodal_Freight_Rail	MA	Springfield, MA	West Springfield
Intermodal_Freight_Rail	MO	St. Louis, MO	St. Louis
Intermodal_Freight_Rail	MO	St. Louis, MO - Lindenwood	St. Louis
Intermodal_Freight_Rail	MN	St. Paul, MN - Midway	St. Paul
Intermodal_Freight_Rail	MA	Stackbridge, MA	Worcester
Intermodal_Freight_Rail	CA	Stockton, CA	Stockton
Intermodal_Freight_Rail	NY	Syracuse, NY	Syracuse
Intermodal_Freight_Rail	PA	Taylor, PA	Taylor
Intermodal_Freight_Rail	OH	Toledo, OH	Toledo
Intermodal_Freight_Rail	AZ	Tucson, AZ	Tucson
Intermodal_Freight_Rail	FL	Winter Haven, FL - Central Florida Intermodal Logistics Center (CFILC)	Winter Haven

Intermodal_Freight_Rail	MA	Worcester, MA	Worcester
Intermodal_Freight_Rail	TX	Wylie, TX	Wylie
Intermodal_Freight_Rail	MS	Yellow Creek State Inland Port	Iuka
Intermodal_Freight_Rail	CA	APM Termianls Pacific (Berths 400-406)	Terminal Island
Intermodal_Freight_Rail	WA	ARGO Yard	Seattle
Intermodal_Freight_Rail	MD	Baltimore, MD - Seagirt Marine Terminal	Baltimore
Intermodal_Freight_Rail	NJ	Balzano Marine Terminal	Camden
Intermodal_Freight_Rail	TX	Barbours Cut Container Terminal	La Porte
Intermodal_Freight_Rail	CA	Bayport Container Terminal	Pasadena
Intermodal_Freight_Rail	CA	Ben E. Nutter Terminal	Oakland
Intermodal_Freight_Rail	CA	Charles P. Howard Terminal	Oakland
Intermodal_Freight_Rail	SC	Charleston, SC	North Charleston
Intermodal_Freight_Rail	GA	Chatham ICTF	Savannah
Intermodal_Freight_Rail	WA	East Sitcum Terminal	Tacoma
Intermodal_Freight_Rail	NJ	Elizabeth Marine Terminal, NJ - ExpressRail (Port Elizabeth)	Port Elizabeth
Intermodal_Freight_Rail	CA	Everport Terminal Services (Berths 226-236)	Terminal Island
Intermodal_Freight_Rail	CA	Fenix Marine Services (Berths 302-305)	Terminal Island
Intermodal_Freight_Rail	GA	Garden City Marine Terminal	Savannah
Intermodal_Freight_Rail	NJ	GCT Bayonne Terminal, NJ	Jersey City
Intermodal_Freight_Rail	NY	GCT New York, NY - ExpressRail (Staten Island)	Staten Island
Intermodal_Freight_Rail	SC	Hugh K. Leatherman Terminal	North Charleston
Intermodal_Freight_Rail	WA	Husky Terminal	Tacoma

Intermodal_Freight_Rail	TX	Jacintoport Terminal	Houston
Intermodal_Freight_Rail	NJ	Kearny, NJ	Kearny
Intermodal_Freight_Rail	NJ	Little Ferry, NJ	North Bergen
Intermodal_Freight_Rail	CA	Long Beach, CA - ICTF	Long Beach
Intermodal_Freight_Rail	CA	Long Beach, CA - International Transportation Service (ITS/Pier G)	Long Beach
Intermodal_Freight_Rail	CA	Long Beach, CA - Long Beach Container Terminal (LBCT/Pier E)	Long Beach
Intermodal_Freight_Rail	CA	Long Beach, CA - Pacific Container Terminal (PCT/Pier J)	Long Beach
Intermodal_Freight_Rail	CA	Long Beach, CA - SSA Terminals (Pier A)	Long Beach
Intermodal_Freight_Rail	CA	Los Angeles, CA - Hobart	Los Angeles
Intermodal_Freight_Rail	CA	Los Angeles, CA - Lamar St (LATC)	Los Angeles
Intermodal_Freight_Rail	CA	Los Angeles, CA - Terminal Island Container Transfer Facility (TICTF)	Terminal Island
Intermodal_Freight_Rail	DE	Marine Terminal	Wilmington
Intermodal_Freight_Rail	GA	Mason ICTF	Garden City
Intermodal_Freight_Rail	CA	Matson Terminal	Oakland
Intermodal_Freight_Rail	NJ	North Bergen, NJ	North Bergen
Intermodal_Freight_Rail	SC	North Charleston Terminal, SC	North Charleston
Intermodal_Freight_Rail	CA	Oakland International Container Terminal (OICT)	Oakland
Intermodal_Freight_Rail	CA	Oakland International Gateway (OIG) - Joint Intermodal Terminal (JIT)	Oakland
Intermodal_Freight_Rail	GA	Ocean Terminal	Savannah
Intermodal_Freight_Rail	PA	Philadelphia, PA - Greenwhich	Philadelphia

Intermodal_Freight_Rail	WA	Pierce County Terminal (PCT)	Tacoma
Intermodal_Freight_Rail	NJ	Port Newark Container Terminal, NJ - ExpressRail (Newark)	Newark
Intermodal_Freight_Rail	OR	Portland, OR - Brooklyn	Portland
Intermodal_Freight_Rail	OR	Portland, OR - Terminal 2 (Guilds Lake)	Portland
Intermodal_Freight_Rail	OR	Portland, OR - Terminal 6	Portland
Intermodal_Freight_Rail	CA	Railport Oakland	Oakland
Intermodal_Freight_Rail	NY	Red Hook Container Terminal	Brooklyn
Intermodal_Freight_Rail	VA	Richmond Marine Terminal (RMT)	Richmond
Intermodal_Freight_Rail	NJ	Salem Marine Terminal (SMT)	Salem
Intermodal_Freight_Rail	WA	Seaport	Olympia
Intermodal_Freight_Rail	WA	Seattle International Gateway (SIG)	Seattle
Intermodal_Freight_Rail	WA	Seattle, WA - South Seattle	Seattle
Intermodal_Freight_Rail	WA	Tacoma South Intermodal Yard (TacSIM)	Tacoma
Intermodal_Freight_Rail	WA	Tacoma, WA - North Yard	Tacoma
Intermodal_Freight_Rail	WA	Terminal 115 (T-115)	Seattle
Intermodal_Freight_Rail	WA	Terminal 18 (T-18)	Seattle
Intermodal_Freight_Rail	WA	Terminal 30 (T-30)	Seattle
Intermodal_Freight_Rail	WA	Terminal 5	Seattle
Intermodal_Freight_Rail	CA	Total Terminals International (TTI/Pier T)	Long Beach
Intermodal_Freight_Rail	CA	TraPac Terminal	Oakland
Intermodal_Freight_Rail	SC	Wando Welch Terminal	Mt. Pleasant
Intermodal_Freight_Rail	WA	Washington United Terminals (WUT)	Tacoma
Intermodal_Freight_Rail	CA	West Basin Container Terminal (WBCT) - China Shipping Holding (Berths 100-109)	San Pedro

Intermodal_Freight_Rail	CA	West Basin Container Terminal (WBCT) - Everglades Company Terminal (Berths 120-126)	San Pedro
Intermodal_Freight_Rail	WA	West Sitcum Terminal	Tacoma
Intermodal_Freight_Rail	CA	Wilmington, CA - TraPac Intermodal Container Transfer Facility	Wilmington
Intermodal_Freight_Rail	CA	Yusen Terminals (Berths 212-225)	Terminal Island
Principal Port	NY	Albany, NY - Mechanicville	Mechanicville
Principal Port	NM	Albuquerque, NM	Albuquerque
Principal Port	TX	Alliance, TX	Haslet
Principal Port	GA	Appalachian Regional Port (Inland Port)	Crandall
Principal Port	WI	Arcadia, WI	Arcadia
Principal Port	GA	Atlanta, GA - Austell	Austell
Principal Port	GA	Atlanta, GA - Hulsey	Atlanta
Principal Port	GA	Atlanta, GA - Inman	Atlanta
Principal Port	MA	Ayer, MA	Ayer
Principal Port	MD	Baltimore, MD	Baltimore
Principal Port	AL	Bessemer, AL - Central Alabama ICTF (CAICTF)	North Bessemer
Principal Port	PA	Bethlehem, PA	Bethlehem
Principal Port	AL	Birmingham, AL	McCalla
Principal Port	IL	Blue Island, IL	Blue Island
Principal Port	NY	Buffalo, NY	Blasdell
Principal Port	NY	Buffalo, NY	Buffalo
Principal Port	IA	Butler Intermodal Terminal	Shell Rock
Principal Port	NJ	Camden Gloucester	Camden
Principal Port	NJ	Camden Gloucester	Salam
Principal Port	NJ	Camden Gloucester	Salem
Principal Port	PA	Chambersburg, PA	Chambersburg

Principal Port	NC	Charlotte Inland Port (CIP)	Charlotte
Principal Port	NC	Charlotte, NC	Charlotte
Principal Port	IL	Chicago, IL - Dolton (Yard Center)	Dolton
Principal Port	IL	Chicago, IL - Northlake (Global II)	Northlake
Principal Port	IL	Chicago, IL - 59th Street	Chicago
Principal Port	IL	Chicago, IL - Bedford Park	Bedford Park
Principal Port	IL	Chicago, IL - 14th Street (Global I)	Chicago
Principal Port	IL	Chicago, IL - 47th Street	Chicago
Principal Port	IL	Chicago, IL - 63rd Street	Chicago
Principal Port	IL	Chicago, IL - Calumet	Chicago
Principal Port	IL	Chicago, IL - Cicero	Cicero
Principal Port	IL	Chicago, IL - Corwith	Chicago
Principal Port	IL	Chicago, IL - Franklin Park (Bensenville Intermodal Terminal)	Franklin Park
Principal Port	IL	Chicago, IL - Harvey (Gateway)	Harvey
Principal Port	IL	Chicago, IL - Joliet (Global IV)	Joliet
Principal Port	IL	Chicago, IL - Landers	Chicago
Principal Port	IL	Chicago, IL - Logistics Park Chicago (LPC)	Elwood
Principal Port	IL	Chicago, IL - Rochelle (Global III)	Rochelle
Principal Port	IL	Chicago, IL - Schiller Park	Schiller Park
Principal Port	IL	Chicago, IL - Willow Springs	Hodgkins
Principal Port	WI	Chippewa Falls, WI	Chippewa Falls
Principal Port	OH	Cincinnati, OH - Gest Street	Cincinnati
Principal Port	OH	Cincinnati, OH - Queensgate Yard	Cincinnati

Principal Port	OH	Cincinnati, OH - Sharonville	Sharonville
Principal Port	OH	Cleveland, OH - Collinwood Yard	Cleveland
Principal Port	FL	Cocoa, FL	Cocoa
Principal Port	OH	Columbus, OH	Columbus
Principal Port	OH	Columbus, OH - Buckeye Yard	Columbus
Principal Port	CA	Commerce, CA	Commerce
Principal Port	IA	Council Bluffs, IA	Council Bluffs
Principal Port	NJ	Croxton, NJ	Jersey City
Principal Port	TX	Dallas, TX - Mesquite	Mesquite
Principal Port	TX	Dallas, TX - Wilmer (Dallas Intermodal Terminal)	Wilmer
Principal Port	IL	Decatur, IL - ADM Intermodal Ramp (Midwest Inland Port)	Decatur
Principal Port	CO	Denver, CO	Denver
Principal Port	CO	Denver, CO - Irondale	Denver
Principal Port	MI	Detroit, MI	Detroit
Principal Port	MI	Detroit, MI - Delray	Detroit
Principal Port	MI	Detroit, MI - Detroit Intermodal Terminal	Detroit
Principal Port	MI	Detroit, MI - Livernois	Detroit
Principal Port	MI	Detroit, MI - Moterm Intermodal Facility (MOT)	Ferndale
Principal Port	TX	Donna, TX - Rio Valley	Donna
Principal Port	IL	Dupo, IL - St. Louis	Dupo
Principal Port	IL	East St. Louis, IL	East St. Louis
Principal Port	TX	El Paso, TX	El Paso
Principal Port	NJ	Erail, NJ	Elizabeth
Principal Port	GA	Fairburn, GA	Fairburn
Principal Port	FL	Fort Pierce, FL	Ft. Pierce
Principal Port	LA	General Cargo Dock	Shreveport

Principal Port	KY	Georgetown, KY	Georgetown
Principal Port	PA	Greencastle, PA - Franklin County Regional Intermodal Facility	Greencastle
Principal Port	NC	Greensboro, NC	Greensboro
Principal Port	PA	Harrisburg, PA	Harrisburg
Principal Port	TX	Houston, TX - Englewood (Wallisville Rd)	Houston
Principal Port	TX	Houston, TX - Kendleton	Beasley
Principal Port	TX	Houston, TX - Pearland	Houston
Principal Port	TX	Houston, TX - Settegast (Kirkpatrick, Blvd)	Houston
Principal Port	AL	Huntsville, AL	Huntsville
Principal Port	IN	Indianapolis, IN	Indianapolis
Principal Port	IN	Indianapolis, IN - Plainfield Intermodal Terminal	Avon
Principal Port	SC	Inland Port Dillon	Dillon
Principal Port	MS	Jackson, MS	Richland
Principal Port	FL	Jacksonville, FL	Jacksonville
Principal Port	FL	Jacksonville, FL - Fowden Intermodal Terminal	Jacksonville
Principal Port	IL	Joliet, IL	Joliet
Principal Port	KS	Kansas City - Logistics Park Kansas City (LPKC)	Edgerton
Principal Port	MO	Kansas City, MO	Kansas City
Principal Port	MO	Kansas City, MO - International Freight Gateway (IFG)	Kansas City
Principal Port	TX	Laredo, TX	Laredo
Principal Port	NV	Las Vegas, NV	Las Vegas
Principal Port	CA	Lathrop, CA	French Camp
Principal Port	NJ	Little Ferry, NJ	North Bergen
Principal Port	CA	Los Angeles, CA - City of Industry	City of Industry

Principal Port	CA	Los Angeles, CA - East Washington Blvd	City of Commerce
Principal Port	KY	Louisville, KY	Louisville
Principal Port	KY	Louisville, KY - Appliance Park	Louisville
Principal Port	KY	Louisville, KY - Buechel	Louisville
Principal Port	AR	Marion, AR	Marion
Principal Port	OH	Marion, OH - Ohio Valley Intermodal Facility	Marion
Principal Port	TN	Memphis, TN	Memphis
Principal Port	TN	Memphis, TN - Rossville	Rossville
Principal Port	FL	Miami, FL	Miami Springs
Principal Port	MN	Minneapolis, MN - Shoreham Yard	Minneapolis
Principal Port	PA	Morrisville, PA	East Langhorne
Principal Port	TN	Nashville, TN	Nashville
Principal Port	MS	Natchez - Adams County Port	Natchez
Principal Port	LA	New Orleans, LA	Avondale
Principal Port	LA	New Orleans, LA	New Orleans
Principal Port	LA	New Orleans, LA	Westwego
Principal Port	VA	Norfolk, VA - Portlock	Chesapeake
Principal Port	OH	North Baltimore, OH - Northwest Ohio ICTF	North Baltimore
Principal Port	NJ	North Bergen	
Principal Port	NE	Omaha, NE	Omaha
Principal Port	AZ	Phoenix, AZ - Glendale	Glendale
Principal Port	PA	Pittsburgh, PA	Wall
Principal Port	PA	Pittsburgh, PA - McKees Rocks	McKees Rocks
Principal Port	MS	Port Bienville	Bay St Louis
Principal Port	FL	Port Canaveral	Port Canaveral
Principal Port	FL	Port Everglades	Fort Lauderdale
Principal Port	TX	Port Freeport	Freeport

Principal Port	MS	Port Itawamba	Fulton
Principal Port	TX	Port Lavaca-Port Comfort	Point Comfort
Principal Port	AK	Port of Alaska in Anchorage	Anchorage
Principal Port	MD	Port of Baltimore	Baltimore
Principal Port	TX	Port of Beaumont	Beaumont
Principal Port	MA	Port of Boston	Charlestown
Principal Port	TX	Port of Brownsville	Brownsville
Principal Port	GA	Port of Brunswick	Brunswick
Principal Port	LA	Port of Caddo-Bossier	Shreveport
Principal Port	SC	Port of Charleston	Charleston
Principal Port	SC	Port of Charleston	Greer
Principal Port	SC	Port of Charleston	Mt. Pleasant
Principal Port	SC	Port of Charleston	North Charleston
Principal Port	TX	Port of Corpus Christi	Corpus Christi
Principal Port	MN	Port of Duluth-Superior	Duluth
Principal Port	FL	Port of Fernandina	Fernandina Beach
Principal Port	TX	Port of Freeport	Freeport
Principal Port	TX	Port of Galveston	Galveston
Principal Port	WA	Port of Grays Harbor	Aberdeen
Principal Port	MS	Port of Gulfport	Gulfport
Principal Port	HI	Port of Hawaii	Honolulu
Principal Port	HI	Port of Hawaii	Kahului
Principal Port	TX	Port of Houston	Houston
Principal Port	TX	Port of Houston	La Porte
Principal Port	TX	Port of Houston	Pasadena
Principal Port	CA	Port of Hueneme	Port Hueneme
Principal Port	FL	Port of Jacksonville	Jacksonville
Principal Port	CA	Port of Long Beach	Long Beach
Principal Port	CA	Port of Los Angeles	San Pedro
Principal Port	CA	Port of Los Angeles	Terminal Island
Principal Port	CA	Port of Los Angeles	Wilmington

Principal Port	CA	Port of Los Angeles/Long Beach	Long Beach
Principal Port	CA	Port of Los Angeles/Long Beach	Los Angeles
Principal Port	FL	Port of Miami	Miami
Principal Port	AL	Port of Mobile	Mobile
Principal Port	NC	Port of Morehead City (NC)	Morehead City
Principal Port	LA	Port of New Orleans	Harahan
Principal Port	LA	Port of New Orleans	New Orleans
Principal Port	NJ	Port of New York and New Jersey	Jersey City
Principal Port	NJ	Port of New York and New Jersey	Kearny
Principal Port	NJ	Port of New York and New Jersey	Newark
Principal Port	NJ	Port of New York and New Jersey	North Bergen
Principal Port	NJ	Port of New York and New Jersey	Port Elizabeth
Principal Port	NJ	Port of New York and New Jersey	Port Newark
Principal Port	NY	Port of New York and New Jersey	Staten Island
Principal Port	NJ	Port of NYNJ	Jersey City
Principal Port	NY	Port of NYNJ	Brooklyn
Principal Port	CA	Port of Oakland	Oakland
Principal Port	WA	Port of Olympia	Olympia
Principal Port	FL	Port of Palm Beach	Riviera Beach
Principal Port	PA	Port of Philadelphia	Philadelphia
Principal Port	TX	Port of Port Arthur	Port Arthur
Principal Port	OR	Port of Portland	Portland
Principal Port	OR	Port of Portland, OR	Portland
Principal Port	RI	Port of Providence	Providence
Principal Port	CA	Port of Richmond, CA	Richmond
Principal Port	CA	Port of San Diego	National City

Principal Port	CA	Port of San Francisco	San Francisco
Principal Port	GA	Port of Savannah	Garden City
Principal Port	GA	Port of Savannah	Savannah
Principal Port	WA	Port of Seattle	Seattle
Principal Port	WA	Port of Tacoma	Tacoma
Principal Port	WA	Port of Vancouver, WA	Vancouver
Principal Port	VA	Port of Virginia	Front Royal
Principal Port	VA	Port of Virginia	Newport News
Principal Port	VA	Port of Virginia	Norfolk
Principal Port	VA	Port of Virginia	Portsmouth
Principal Port	VA	Port of Virginia	Richmond
Principal Port	TX	Port of West Calhoun	Long Mott
Principal Port	NC	Port of Wilmington	Wilmington
Principal Port	DE	Port of Wilmington, DE	Wilmington
Principal Port	NC	Port of Wilmington, NC	Wilmington
Principal Port	FL	Port Panama City	Panama City
Principal Port	FL	Port Tampa Bay	Tampa
Principal Port	OR	Port Westward Industrial Park	Clatskanie
Principal Port	VA	Portsmouth, VA	Portsmouth
Principal Port	GA	Post of Savannah	Savannah
Principal Port	PA	Rutherford, PA	Harrisburg
Principal Port	UT	Salt Lake City, UT	Salt Lake City
Principal Port	TX	San Antonio, TX - SAIT	Von Ormy
Principal Port	CA	San Bernardino, CA	San Bernardino
Principal Port	NM	Santa Teresa, NM	Santa Teresa
Principal Port	GA	Savannah Gateway Industrial Hub	Rincon
Principal Port	GA	Savannah, GA	Savannah
Principal Port	NV	Sparks, NV	Sparks
Principal Port	WA	Spokane, WA	Spokane
Principal Port	MA	Springfield, MA	West Springfield

Principal Port	MO	St. Louis, MO	St. Louis
Principal Port	MO	St. Louis, MO - Lindenwood	St. Louis
Principal Port	MN	St. Paul, MN - Midway	St. Paul
Principal Port	MA	Stackbridge, MA	Worcester
Principal Port	CA	Stockton, CA	Stockton
Principal Port	NY	Syracuse, NY	Syracuse
Principal Port	PA	Taylor, PA	Taylor
Principal Port	OH	Toledo, OH	Toledo
Principal Port	AZ	Tucson, AZ	Tucson
Principal Port	MA	West Springfield	
Principal Port	FL	Winter Haven, FL - Central Florida Intermodal Logistics Center (CFILC)	Winter Haven
Principal Port	MA	Worcester, MA	Worcester
Principal Port	TX	Wylie, TX	Wylie
Principal Port	MS	Yellow Creek State Inland Port	Iuka
Principal Port	MA	Boston, MA	Boston
Principal Port	OH	Cincinnati-Northern KY, Ports of	Cincinnati
Principal Port	OH	Cleveland-Cuyahoga Port, OH	Cleveland
Principal Port	MN	Duluth-Superior, MN and WI	Duluth
Principal Port	IL	E Iowa and W Illinois, IA IL	Rock Island
Principal Port	WV	Huntington-Tristate, KY, OH, WV	Huntington
Principal Port	IL	Illinois International Port, IL	Chicago
Principal Port	IL	Illinois Waterway Ports, IL	Granite City
Principal Port	IN	Indiana (Northern District), IN	Burns Harbor
Principal Port	MS	Jackson County Port, MS	Pascagoula

Principal Port	LA	Lake Charles Harbor District, LA	Lake Charles
Principal Port	KY	Louisville-Jefferson Port, KY	Louisville
Principal Port	IL	Mid-America Port, IA, IL, and MO	Quincy
Principal Port	OH	Mid-Ohio Valley Port, OH and WV	Marietta
Principal Port	AL	Mobile, AL	Mobile
Principal Port	MO	New Bourbon Port Authority, MO	Perryville
Principal Port	CT	New Haven, CT	New Haven
Principal Port	NY	New York, NY & NJ	New York
Principal Port	LA	Plaquemines Port District, LA	Belle Chasse
Principal Port	LA	Port of Greater Baton Rouge, LA	Baton Rouge
Principal Port	WA	Port of Kalama, WA	Kalama
Principal Port	WA	Port of Longview, WA	Longview
Principal Port	PR	San Juan, PR	San Juan
Principal Port	NJ	South Jersey Port District, NJ	Camden
Principal Port	LA	South Louisiana, LA, Port of	Reserve
Principal Port	TX	Texas City, TX	Texas City
Principal Port	MN	Two Harbors, MN	Two Harbors
Principal Port	AK	Valdez, AK	Valdez
Truck Stop/Parking	AL	Grand Bay Welcome Center/I-10 EB/0.485	Grand Bay
Truck Stop/Parking	FL	NHS Rest Stop or Truck Facility 46/I-95S/106	Palm City
Truck Stop/Parking	FL	Okahumpka Service Plaza/Florida's Turnpike/299	Wildwood
Truck Stop/Parking	GA	Georgia Weigh Station Region 2 South(Franklin)/I-85S/170	Carnesville

Truck Stop/Parking	GA	Georgia Weigh Station Region 2 North (Franklin)/I-85N/171	Carnesville
Truck Stop/Parking	IN	Greenfield Rest Area Eastbound (I-70E, MM 107)/I-70E/107	Greenfield
Truck Stop/Parking	IN	Greenfield Rest Area Westbound (I-70W, MM 107)/I-70W/107	Greenfield
Truck Stop/Parking	IN	Centerville Welcome Center Westbound (I-70W, MM 143)/I-70W/143	Centerville
Truck Stop/Parking	IN	Pipe Creek Rest Area Northbound (I-69N, MM251)/I-69N/251	NA
Truck Stop/Parking	IN	Pipe Creek Rest Area Southbound (I-69S, MM251)/I-69S/251	NA
Truck Stop/Parking	IN	Auburn Rest Area Northbound (I-69N, MM 325)/I-69N/325	Auburn
Truck Stop/Parking	KY	I-65 North Hart County Rest Area/I-65N/60	NA
Truck Stop/Parking	KY	I-65 South Hart County Rest Area/I-65S/60	NA
Truck Stop/Parking	ME	NHS Rest Stop or Truck Facility 9/I-95 N/NA	Kittery
Truck Stop/Parking	MO	Conway EB (WC)/I-44E/109	Conway
Truck Stop/Parking	MO	Conway WB (WC)/I-44W/109	Conway
Truck Stop/Parking	NJ	Molly Pitcher/I-95 SB/71.7	Cranbury
Truck Stop/Parking	NJ	Vince Lombardi/I-95 NB/SB/MP 115.9	Ridgefield
Truck Stop/Parking	OH	Ohio Turnpike Plaza/I-80E/I-90E/NA	Freedom
Truck Stop/Parking	OH	Ohio Turnpike Plaza/I-80W/I-90W/NA	Freedom
Truck Stop/Parking	OH	Ohio Turnpike Plaza/I-80E/I-90E/NA	Broadway Heights

Truck Stop/Parking	OH	Ohio Turnpike Plaza/I-80W-90W/NA	Broadway Heights
Truck Stop/Parking	OH	Ohio Turnpike Plaza/I-80W-90W/NA	Amherst
Truck Stop/Parking	OH	Ohio Turnpike Plaza/I-80E/I-90E/NA	Amherst
Truck Stop/Parking	OH	Ohio Turnpike Plaza/I-80E/I-90E/MP 21	West Unity
Truck Stop/Parking	OH	Ohio Turnpike Plaza/I-80W-90W/MP 21	West Unity
Truck Stop/Parking	PA	NHS Rest Stop or Truck Facility 64/I-76 E - PTC Mainline/MP 112.3	Somerset Twp
Truck Stop/Parking	PA	NHS Rest Stop or Truck Facility 58/I-70 & I-76 W - PTC Mainline/MP 112.3	Somerset Twp
Truck Stop/Parking	PA	NHS Rest Stop or Truck Facility 56/I-70 & I-76 W - PTC Mainline/MP 77.6	Hempfield Twp
Truck Stop/Parking	PA	NHS Rest Stop or Truck Facility 49/I-476 N & S - PTC NE Ext./MP 55.9	Upper & Lower Macungie Twp
Truck Stop/Parking	PA	NHS Rest Stop or Truck Facility 52/I-476 N & S - PTC NE Ext./MP 86.1	Penn Forest Twp
Truck Stop/Parking	WV	Morton Travel Plaza/I-77/MP 18	Summersville
Truck Stop/Parking	WV	Tamarack/I77/MP 45	Beckley
Truck Stop/Parking	WY	Fort Bridger Truck parking area/I-80/MM 34	NA
Truck Stop/Parking	OK	EZ Go WB EB/I-44 EB WB	
Truck Stop/Parking	OH	Ohio Turnpike Mahoning Valley Service Plaza/I-76W	
Truck Stop/Parking	OH	Ohio Turnpike Glacier Hills Service Plaza/I-76E	
Truck Stop/Parking	KS	Lawrence Service Area/I-70 EB & WB	
Truck Stop/Parking	IN	Truck parking Rest Area/I-90WB	

Truck Stop/Parking	IN	Truck parking Rest Area/I-90EB	
Truck Stop/Parking	IN	Truck parking Rest Area/I-90EB	
Truck Stop/Parking	IN	Truck parking Rest Area/I-90WB	
Truck Stop/Parking	AR	Love's Travel Stop, 116 Ron Harrod Rd	Prescott
Truck Stop/Parking	CA	Love's Travel Stop, 2700 S. Blackstone St.	Tulare
Truck Stop/Parking	CO	Love's Travel Stop, 1191 S. 1st Street	Bennett
Truck Stop/Parking	FL	Love's Travel Stop, 1800 Highway 559	Auburndale
Truck Stop/Parking	IA	Love's Travel Stop, 11820 Hickman Road	Clive
Truck Stop/Parking	IL	Love's Travel Stop, 203 N Haughton Hwy	Greenup
Truck Stop/Parking	IL	Love's Travel Stop, 201 Love's Crossing	Hampshire
Truck Stop/Parking	IN	Love's Travel Stop, 3150 Grant St	Gary
Truck Stop/Parking	IN	Love's Travel Stop, 13615 Blue Lick Rd.	Memphis
Truck Stop/Parking	KY	Love's Travel Stop, 4000 L&N Turnpike	Horse Cave
Truck Stop/Parking	LA	Love's Travel Stop, 9600 Highway 80 W	Greenwood
Truck Stop/Parking	NM	Love's Travel Stop, 1900 Mountain Rd.	Tucumcari
Truck Stop/Parking	TN	Love's Travel Stop, 260 TVA Road,	Jasper
Truck Stop/Parking	TX	Love's Travel Stop, 1703 I-10	Baytown
Truck Stop/Parking	TX	Love's Travel Stop, 210 Patton St.	Houston
Truck Stop/Parking	TX	Love's Travel Stop, 1901 W. I-20	Odessa
Truck Stop/Parking	TX	Love's Travel Stop, 1610 Cotton Gin Rd	Troy

Truck Stop/Parking	OH	Pilot Travel Center, 2246 OH-45	Austinburg
Truck Stop/Parking	OH	Pilot Travel Center, 1150 North Canfield-Niles Road	Austintown
Truck Stop/Parking	OH	Pilot Travel Center, 6830 Franklin-Lebanon Road	Franklin
Truck Stop/Parking	OH	Pilot Travel Center, 8924 Lake Road	Seville
Truck Stop/Parking	MI	Pilot Travel Center, 6158 US-223	Ottawa Lake
Truck Stop/Parking	IN	Pilot Travel Center, 2640 North 600 West	Greenfield
Truck Stop/Parking	WI	Pilot Travel Center, 2031 West Ryan Road	Oak Creek
Truck Stop/Parking	IA	Pilot Travel Center, 3500 North Plainview Road	Walcott
Truck Stop/Parking	MO	Pilot Travel Center, 1701 Ashley Road	Boonville
Truck Stop/Parking	KY	Pilot Travel Center, 8190 Pembroke-Oak Grove Road	Oak Grove
Truck Stop/Parking	KY	Pilot Travel Center, 489 Pendleton Road	Sulphur
Truck Stop/Parking	TN	Pilot Travel Center, 15559 Highway 13 South	Hurricane Mills
Truck Stop/Parking	LA	Pilot Dealer, 4301 South Main Street	Laplace
Truck Stop/Parking	GA	Pilot Travel Center, 4431 Union Road	Tifton
Truck Stop/Parking	CT	Pilot Travel Center, 433 Old Gate Lane	Milford
Truck Stop/Parking	GA	Pilot Travel Center, 2965 Highway 247C	Byron
Truck Stop/Parking	IN	Pilot Travel Center, 2501 Burr Street	Gary
Truck Stop/Parking	NM	Flying J, 1 Giant Crossing Po Box 960	Jamestown
Truck Stop/Parking	IL	Pilot Travel Center, 699 State Route 203	East St. Louis

Truck Stop/Parking	KY	Pilot Travel Center, 110 Triport Road	Georgetown
Truck Stop/Parking	IA	Pilot Travel Center, 11957 Douglas Avenue	Des Moines
Truck Stop/Parking	CA	Pilot Travel Center, 8701 Highway 395	Hesperia
Truck Stop/Parking	TN	Pilot Travel Center, 921 Murfreesboro Rd	Lebanon
Truck Stop/Parking	GA	Pilot Travel Center, 319 Deer Head Cove Road	Rising Fawn
Truck Stop/Parking	AR	Pilot Travel Center, 1100 Martin Luther King Boulevard	West Memphis
Truck Stop/Parking	TX	Pilot Travel Center, 8055 South I-35	Robinson
Truck Stop/Parking	TX	Pilot Travel Center, 8787 South Lancaster Road	Dallas
Truck Stop/Parking	TX	Pilot Travel Center, 2400 Alliance Gateway Fwy.	Fort Worth
Truck Stop/Parking	KY	Pilot Travel Center, 2940 Scottsville Road	Franklin
Truck Stop/Parking	AZ	Pilot Travel Center, 619 South Sunshine Boulevard	Eloy
Truck Stop/Parking	AZ	Pilot Travel Center, 900 North 99Th Avenue	Avondale
Truck Stop/Parking	PA	Flying J, 2210 Camp Swatara Road	Frystown
Truck Stop/Parking	PA	Pilot Dealer, 482 Suedberg Road	Pine Grove
Truck Stop/Parking	NC	Flying J US Dealer, 125 Plaza Lane	Mount Airy
Truck Stop/Parking	GA	Pilot Travel Center, 491 St. Mary's Road	St. Mary's
Truck Stop/Parking	AL	Flying J, 6098 Macashan Dr	Mccalla
Truck Stop/Parking	AL	Flying J, 224 Daniel Payne Drive	Birmingham
Truck Stop/Parking	AL	Flying J, 2190 Ross Clark Circle	Dothan

Truck Stop/Parking	AL	Flying J, 900 Tyson Road	Hope Hull
Truck Stop/Parking	AR	Flying J, 42 Bradley Cove Road	Russellville
Truck Stop/Parking	AR	Flying J, 3400 Service Loop Road	West Memphis
Truck Stop/Parking	AZ	Flying J, 14190 Flying J" Rd. Box 801"	Ehrenberg
Truck Stop/Parking	AZ	Flying J, 16189 S Sunshine Blvd	Eloy
Truck Stop/Parking	AZ	Flying J, 6700 West Latham Street	Phoenix
Truck Stop/Parking	CA	Flying J, 17047 Zachary Ave	Bakersfield
Truck Stop/Parking	CA	Flying J, 2611 Fisher Blvd.	Barstow
Truck Stop/Parking	CA	Flying J, 42810 Frazier Mountain Park Rd	Lebec
Truck Stop/Parking	CA	Flying J, 15100 North Thornton Rd	Lodi
Truck Stop/Parking	CA	Flying J, 1501 North Jack Tone Road	Ripon
Truck Stop/Parking	CO	Flying J, 16751 East 32nd Ave	Aurora
Truck Stop/Parking	CO	Flying J, 2495 Williams Ave	Limon
Truck Stop/Parking	FL	Flying J, 100 North Kings Hwy	Fort Pierce
Truck Stop/Parking	FL	Flying J, 32670 Blue Star Hwy	Midway
Truck Stop/Parking	FL	Flying J, 29933 State Road 52	Dade City
Truck Stop/Parking	FL	Flying J, 950 State Road 206 West	St. Augustine
Truck Stop/Parking	GA	Flying J, 2990 US Hwy 17 South	Brunswick
Truck Stop/Parking	GA	Flying J, 10226 Old Federal Road	Carnesville
Truck Stop/Parking	GA	Flying J, 1125 Bucksnort Road	Jackson

Truck Stop/Parking	GA	Flying J, 7001 Lake Park Bellville Road	Lake Park
Truck Stop/Parking	GA	Flying J, 288 Resaca Beach Blvd	Resaca
Truck Stop/Parking	GA	Flying J, 3600 Highway 77 South	Union Point
Truck Stop/Parking	GA	Flying J, 650 Carrollton Street	Temple
Truck Stop/Parking	IA	Flying J, 8200 N.W. Blvd.	Davenport
Truck Stop/Parking	IL	Flying J, 140 Racehorse Dr.	Alorton
Truck Stop/Parking	IL	Flying J, 1701 W Evergreen Avenue	Effingham
Truck Stop/Parking	IL	Flying J, 343 Civic Road	LaSalle
Truck Stop/Parking	IL	Flying J, 1310 East Chain of Rocks Road	Pontoon Beach
Truck Stop/Parking	IL	Flying J, 16049 Willowbrook Road	South Beloit
Truck Stop/Parking	IN	Flying J, 1401 Ripley Street	Lake Station
Truck Stop/Parking	IN	Flying J, 520 South State Road 39	Lebanon
Truck Stop/Parking	IN	Flying J, 3231 East 181st Avenue	Hebron
Truck Stop/Parking	IN	Flying J, 5300 South State Rte. 3	Spiceland
Truck Stop/Parking	IN	Flying J, 82 White Street	Whiteland
Truck Stop/Parking	KY	Flying J, 15236 State Route 180	Catlettsburg
Truck Stop/Parking	KY	Flying J, 4380 Nashville Road	Franklin
Truck Stop/Parking	KY	Flying J, 13019 Walton Verona Rd	Walton
Truck Stop/Parking	LA	Flying J, 9510 Greenwood Road	Greenwood
Truck Stop/Parking	MO	Flying J, 11570 Hwy Ff	Joplin
Truck Stop/Parking	MO	Flying J, 703 State Hwy 80	Matthews
Truck Stop/Parking	MO	Flying J, 700 J Hwy	Peculiar

Truck Stop/Parking	MO	Flying J, 825 North Loop Road	Sullivan
Truck Stop/Parking	MO	Flying J, 1 Campbranch Rd	Warrenton
Truck Stop/Parking	MS	Flying J, 9351 Canal Road	Gulfport
Truck Stop/Parking	MS	Flying J, 685 Highway 80 East	Pearl
Truck Stop/Parking	NC	Flying J, 1043 Jimmie Kerr Rd	Graham
Truck Stop/Parking	NC	Flying J, 1800 Princeton-Kenly Road	Kenly
Truck Stop/Parking	ND	Flying J, 3150 39th St SW Suite A	Fargo
Truck Stop/Parking	NE	Flying J, 15010 South State Hwy 31	Gretna
Truck Stop/Parking	NJ	Flying J, 326 Slapes Corner	Carneys Point
Truck Stop/Parking	NM	Flying J, 9911 Avalon Road Nw	Albuquerque
Truck Stop/Parking	NM	Flying J, 11 Old Hwy 70	Lordsburg
Truck Stop/Parking	NV	Flying J, 156 Hwy 93 South	Wells
Truck Stop/Parking	NY	Flying J, 8484 Allegheny Road	Pembroke
Truck Stop/Parking	OH	Flying J, 2349 Center Road	Austinburg
Truck Stop/Parking	OH	Flying J, 420 East Main Street	Beaverdam
Truck Stop/Parking	OH	Flying J, 7735 East State Rt 37	Berkshire
Truck Stop/Parking	OH	Flying J, 2226 North Main Street	Hubbard
Truck Stop/Parking	OH	Flying J, 9935 Sr 41	Jeffersonville
Truck Stop/Parking	OH	Flying J, 10480 Baltimore	Millersport
Truck Stop/Parking	OH	Flying J, 26415 Warns Road	Lake Township
Truck Stop/Parking	OK	Flying J, 1255 Gentry	Checotah

Truck Stop/Parking	OK	Flying J, 701 South Morgan Road	Oklahoma City
Truck Stop/Parking	OK	Flying J, 2400 So 4th Route	Sayre
Truck Stop/Parking	PA	Flying J, 1501 Harrisburg Pike	Carlisle
Truck Stop/Parking	PA	Flying J, 5609 Nittany Valley Drive	Mill Hall
Truck Stop/Parking	SC	Flying J, 1011 North Mountain St	Blacksburg
Truck Stop/Parking	SC	Flying J, 5901 Fairfield Road	Columbia
Truck Stop/Parking	SC	Flying J, 111 Mill Branch Road	Latta
Truck Stop/Parking	SD	Flying J, 5201 Granite Lane	Sioux Falls
Truck Stop/Parking	TN	Flying J, 1420 Hwy 96 North	Fairview
Truck Stop/Parking	TN	Flying J, 800 Watt Road	Knoxville
Truck Stop/Parking	TX	Flying J, 9601 I-40 E Exit 76	Amarillo
Truck Stop/Parking	TX	Flying J, 3001 Mountain Pass Blvd	Anthony
Truck Stop/Parking	TX	Flying J, 1876 East Freeway	Baytown
Truck Stop/Parking	TX	Flying J, 7425 Bonnie View Road	Dallas
Truck Stop/Parking	TX	Flying J, 1305 East Monte Cristo Road	Edinburg
Truck Stop/Parking	TX	Flying J, 15919 North Freeway	Houston
Truck Stop/Parking	TX	Flying J, 1011 Beltway Parkway	Laredo
Truck Stop/Parking	TX	Flying J, 23412 Hwy 242	New Caney
Truck Stop/Parking	TX	Flying J, 7112 I-10 West	Orange
Truck Stop/Parking	TX	Flying J, 100 E Pinehurst	Pecos
Truck Stop/Parking	TX	Flying J, I-20 Exit 277 101 N FM 707	Tye

Truck Stop/Parking	TX	Flying J, 2409 So New Road	Waco
Truck Stop/Parking	VA	Flying J, 24279 Rogers Clark Blvd.	Carmel Church
Truck Stop/Parking	VA	Flying J, 139 Factory Outlet Drive	Fort Chiswell
Truck Stop/Parking	VA	Flying J, 3249 Chapman Road	Wytheville
Truck Stop/Parking	WI	Flying J, 780 State Hwy 54	Black River Falls
Truck Stop/Parking	WY	Flying J, 2250 Etchepare Drive	Cheyenne
Truck Stop/Parking	WY	Flying J, I-80 Johnson Road	Rawlins
Truck Stop/Parking	MD	Flying J, 1 Center Drive	Northeast
Truck Stop/Parking	MD	Flying J, 221 Belle Hill Road	Elkton
Truck Stop/Parking	VA	Flying J, 23866 Rogers Clark Blvd.	Ruther Glen
Truck Stop/Parking	CA	Pilot Dealer, 2828 El Centro Road	Sacramento
Truck Stop/Parking	IN	Pilot Dealer, 3037 Goshen Road	Fort Wayne
Truck Stop/Parking	IL	Flying J US Dealer, 101 South 45th Street	Mt. Vernon
Truck Stop/Parking	IA	Pilot Dealer, 7005 North Chestnut Street	Avoca
Truck Stop/Parking	MI	Flying J, 21055 West Road	Woodhaven
Truck Stop/Parking	VA	Pilot Dealer, 918 West Atlantic	Emporia
Truck Stop/Parking	NC	Pilot Dealer, 65 Sadler Road	Dunn
Truck Stop/Parking	NE	Bosselman, 3335 West Wood River Road	Grand Island
Truck Stop/Parking	KS	Pilot Travel Center, 1944 N. 9Th Street	Salina
Truck Stop/Parking	NE	Flying J, 109 Circle Road	Big Springs
Truck Stop/Parking	MT	Town Pump, 602 8Th Avenue North	Columbus

Truck Stop/Parking	MT	Town Pump, 1000 Grizzly Trail	Rocker
Truck Stop/Parking	IA	Flying J, 3231 Adventureland Drive	Altoona (Des Moines Area)
Truck Stop/Parking	MT	Town Pump, 2711 N. Frontage Road	Billings
Truck Stop/Parking	NV	Flying J, 480 Truck Inn Way	Fernley
Truck Stop/Parking	MT	Town Pump, 73 Highway 16	Glendive
Truck Stop/Parking	AZ	Pilot Dealer, 942 E Pima St	Gila Bend
Truck Stop/Parking	AZ	Pilot Dealer, 1851 State Highway 77	Holbrook
Truck Stop/Parking	SC	Pilot Dealer, 175 Truck Stop Rd	Cowpens
Truck Stop/Parking	GA	Pilot Travel Center, 2995 GA-36	Jackson
Truck Stop/Parking	VA	Pilot Travel Center, 1318 East Lee Highway	Wytheville
Truck Stop/Parking	VA	Pilot Travel Center, 1014 Mt. Olive Road	Tom's Brook
Truck Stop/Parking	VA	Pilot Travel Center, 713 Oakland Circle	Raphine
Truck Stop/Parking	VA	TA Ashland, 100 North Carter Rd	Ashland
Truck Stop/Parking	NC	TA Greensboro, 1101 NC Highway 61	Whitsett
Truck Stop/Parking	PA	TA Brookville, 245 Allegheny Blvd.	Brookville
Truck Stop/Parking	NJ	TA Columbia, 2 Simpson Road	Columbia
Truck Stop/Parking	AZ	TA Eloy, 2949 North Toltec Road	Eloy
Truck Stop/Parking	IN	TA Gary, 2510 Burr St.	Gary
Truck Stop/Parking	OH	TA Dayton, 6762 US Rte 127	Eaton
Truck Stop/Parking	PA	TA Harrisburg, 7848 Linglestown Road	Harrisburg

Truck Stop/Parking	NM	TA Las Cruces, 202 N. Motel Blvd	Las Cruces
Truck Stop/Parking	OH	TA Lodi, 8834 Lake Road	Seville
Truck Stop/Parking	AL	TA Tuscaloosa, 3501 Buttermilk Road	Tuscaloosa
Truck Stop/Parking	TX	TA Baytown, 6800 Thompson Road	Baytown
Truck Stop/Parking	MD	TA Elkton, 1400 Elkton Road	Elkton
Truck Stop/Parking	CT	TA Willington, 327 Ruby Road	Willington
Truck Stop/Parking	SC	TA Spartanburg, 1402 East Main St.	Duncan
Truck Stop/Parking	CA	Petro Ontario, 4325 E. Guasti Rd.	Ontario
Truck Stop/Parking	OH	TA Kingsville, 5551 St Rt 193	Kingsville
Truck Stop/Parking	IL	TA Chicago North, 16650 W. Russell Road	Zion
Truck Stop/Parking	WV	TA Wheeling, 270 W. Alexander Road	Valley Grove
Truck Stop/Parking	OK	TA Oklahoma City East, 801 South Council Road	Oklahoma City
Truck Stop/Parking	CA	TA Corning, 3524 South Highway 99 W	Corning
Truck Stop/Parking	CA	TA Coachella, 46155 Dillon Road	Coachella
Truck Stop/Parking	FL	TA Wildwood, 556 St. Rt. 44	Wildwood
Truck Stop/Parking	TX	TA Amarillo, 7000 E. Interstate 40	Amarillo
Truck Stop/Parking	OR	TA Aurora, 21856 Bents Road NE	Aurora
Truck Stop/Parking	CA	TA Redding, 19483 Knighton Road	Redding
Truck Stop/Parking	UT	TA Tooele, 8836 North Highway 40	Salt Lake City
Truck Stop/Parking	IN	TA Seymour, 2636 E. Tipton St.	Seymour

Truck Stop/Parking	PA	TA Lamar, 5600 Nittany Valley Drive	Lamar
Truck Stop/Parking	MI	TA Monroe, 1255 N Dixie Hwy	Monroe
Truck Stop/Parking	MO	TA Mt. Vernon, 1000 E. Mt. Vernon Blvd.	Mt.Vernon
Truck Stop/Parking	PA	TA Breezewood, 16567 Lincoln Highway	Breezewood
Truck Stop/Parking	IA	TA Walcott, 755 W. Iowa 80 Road	Walcott
Truck Stop/Parking	OR	TA Coburg, 32910 E. Pearl St.	Coburg
Truck Stop/Parking	NM	TA Albuquerque, 2501 University Blvd., NE	Albuquerque
Truck Stop/Parking	OH	TA Toledo, 3483 Libbey Road	Perrysburg
Truck Stop/Parking	MI	TA Ann Arbor, 200 Baker Road	Dexter
Truck Stop/Parking	KS	TA Oakley, 1001 Hwy 40	Oakley
Truck Stop/Parking	IL	TA Bloomington, 505 Truckers Lane	Bloomington
Truck Stop/Parking	MI	TA Sawyer, 6100 Sawyer Road	Sawyer
Truck Stop/Parking	VA	TA Richmond, 10134 Lewistown Road	Ashland
Truck Stop/Parking	GA	TA Cartersville, 981 Cassville-White Road	Cartersville
Truck Stop/Parking	TX	TA San Antonio, 6170 I-10 East	San Antonio
Truck Stop/Parking	CO	TA Commerce City, 5101 Quebec Street	Commerce City
Truck Stop/Parking	MD	TA Baltimore South, 7401 Assateague Drive	Jessup
Truck Stop/Parking	TX	TA Laredo, 1010 Beltway Parkway	Laredo
Truck Stop/Parking	CA	TA Buttonwillow, 27769 Lagoon Drive	Buttonwillow
Truck Stop/Parking	CA	TA Ontario, 4265 East Guasti Road	Ontario

Truck Stop/Parking	CA	TA Santa Nella, 12310 South Highway 33	Santa Nella
Truck Stop/Parking	ID	TA Boise, 4115 Broadway Ave	Boise
Truck Stop/Parking	NV	TA Sparks, 200 North McCarren	Sparks
Truck Stop/Parking	IN	TA Whitestown, 5930 East State Road 334	Whitestown
Truck Stop/Parking	GA	TA Savannah, 4401 Hwy. 17	Richmond Hill
Truck Stop/Parking	NV	TA Mill City, 6000 E. Frontage Road	Mill City
Truck Stop/Parking	OR	TA Troutdale, 790 N W Frontage Road	Troutdale
Truck Stop/Parking	WY	TA Ft. Bridger, I-80 at Bigelow Road, Exit 30	Ft. Bridger
Truck Stop/Parking	FL	TA Vero Beach, 8909 20th Street	Vero Beach
Truck Stop/Parking	TN	TA Davy Crockett Travel Center, 195 Van Hill Road	Greeneville
Truck Stop/Parking	NY	TA Maybrook, 125 Neelytown Road	Montgomery
Truck Stop/Parking	PA	TA Bloomsburg, 6 Buckhorn Road	Bloomsburg
Truck Stop/Parking	PA	TA Greencastle, 10835 John Wayne Drive	Greencastle
Truck Stop/Parking	PA	TA Harborcreek, 4050 Depot Road	Erie
Truck Stop/Parking	MD	TA Baltimore, 5501 O'Donnell Street	Baltimore
Truck Stop/Parking	NJ	TA Paulsboro, 171 Berkley Road	Paulsboro
Truck Stop/Parking	IN	TA Lake Station, 1201 Ripley Street	Lake Station
Truck Stop/Parking	IN	TA Porter, 1600 West US Hwy 20	Porter
Truck Stop/Parking	AR	TA Prescott, 1806 Hwy 371 West	Prescott

Truck Stop/Parking	AZ	TA Tonopah, 1010 N. 339th Avenue	Tonopah
Truck Stop/Parking	AZ	TA Willcox, 1501 North Fort Grant Road	Willcox
Truck Stop/Parking	CA	TA Barstow, 2930 Lenwood Road	Barstow
Truck Stop/Parking	NM	TA Moriarty, 1700 U.S. Route 66 West	Moriarty
Truck Stop/Parking	TX	TA New Braunfels, 4817 I-35 North	New Braunfels
Truck Stop/Parking	TX	TA Terrell, 1700 Wilson Road	Terrell
Truck Stop/Parking	WY	TA Rawlins, 1400 Higley Blvd., Exit 214	Rawlins
Truck Stop/Parking	IL	TA Morris, 21 Romines Drive	Morris
Truck Stop/Parking	LA	TA Greenwood, 8560 Greenwood Rd	Greenwood
Truck Stop/Parking	CA	TA Wheeler Ridge, 5552 Wheeler Ridge Road	Arvin
Truck Stop/Parking	MI	TA Battle Creek, 15874 Eleven Mile Rd.	Battle Creek
Truck Stop/Parking	KS	TA Beto Junction, 2775 Highway 75	Lebo
Truck Stop/Parking	RI	TA West Greenwich, 849 Victory Hwy West	West Greenwich
Truck Stop/Parking	MT	TA Missoula, 8018 Hwy 93 N	Missoula
Truck Stop/Parking	TN	TA Knoxville West, 615 Watt Road	Knoxville
Truck Stop/Parking	OR	TA Huntington, 5945 US Hwy 30	Huntington
Truck Stop/Parking	FL	TA Lake City, 14197 South US HWY 441	Lake City
Truck Stop/Parking	TX	Petro El Paso, 1295 Horizon Blvd.	El Paso
Truck Stop/Parking	TX	Petro Weatherford, 2001 Santa Fe Dr	Weatherford
Truck Stop/Parking	WY	Petro Laramie, 1855 West Curtis	Laramie

Truck Stop/Parking	TX	Petro Beaumont, 5405 Walden Rd	Beaumont
Truck Stop/Parking	TX	Petro San Antonio, 1112 Ackerman Road	San Antonio
Truck Stop/Parking	AZ	Petro Eloy, 5235 N. Sunland Gin Rd.	Casa Grande
Truck Stop/Parking	TX	Petro Amarillo, 8500 E I-40 @ Lakeside Drive	Amarillo
Truck Stop/Parking	LA	Petro Shreveport, 6910 W. Bert Kouns Industrial Loop	Shreveport
Truck Stop/Parking	LA	Petro Hammond, 2100 S.W. Railroad Ave.	Hammond
Truck Stop/Parking	AR	Petro W. Memphis, 3900 Petro Road	West Memphis
Truck Stop/Parking	TN	Petro Knoxville, 722 Watt Road	Knoxville
Truck Stop/Parking	NM	Petro Milan, 1430 Motel Drive	Milan
Truck Stop/Parking	NJ	Petro Bordentown, 402 Rising Sun Square Road	Bordentown
Truck Stop/Parking	AZ	Petro Kingman, 970 South Blake Ranch Road	Kingman
Truck Stop/Parking	OK	Petro Oklahoma City, 20 Martin Luther King Blvd	Oklahoma City
Truck Stop/Parking	OH	Petro Perrysburg, 26416 Baker Rd.	Perrysburg
Truck Stop/Parking	MO	Petro Kingdom City, 3304 Gold Road	Kingdom City
Truck Stop/Parking	AL	Petro Bucksville, 22526 Highway 216	McCalla
Truck Stop/Parking	OH	Petro Girard, 1 Petro Place	Girard
Truck Stop/Parking	IL	Petro Effingham, 1805 West Fayette Ave	Effingham
Truck Stop/Parking	GA	Petro Atlanta, 3181 Donald Lee Hollowell Pkwy.	Atlanta
Truck Stop/Parking	FL	Petro Ocala, 7401 West Hwy 318	Reddick

Truck Stop/Parking	OH	Petro North Baltimore, 12906 Deshler Rd.	North Baltimore
Truck Stop/Parking	AR	Petro N. Little Rock, 3205 Valentine Road	North Little Rock
Truck Stop/Parking	CA	Petro Wheeler Ridge, 5821 Dennis McCarthy Dr.	Lebec
Truck Stop/Parking	MS	Petro Jackson, 970 I-20 W. Frontage Rd.	Jackson
Truck Stop/Parking	NC	Petro Mebane, 500 Buckhorn Road	Mebane
Truck Stop/Parking	KY	Petro Glendale, 554 W. Glendale Hodgenville Road	Glendale
Truck Stop/Parking	NV	Petro North Las Vegas, 6595 North Hollywood Blvd	North Las Vegas
Truck Stop/Parking	TX	TA Hillsboro, 160 State Hwy 77	Hillsboro
Truck Stop/Parking	PA	Petro Carlisle, 1201 Harrisburg Ave, Route 11	Carlisle
Truck Stop/Parking	NV	Petro Sparks, 1950 East Greg St.	Sparks
Truck Stop/Parking	WA	Petro Spokane, 10506 West Aero Road	Spokane
Truck Stop/Parking	IN	Petro Angola, 7265 North Baker Road	Fremont
Truck Stop/Parking	AL	Petro Gadsden, 1724 West Grand Avenue	Gadsden
Truck Stop/Parking	MO	Petro Joplin, 4240 Highway 43	Joplin
Truck Stop/Parking	OH	Petro New Paris, 9787 US Route 40 West	New Paris
Truck Stop/Parking	IL	Petro Rochelle, 900 Petro Drive	Rochelle
Truck Stop/Parking	ND	Petro Fargo, 4510 19th Ave S.W.	Fargo
Truck Stop/Parking	NE	Petro York, 4700 S. Lincoln Ave.	York
Truck Stop/Parking	WI	Petro Racine, 717 South Sylvania Ave	Sturtevant

Truck Stop/Parking	IN	Petro Gary, 3001 Grant Street	Gary
Truck Stop/Parking	NY	Petro Waterloo, 1255 Route 414	Waterloo
Truck Stop/Parking	VA	Petro Glade Spring, 12433 Maple St.	Glade Spring
Truck Stop/Parking	GA	Petro Carnesville, 10200 Old Federal Rd.	Carnesville
Truck Stop/Parking	PA	Petro Scranton, 98 Grove St.	DuPont
Truck Stop/Parking	IN	Petro Gaston, 14000 West State Road 28	Gaston
Truck Stop/Parking	IN	Petro Remington, 4230 West Highway 24	Remington
Truck Stop/Parking	NM	Petro Deming, 14150 Hwy 418 SW	Deming
Truck Stop/Parking	MN	Petro Clearwater, 950 State Highway 24	Clearwater
Truck Stop/Parking	NV	Petro Wells, 1440 6th Street	Wells
Truck Stop/Parking	SC	Petro Florence, 3001 TV Rd.	Florence
Truck Stop/Parking	TX	Petro Pearsall, 110 S. I-35 Frontage Rd.	Pearsall
Truck Stop/Parking	NC	Petro Kenly, 923 Johnston Pkwy.	Kenly
Truck Stop/Parking	AL	Petro Dodge City, 426 Alabama Highway 69 S	Hanceville
Truck Stop/Parking	MN	Petro Albert Lea, 820 Happy Trails Lane	Albert Lea
Truck Stop/Parking	IL	Petro Wilmington, 24225 W. Lorenzo Road	Wilmington
Truck Stop/Parking	WI	Petro Portage, North 5800 Kinney Rd.	Portage
Truck Stop/Parking	VA	Petro Raphine, 2440 Raphine Road	Raphine
Truck Stop/Parking	VA	TA Lexington, 2516 N. Lee Highway	Lexington
Truck Stop/Parking	WI	TA Express Osseo, 12613 Gunderson Road	Osseo

Truck Stop/Parking	MO	Petro Oak Grove, 301 SW First Street	Oak Grove
Truck Stop/Parking	MO	TA Cuba, 5922 MO - 19	Cuba
Truck Stop/Parking	MO	TA Mt. Vernon, 1501 East Mt. Vernon Blvd	Mt Vernon
Truck Stop/Parking	KS	TA Garden City, 1265 Solar Avenue	Garden City

Appendix D: List of Zero-Emission Freight Corridors in Phase 1

State	Road Name	Route Sign	County Name	Description
AL	I 20	I 20	CALHOUN	Interstate Highway
AL	I 20	I 20	CLEBURNE	Interstate Highway
AL	I 20	I 20	ST. CLAIR	Interstate Highway
AL	I 20	I 20	TALLADEGA	Interstate Highway
AZ	I 10	I 10	LA PAZ	Interstate Highway
AZ	I 10	I 10	LA PAZ	Interstate Highway
AZ	I 10	I 10	MARICOPA	Interstate Highway
AZ	I 10	I 10	MARICOPA	Interstate Highway
AZ	I 10	I 10	PIMA	Interstate Highway
AZ	I 10	I 10	PIMA	Interstate Highway
AZ	I 10	I 10	PINAL	Interstate Highway
AZ	I 10	I 10	PINAL	Interstate Highway
AZ	I 17	I 17	MARICOPA	Interstate Highway
AZ	I 19	I 19	PIMA	Interstate Highway
AZ	SR 51	SR 51	MARICOPA	Other Controlled Access Highway
CA	SANTA MONICA FWY	I 10	LOS ANGELES	Interstate Highway
CA	I 10	I 10	LOS ANGELES	Interstate Highway
CA	I 10	I 10	RIVERSIDE	Interstate Highway
CA	I 10	I 10	RIVERSIDE	Interstate Highway
CA	I 10	I 10	SAN BERNARDINO	Interstate Highway
CA	I 105	I 105	LOS ANGELES	Interstate Highway
CA	HARBOR FREEWAY	I 110	LOS ANGELES	Interstate Highway
CA	I 15	I 15	RIVERSIDE	Interstate Highway
CA	I 15	I 15	RIVERSIDE	Interstate Highway
CA	I 15	I 15	SAN BERNARDINO	Interstate Highway
CA	I 15	I 15	SAN DIEGO	Interstate Highway

CA	I 205	I 205	ALAMEDA	Interstate Highway
CA	I 205	I 205	SAN JOAQUIN	Interstate Highway
CA	I 210	I 210	LOS ANGELES	Interstate Highway
CA	I 215	I 215	RIVERSIDE	Interstate Highway
CA	I 215	I 215	RIVERSIDE	Interstate Highway
CA	I 215	I 215	SAN BERNARDINO	Interstate Highway
CA	I 238	I 238	ALAMEDA	Interstate Highway
CA	I 280	I 280	SAN FRANCISCO	Interstate Highway
CA	I 280	I 280	SAN MATEO	Interstate Highway
CA	I 280	I 280	SANTA CLARA	Interstate Highway
CA	I 380	I 380	SAN MATEO	Interstate Highway
CA	SAN DIEGO FWY	I 405	LOS ANGELES	Interstate Highway
CA	SAN DIEGO FWY	I 405	ORANGE	Interstate Highway
CA	I 5	I 5	FRESNO	Interstate Highway
CA	I 5	I 5	KERN	Interstate Highway
CA	I 5	I 5	LOS ANGELES	Interstate Highway
CA	I 5	I 5	MERCED	Interstate Highway
CA	SAN DIEGO FWY	I 5	ORANGE	Interstate Highway
CA	SAN DIEGO FWY	I 5	ORANGE	Interstate Highway
CA	I 5	I 5	ORANGE	Interstate Highway
CA	I 5	I 5	SACRAMENTO	Interstate Highway
CA	SAN DIEGO FWY	I 5	SAN DIEGO	Interstate Highway
CA	SAN DIEGO FWY	I 5	SAN DIEGO	Interstate Highway
CA	I 5 LOCAL BYPASS LANES	I 5	SAN DIEGO	Interstate Highway
CA	I 5	I 5	SAN DIEGO	Interstate Highway
CA	I 5	I 5	SAN JOAQUIN	Interstate Highway
CA	I 5	I 5	STANISLAUS	Interstate Highway
CA	I 5	I 5	YOLO	Interstate Highway
CA	I 505	I 505	SOLANO	Interstate Highway
CA	I 580	I 580	ALAMEDA	Interstate Highway
CA	I 580	I 580	CONTRA COSTA	Interstate Highway

CA	I 580	I 580	MARIN	Interstate Highway
CA	I 580	I 580	SAN JOAQUIN	Interstate Highway
CA	I 605	I 605	LOS ANGELES	Interstate Highway
CA	I 605	I 605	ORANGE	Interstate Highway
CA	I 680	I 680	ALAMEDA	Interstate Highway
CA	I 680	I 680	CONTRA COSTA	Interstate Highway
CA	I 680	I 680	SANTA CLARA	Interstate Highway
CA	I 680	I 680	SOLANO	Interstate Highway
CA	I 710	I 710	LOS ANGELES	Interstate Highway
CA	I 780	I 780	SOLANO	Interstate Highway
CA	I 8	I 8	SAN DIEGO	Interstate Highway
CA	I 8	I 8	SAN DIEGO	Interstate Highway
CA	I 80	I 80	ALAMEDA	Interstate Highway
CA	I 80	I 80	CONTRA COSTA	Interstate Highway
CA	I 80	I 80	NAPA	Interstate Highway
CA	I 80	I 80	PLACER	Interstate Highway
CA	I 80	I 80	SACRAMENTO	Interstate Highway
CA	I 80	I 80	SAN FRANCISCO	Interstate Highway
CA	I 80	I 80	SOLANO	Interstate Highway
CA	I 80	I 80	YOLO	Interstate Highway
CA	I 805	I 805	SAN DIEGO	Interstate Highway
CA	I 5 LOCAL BYPASS LANES	I 805	SAN DIEGO	Interstate Highway
CA	I 880	I 880	ALAMEDA	Interstate Highway
CA	I 880	I 880	SANTA CLARA	Interstate Highway
CA	I 980	I 980	ALAMEDA	Interstate Highway
CA	SR 120	SR 120	SAN JOAQUIN	Other Controlled Access Highway
CA	SR 134	SR 134	LOS ANGELES	Other Controlled Access Highway
CA	SR 14	SR 14	LOS ANGELES	Other Controlled Access Highway
CA	SR 170	SR 170	LOS ANGELES	Other Controlled Access Highway

CA	SR 22	SR 22	ORANGE	Other Controlled Access Highway
CA	SR 23	SR 23	VENTURA	Other Controlled Access Highway
CA	SR 4	SR 4	SAN JOAQUIN	Other Controlled Access Highway
CA	SR 47	SR 47	LOS ANGELES	Other Controlled Access Highway
CA	COSTA MESA FWY	SR 55	ORANGE	Other Controlled Access Highway
CA	SR 57	SR 57	LOS ANGELES	Other Controlled Access Highway
CA	SR 57	SR 57	ORANGE	Other Controlled Access Highway
CA	SR 58	SR 58	KERN	Other Controlled Access Highway
CA	POMONA FWY	SR 60	LOS ANGELES	Other Controlled Access Highway
CA	POMONA FWY	SR 60	LOS ANGELES	Other Controlled Access Highway
CA	SR 60	SR 60	LOS ANGELES	Other Controlled Access Highway
CA	SR 60	SR 60	RIVERSIDE	Other Controlled Access Highway
CA	POMONA FWY	SR 60	RIVERSIDE	Other Controlled Access Highway
CA	SR 60	SR 60	RIVERSIDE	Other Controlled Access Highway
CA	POMONA FWY	SR 60	SAN BERNARDINO	Other Controlled Access Highway
CA	POMONA FWY	SR 60	SAN BERNARDINO	Other Controlled Access Highway
CA	SR 71	SR 71	LOS ANGELES	Other Controlled Access Highway
CA	LONG BEACH FWY	SR 710	LOS ANGELES	Other Controlled Access Highway
CA	SR 91	SR 91	LOS ANGELES	Other Controlled Access Highway
CA	SR 91	SR 91	ORANGE	Other Controlled Access Highway

CA	SR 91	SR 91	RIVERSIDE	Other Controlled Access Highway
CA	SR 99	SR 99	KERN	Other Controlled Access Highway
CA	SR 99	SR 99	MADERA	Other Controlled Access Highway
CA	SR 99	SR 99	MERCED	Other Controlled Access Highway
CA	SR 99	SR 99	MERCED	Arterial or Major Collector
CA	SR 99	SR 99	SACRAMENTO	Other Controlled Access Highway
CA	SR 99	SR 99	SAN JOAQUIN	Other Controlled Access Highway
CA	SR 99	SR 99	STANISLAUS	Other Controlled Access Highway
CA	US 101	US 101	LOS ANGELES	Other Controlled Access Highway
CA	US 101	US 101	SAN FRANCISCO	Other Controlled Access Highway
CA	US 101	US 101	SAN MATEO	Other Controlled Access Highway
CA	US 101	US 101	SANTA CLARA	Other Controlled Access Highway
CA	US 101	US 101	VENTURA	Other Controlled Access Highway
CA	US 50	US 50	SACRAMENTO	Other Controlled Access Highway
CA	US 50	US 50	YOLO	Other Controlled Access Highway
CA	I 580 TRUCK LANE		ALAMEDA	Express Lane (Truck Only)
CA	I 5 - TRUCK ROUTE S		LOS ANGELES	Express Lane (Truck Route)
CA	I 5 - TRUCK ROUTE N		LOS ANGELES	Express Lane (Truck Route)
CA	I 215 / SR 60 TRUCK LANE		RIVERSIDE	Express Lane (Truck Route)
CA	POMERADO RD		SAN DIEGO	Arterial or Major Collector
CA	LAUREL ST		SAN DIEGO	Arterial or Major Collector
CA	GRAPE ST		SAN DIEGO	Arterial or Major Collector
CA	HAWTHORNE ST		SAN DIEGO	Arterial or Major Collector

CA	CESAR CHAVEZ ST		SAN FRANCISCO	Arterial or Major Collector
CA	ROTH RD		SAN JOAQUIN	Arterial or Major Collector
CA	LAS POSAS RD		VENTURA	Arterial or Major Collector
CO	I 225	I 225	ADAMS	Interstate Highway
CO	I 225	I 225	ARAPAHOE	Interstate Highway
CO	I 225	I 225	DENVER	Interstate Highway
CO	I 25	I 25	ADAMS	Interstate Highway
CO	I 25	I 25	ARAPAHOE	Interstate Highway
CO	I 25	I 25	BROOMFIELD	Interstate Highway
CO	I 25	I 25	DENVER	Interstate Highway
CO	I 25	I 25	DOUGLAS	Interstate Highway
CO	I 25	I 25	EL PASO	Interstate Highway
CO	I 25	I 25	LARIMER	Interstate Highway
CO	I 25	I 25	WELD	Interstate Highway
CO	I 270	I 270	ADAMS	Interstate Highway
CO	I 270	I 270	DENVER	Interstate Highway
CO	I 70	I 70	ADAMS	Interstate Highway
CO	I 70	I 70	DENVER	Interstate Highway
CO	I 70	I 70	JEFFERSON	Interstate Highway
CO	I 76	I 76	ADAMS	Interstate Highway
CO	I 76	I 76	DENVER	Interstate Highway
CO	I 76	I 76	JEFFERSON	Interstate Highway
CT	I 291	I 291	HARTFORD	Interstate Highway
CT	I 684	I 684	FAIRFIELD	Interstate Highway
CT	I 84	I 84	HARTFORD	Interstate Highway
CT	I 84	I 84	TOLLAND	Interstate Highway
CT	I 84	I 84	WINDHAM	Interstate Highway
CT	I 90	I 90	TOLLAND	Interstate Highway
CT	I 91	I 91	HARTFORD	Interstate Highway
CT	I 91	I 91	MIDDLESEX	Interstate Highway
CT	I 91	I 91	NEW HAVEN	Interstate Highway

CT	I 95	I 95	FAIRFIELD	Interstate Highway
CT	I 95	I 95	NEW HAVEN	Interstate Highway
DC	I 295	I 295	DISTRICT OF COLUMBIA	Interstate Highway
DC	I 395	I 395	DISTRICT OF COLUMBIA	Interstate Highway
DC	I 66	I 66	DISTRICT OF COLUMBIA	Interstate Highway
DC	I 695	I 695	DISTRICT OF COLUMBIA	Interstate Highway
DE	I 295	I 295	NEW CASTLE	Interstate Highway
DE	I 495	I 495	NEW CASTLE	Interstate Highway
DE	I 95	I 95	NEW CASTLE	Interstate Highway
FL	I 10	I 10	BAKER	Interstate Highway
FL	I 10	I 10	DUVAL	Interstate Highway
FL	I 10	I 10	NASSAU	Interstate Highway
FL	I 295	I 295	DUVAL	Interstate Highway
FL	I 595	I 595	BROWARD	Interstate Highway
FL	I 75	I 75	BROWARD	Interstate Highway
FL	I 75	I 75	MIAMI-DADE	Interstate Highway
FL	I 95	I 95	BROWARD	Interstate Highway
FL	I 95	I 95	DUVAL	Interstate Highway
FL	I 95	I 95	MIAMI-DADE	Interstate Highway
FL	I 95	I 95	NASSAU	Interstate Highway
FL	I 95	I 95	PALM BEACH	Interstate Highway
FL	I 95	I 95	ST. JOHNS	Interstate Highway
GA	I 16	I 16	CHATHAM	Interstate Highway
GA	I 20	I 20	CARROLL	Interstate Highway
GA	I 20	I 20	COBB	Interstate Highway
GA	I 20	I 20	DEKALB	Interstate Highway
GA	I 20	I 20	DEKALB	Interstate Highway
GA	I 20	I 20	DOUGLAS	Interstate Highway
GA	I 20	I 20	FULTON	Interstate Highway

GA	I 20	I 20	HARALSON	Interstate Highway
GA	I 20	I 20	MORGAN	Interstate Highway
GA	I 20	I 20	MORGAN	Interstate Highway
GA	I 20	I 20	NEWTON	Interstate Highway
GA	I 20	I 20	NEWTON	Interstate Highway
GA	I 20	I 20	ROCKDALE	Interstate Highway
GA	I 20	I 20	WALTON	Interstate Highway
GA	I 285	I 285	CLAYTON	Interstate Highway
GA	I 285	I 285	COBB	Interstate Highway
GA	I 285	I 285	DEKALB	Interstate Highway
GA	I 285	I 285	FULTON	Interstate Highway
GA	I 475	I 475	BIBB	Interstate Highway
GA	I 475	I 475	MONROE	Interstate Highway
GA	I 516	I 516	CHATHAM	Interstate Highway
GA	I 575	I 575	COBB	Interstate Highway
GA	I 675	I 675	CLAYTON	Interstate Highway
GA	I 675	I 675	CLAYTON	Interstate Highway
GA	I 675	I 675	DEKALB	Interstate Highway
GA	I 675	I 675	HENRY	Interstate Highway
GA	I 75	I 75	BARTOW	Interstate Highway
GA	I 75	I 75	BUTTS	Interstate Highway
GA	I 75	I 75	BUTTS	Interstate Highway
GA	I 75	I 75	CATOOSA	Interstate Highway
GA	I 75	I 75	CHEROKEE	Interstate Highway
GA	I 75	I 75	CLAYTON	Interstate Highway
GA	I 75	I 75	CLAYTON	Interstate Highway
GA	I 75	I 75	COBB	Interstate Highway
GA	I 75	I 75	FULTON	Interstate Highway
GA	I 75	I 75	GORDON	Interstate Highway
GA	I 75	I 75	HENRY	Interstate Highway
GA	I 75	I 75	HENRY	Interstate Highway

GA	I 75	I 75	LAMAR	Interstate Highway
GA	I 75	I 75	MONROE	Interstate Highway
GA	I 75	I 75	SPALDING	Interstate Highway
GA	I 75	I 75	WHITFIELD	Interstate Highway
GA	I 85	I 85	BANKS	Interstate Highway
GA	I 85	I 85	BARROW	Interstate Highway
GA	I 85	I 85	CLAYTON	Interstate Highway
GA	I 85	I 85	COWETA	Interstate Highway
GA	I 85	I 85	COWETA	Interstate Highway
GA	I 85	I 85	DEKALB	Interstate Highway
GA	I 85	I 85	FRANKLIN	Interstate Highway
GA	I 85	I 85	FULTON	Interstate Highway
GA	I 85	I 85	FULTON	Interstate Highway
GA	I 85	I 85	GWINNETT	Interstate Highway
GA	I 85	I 85	HART	Interstate Highway
GA	I 85	I 85	JACKSON	Interstate Highway
GA	I 95	I 95	BRYAN	Interstate Highway
GA	I 95	I 95	CAMDEN	Interstate Highway
GA	I 95	I 95	CHATHAM	Interstate Highway
GA	I 95	I 95	EFFINGHAM	Interstate Highway
GA	I 95	I 95	GLYNN	Interstate Highway
GA	I 95	I 95	LIBERTY	Interstate Highway
GA	I 95	I 95	MCINTOSH	Interstate Highway
GA	I 985	I 985	GWINNETT	Interstate Highway
GA	SR 16	SR 16	BUTTS	Arterial or Major Collector
IL	KENNEDY EXPY	I 190	COOK	Interstate Highway
IL	I 255	I 255	MONROE	Interstate Highway
IL	I 270	I 270	MADISON	Interstate Highway
IL	I 290	I 290	COOK	Interstate Highway
IL	I 290	I 290	DUPAGE	Interstate Highway
IL	I 294	I 294	COOK	Interstate Highway

IL	I 294	I 294	DUPAGE	Interstate Highway
IL	I 294	I 294	LAKE	Interstate Highway
IL	I 355	I 355	COOK	Interstate Highway
IL	I 355	I 355	DUPAGE	Interstate Highway
IL	I 355	I 355	WILL	Interstate Highway
IL	I 39	I 39	LASALLE	Interstate Highway
IL	I 55	I 55	COOK	Interstate Highway
IL	I 55	I 55	DUPAGE	Interstate Highway
IL	I 55	I 55	MADISON	Interstate Highway
IL	I 55	I 55	ST. CLAIR	Interstate Highway
IL	I 55	I 55	WILL	Interstate Highway
IL	I 57	I 57	COOK	Interstate Highway
IL	I 57	I 57	WILL	Interstate Highway
IL	I 70	I 70	BOND	Interstate Highway
IL	I 70	I 70	FAYETTE	Interstate Highway
IL	I 70	I 70	MADISON	Interstate Highway
IL	I 80	I 80	BUREAU	Interstate Highway
IL	I 80	I 80	COOK	Interstate Highway
IL	I 80	I 80	GRUNDY	Interstate Highway
IL	I 80	I 80	HENRY	Interstate Highway
IL	I 80	I 80	LASALLE	Interstate Highway
IL	I 80	I 80	WILL	Interstate Highway
IL	I 88	I 88	COOK	Interstate Highway
IL	I 88	I 88	DUPAGE	Interstate Highway
IL	I 88	I 88	KANE	Interstate Highway
IL	I 90	I 90	BOONE	Interstate Highway
IL	I 90	I 90	COOK	Interstate Highway
IL	KENNEDY EXPY	I 90	COOK	Interstate Highway
IL	I 90	I 90	KANE	Interstate Highway
IL	I 90	I 90	MCHENRY	Interstate Highway
IL	KENNEDY EXPY	I 94	COOK	Interstate Highway

IL	I 94	I 94	COOK	Interstate Highway
IL	I 94	I 94	LAKE	Interstate Highway
IN	I 65	I 65	JASPER	Interstate Highway
IN	I 65	I 65	LAKE	Interstate Highway
IN	I 65	I 65	NEWTON	Interstate Highway
IN	I 65	I 65	TIPPECANOE	Interstate Highway
IN	I 65	I 65	WHITE	Interstate Highway
IN	I 70	I 70	WAYNE	Interstate Highway
IN	I 80	I 80	ELKHART	Interstate Highway
IN	I 80	I 80	LAGRANGE	Interstate Highway
IN	I 80	I 80	LAKE	Interstate Highway
IN	I 80	I 80	LAPORTE	Interstate Highway
IN	I 80	I 80	PORTER	Interstate Highway
IN	I 80	I 80	ST. JOSEPH	Interstate Highway
IN	I 80	I 80	STEUBEN	Interstate Highway
IN	I 90	I 90	LAKE	Interstate Highway
IN	I 94	I 94	LAKE	Interstate Highway
IN	I 94	I 94	LAPORTE	Interstate Highway
IN	I 94	I 94	PORTER	Interstate Highway
KY	I 75	I 75	KENTON	Interstate Highway
LA	I 10	I 10	CALCASIEU	Interstate Highway
MA	I 290	I 290	MIDDLESEX	Interstate Highway
MA	I 290	I 290	WORCESTER	Interstate Highway
MA	I 291	I 291	HAMPDEN	Interstate Highway
MA	I 495	I 495	ESSEX	Interstate Highway
MA	I 495	I 495	MIDDLESEX	Interstate Highway
MA	I 495	I 495	WORCESTER	Interstate Highway
MA	I 84	I 84	WORCESTER	Interstate Highway
MA	MASSACHUSETTS TPKE	I 90	MIDDLESEX	Interstate Highway
MA	MASSACHUSETTS TPKE	I 90	SUFFOLK	Interstate Highway
MA	MASSACHUSETTS TPKE	I 90	WORCESTER	Interstate Highway

MA	I 91	I 91	HAMPDEN	Interstate Highway
MA	I 93	I 93	ESSEX	Interstate Highway
MA	I 93	I 93	MIDDLESEX	Interstate Highway
MA	I 93	I 93	NORFOLK	Interstate Highway
MA	I 93	I 93	SUFFOLK	Interstate Highway
MA	I 93 N	I 93 N	MIDDLESEX	Interstate Highway
MA	I 93 N	I 93 N	SUFFOLK	Interstate Highway
MA	I 95	I 95	BRISTOL	Interstate Highway
MA	I 95	I 95	ESSEX	Interstate Highway
MA	I 95	I 95	MIDDLESEX	Interstate Highway
MA	I 95	I 95	NORFOLK	Interstate Highway
MA	MA 1A	MA 1A	SUFFOLK	Other Controlled Access Highway
MA	MA 2	MA 2	MIDDLESEX	Other Controlled Access Highway
MA	HARBORSIDE DR		SUFFOLK	Arterial or Major Collector
MD	I 195	I 195	ANNE ARUNDEL	Interstate Highway
MD	I 195	I 195	BALTIMORE	Interstate Highway
MD	I 270	I 270	MONTGOMERY	Interstate Highway
MD	I 270 - EXPRESS LANES	I 270	MONTGOMERY	Interstate Highway
MD	I 270 S	I 270 S	MONTGOMERY	Interstate Highway
MD	I 295	I 295	PRINCE GEORGE'S	Interstate Highway
MD	I 370	I 370	MONTGOMERY	Interstate Highway
MD	I 395	I 395	BALTIMORE CITY	Interstate Highway
MD	I 495	I 495	MONTGOMERY	Interstate Highway
MD	I 495	I 495	PRINCE GEORGE'S	Interstate Highway
MD	I 695	I 695	ANNE ARUNDEL	Interstate Highway
MD	I 695	I 695	ANNE ARUNDEL	Other Controlled Access Highway
MD	I 695	I 695	BALTIMORE	Interstate Highway
MD	I 70	I 70	BALTIMORE	Interstate Highway
MD	I 70	I 70	BALTIMORE CITY	Interstate Highway
MD	I 70	I 70	CARROLL	Interstate Highway

MD	I 70	I 70	FREDERICK	Interstate Highway
MD	I 70	I 70	HOWARD	Interstate Highway
MD	I 795	I 795	BALTIMORE	Interstate Highway
MD	I 81	I 81	WASHINGTON	Interstate Highway
MD	I 83	I 83	BALTIMORE	Interstate Highway
MD	JONES FALLS EXPY	I 83	BALTIMORE	Interstate Highway
MD	I 83	I 83	BALTIMORE CITY	Interstate Highway
MD	I 895	I 895	ANNE ARUNDEL	Interstate Highway
MD	I 895	I 895	BALTIMORE	Interstate Highway
MD	I 895	I 895	BALTIMORE CITY	Interstate Highway
MD	I 895	I 895	HOWARD	Interstate Highway
MD	I 95	I 95	BALTIMORE	Interstate Highway
MD	I 95	I 95	BALTIMORE CITY	Interstate Highway
MD	I 95	I 95	CECIL	Interstate Highway
MD	I 95	I 95	HARFORD	Interstate Highway
MD	I 95	I 95	HOWARD	Interstate Highway
MD	I 95	I 95	PRINCE GEORGE'S	Interstate Highway
MD	I 97	I 97	ANNE ARUNDEL	Interstate Highway
MD	I 97	I 97	ANNE ARUNDEL	Other Controlled Access Highway
MD	MD 100	MD 100	ANNE ARUNDEL	Other Controlled Access Highway
MD	MD 100	MD 100	HOWARD	Other Controlled Access Highway
MD	WATERLOO RD	MD 175	HOWARD	Arterial or Major Collector
MD	BALTIMORE-WASHINGTON PKWY	MD 295	ANNE ARUNDEL	Other Controlled Access Highway
MD	MD 995A	MD 995A	ANNE ARUNDEL	Arterial or Major Collector
MD	US 50	US 50	ANNE ARUNDEL	Other Controlled Access Highway
MD	US 50	US 50	ANNE ARUNDEL	Interstate Highway
MD	US 50	US 50	PRINCE GEORGE'S	Interstate Highway
MD	US 50	US 50	PRINCE GEORGE'S	Other Controlled Access Highway

MD	US 50	US 50	QUEEN ANNE'S	Other Controlled Access Highway
MD	AVIATION BLVD		ANNE ARUNDEL	Arterial or Major Collector
MD	HANOVER ST		BALTIMORE CITY	Arterial or Major Collector
MD	I 270 - LOCAL LANES		MONTGOMERY	Interstate Highway
ME	I 295	I 295	CUMBERLAND	Interstate Highway
ME	I 95	I 95	CUMBERLAND	Interstate Highway
ME	I 95	I 95	YORK	Interstate Highway
MI	I 194	I 194	CALHOUN	Interstate Highway
MI	I 275	I 275	MONROE	Interstate Highway
MI	I 275	I 275	WAYNE	Interstate Highway
MI	I 69	I 69	CALHOUN	Interstate Highway
MI	I 696	I 696	MACOMB	Interstate Highway
MI	I 696	I 696	OAKLAND	Interstate Highway
MI	I 75	I 75	MONROE	Interstate Highway
MI	I 75	I 75	OAKLAND	Interstate Highway
MI	I 75	I 75	WAYNE	Interstate Highway
MI	I 94	I 94	BERRIEN	Interstate Highway
MI	I 94	I 94	CALHOUN	Interstate Highway
MI	I 94	I 94	JACKSON	Interstate Highway
MI	I 94	I 94	KALAMAZOO	Interstate Highway
MI	I 94	I 94	WASHTENAW	Interstate Highway
MI	I 94	I 94	WAYNE	Interstate Highway
MI	I 96	I 96	OAKLAND	Interstate Highway
MI	I 96	I 96	WAYNE	Interstate Highway
MO	I 170	I 170	ST. LOUIS	Interstate Highway
MO	I 255	I 255	ST. LOUIS	Interstate Highway
MO	I 270	I 270	ST. LOUIS	Interstate Highway
MO	I 270	I 270	ST. LOUIS CITY	Interstate Highway
MO	I 44	I 44	CRAWFORD	Interstate Highway
MO	I 44	I 44	FRANKLIN	Interstate Highway
MO	I 44	I 44	PHELPS	Interstate Highway

MO	I 44	I 44	ST. LOUIS	Interstate Highway
MO	I 44	I 44	ST. LOUIS CITY	Interstate Highway
MO	I 55	I 55	JEFFERSON	Interstate Highway
MO	I 55	I 55	ST. LOUIS	Interstate Highway
MO	I 55	I 55	ST. LOUIS CITY	Interstate Highway
MO	I 64	I 55	ST. LOUIS CITY	Interstate Highway
MO	I 64	I 64	ST. CHARLES	Interstate Highway
MO	I 64	I 64	ST. LOUIS	Interstate Highway
MO	I 64	I 64	ST. LOUIS CITY	Interstate Highway
MO	I 70	I 70	CALLAWAY	Interstate Highway
MO	I 70	I 70	MONTGOMERY	Interstate Highway
MO	I 70	I 70	ST. CHARLES	Interstate Highway
MO	I 70	I 70	ST. LOUIS	Interstate Highway
MO	I 70	I 70	ST. LOUIS CITY	Interstate Highway
MO	I 70	I 70	WARREN	Interstate Highway
NC	I 277	I 277	MECKLENBURG	Interstate Highway
NC	CHARLOTTE BELTWAY	I 485	MECKLENBURG	Interstate Highway
NC	I 77	I 77	MECKLENBURG	Interstate Highway
NC	I 85	I 85	CABARRUS	Interstate Highway
NC	I 85	I 85	CLEVELAND	Interstate Highway
NC	I 85	I 85	DAVIDSON	Interstate Highway
NC	I 85	I 85	GASTON	Interstate Highway
NC	I 85	I 85	MECKLENBURG	Interstate Highway
NC	I 85	I 85	ROWAN	Interstate Highway
NC	I 95	I 95	HALIFAX	Interstate Highway
NC	I 95	I 95	NORTHAMPTON	Interstate Highway
NH	I 293	I 293	HILLSBOROUGH	Interstate Highway
NH	F E EVERETT TPKE	I 293	HILLSBOROUGH	Interstate Highway
NH	F E EVERETT TPKE	I 293	MERRIMACK	Interstate Highway
NH	I 393	I 393	MERRIMACK	Interstate Highway
NH	I 89	I 89	MERRIMACK	Interstate Highway

NH	I 93	I 93	HILLSBOROUGH	Interstate Highway
NH	F E EVERETT TPKE	I 93	MERRIMACK	Interstate Highway
NH	I 93	I 93	MERRIMACK	Interstate Highway
NH	I 93	I 93	ROCKINGHAM	Interstate Highway
NH	BLUE STAR TPKE	I 95	ROCKINGHAM	Interstate Highway
NJ	I 195	I 195	MERCER	Interstate Highway
NJ	I 278	I 278	UNION	Interstate Highway
NJ	I 280	I 280	ESSEX	Interstate Highway
NJ	I 280	I 280	HUDSON	Interstate Highway
NJ	I 280	I 280	MORRIS	Interstate Highway
NJ	I 287	I 287	BERGEN	Interstate Highway
NJ	I 287	I 287	MIDDLESEX	Interstate Highway
NJ	I 287	I 287	MORRIS	Interstate Highway
NJ	I 287	I 287	PASSAIC	Interstate Highway
NJ	I 287	I 287	SOMERSET	Interstate Highway
NJ	I 295	I 295	BURLINGTON	Interstate Highway
NJ	I 295	I 295	CAMDEN	Interstate Highway
NJ	I 295	I 295	SALEM	Interstate Highway
NJ	I 676	I 676	CAMDEN	Interstate Highway
NJ	I 676 - BEN FRANKLIN BRG TOLL PLAZA	I 676	CAMDEN	Interstate Highway
NJ	NORTH-SOUTH FWY	I 76	CAMDEN	Interstate Highway
NJ	I 76	I 76	CAMDEN	Interstate Highway
NJ	I 78	I 78	ESSEX	Interstate Highway
NJ	NEWARK BAY BRIDGE	I 78	ESSEX	Interstate Highway
NJ	I 78 - NEWARK EB TOLL PLAZA	I 78	ESSEX	Interstate Highway
NJ	NEWARK BAY BRIDGE	I 78	HUDSON	Interstate Highway
NJ	I 78	I 78	HUDSON	Interstate Highway
NJ	HOLLAND TUNNEL	I 78	HUDSON	Interstate Highway
NJ	I 78	I 78	HUNTERDON	Interstate Highway
NJ	I 78	I 78	SOMERSET	Interstate Highway
NJ	I 78	I 78	UNION	Interstate Highway

NJ	I 78	I 78	WARREN	Interstate Highway
NJ	I 80	I 80	BERGEN	Interstate Highway
NJ	I 80	I 80	ESSEX	Interstate Highway
NJ	I 80	I 80	MORRIS	Interstate Highway
NJ	I 80 - LOCAL LANES	I 80	MORRIS	Interstate Highway
NJ	I 80 - EXPRESS LANES	I 80	MORRIS	Interstate Highway
NJ	I 80	I 80	PASSAIC	Interstate Highway
NJ	I 80	I 80	SUSSEX	Interstate Highway
NJ	I 80	I 80	WARREN	Interstate Highway
NJ	I 95 EXT - LOCAL LANES	I 95	BERGEN	Interstate Highway
NJ	NEW JERSEY TPKE - EASTERN SPUR	I 95	BERGEN	Interstate Highway
NJ	I 95 NB APPROACH to I 80	I 95	BERGEN	Interstate Highway
NJ	NEW JERSEY TPKE - WESTERN SPUR	I 95	BERGEN	Interstate Highway
NJ	NEW JERSEY TPKE - I 95 EXT	I 95	BERGEN	Interstate Highway
NJ	I 95 EXT - EXPRESS LANES	I 95	BERGEN	Interstate Highway
NJ	GEORGE WASHINGTON BRG - LOWER DECK APPROACH	I 95	BERGEN	Interstate Highway
NJ	GEORGE WASHINGTON BRG - LOWER DECK	I 95	BERGEN	Interstate Highway
NJ	GEORGE WASHINGTON BRG - UPPER DECK	I 95	BERGEN	Interstate Highway
NJ	GEORGE WASHINGTON BRG - UPPER DECK APPROACH	I 95	BERGEN	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	BURLINGTON	Interstate Highway
NJ	I 95	I 95	BURLINGTON	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	ESSEX	Interstate Highway
NJ	NEW JERSEY TPKE - EASTERN SPUR	I 95	ESSEX	Interstate Highway
NJ	NEW JERSEY TPKE - WESTERN SPUR	I 95	ESSEX	Interstate Highway
NJ	NEW JERSEY TPKE - EASTERN SPUR	I 95	HUDSON	Interstate Highway
NJ	NEW JERSEY TPKE - WESTERN SPUR	I 95	HUDSON	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	MERCER	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	MIDDLESEX	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	UNION	Interstate Highway

NJ	US 1 - LOCAL LANES	US 1	ESSEX	Other Controlled Access Highway
NJ	I 76 CONNECTOR		CAMDEN	Other Controlled Access Highway
NV	I 15	I 15	CLARK	Interstate Highway
NV	I 515	I 515	CLARK	Interstate Highway
NV	US 95	US 95	CLARK	Other Controlled Access Highway
NY	I 278	I 278	BRONX	Interstate Highway
NY	RFK TRIBOROUGH BRG	I 278	BRONX	Interstate Highway
NY	GOWANUS EXPY	I 278	KINGS	Interstate Highway
NY	BROOKLYN-QUEENS EXPY	I 278	KINGS	Interstate Highway
NY	VERRAZANO-NARROWS BRG - UPPER DECK APPROACH LANE	I 278	KINGS	Interstate Highway
NY	VERRAZANO-NARROWS BRG - UPPER DECK	I 278	KINGS	Interstate Highway
NY	RFK TRIBOROUGH BRG	I 278	NEW YORK	Interstate Highway
NY	RFK TRIBOROUGH BRG	I 278	QUEENS	Interstate Highway
NY	BROOKLYN-QUEENS EXPY	I 278	QUEENS	Interstate Highway
NY	GRAND CENTRAL PKWY	I 278	QUEENS	Interstate Highway
NY	I 278	I 278	RICHMOND	Interstate Highway
NY	VERRAZANO-NARROWS BRG - UPPER DECK APPROACH LANE	I 278	RICHMOND	Interstate Highway
NY	VERRAZANO-NARROWS BRG - LOWER DECK APPROACH LANE	I 278	RICHMOND	Interstate Highway
NY	VERRAZANO-NARROWS BRG - UPPER DECK	I 278	RICHMOND	Interstate Highway
NY	I 287	I 287	ROCKLAND	Interstate Highway
NY	CROSS-WESTCHESTER EXPY	I 287	WESTCHESTER	Interstate Highway
NY	I 290	I 290	ERIE	Interstate Highway
NY	CLEARVIEW EXPY	I 295	BRONX	Interstate Highway
NY	THROGS NECK BRG	I 295	BRONX	Interstate Highway
NY	CLEARVIEW EXPY	I 295	QUEENS	Interstate Highway
NY	THROGS NECK BRG	I 295	QUEENS	Interstate Highway
NY	ROCHESTER OUTER LP	I 390	MONROE	Interstate Highway

NY	GENESEE EXPY	I 390	MONROE	Interstate Highway
NY	BROOKLYN-BATTERY TUNNEL	I 478	KINGS	Interstate Highway
NY	BROOKLYN-BATTERY TUNNEL	I 478	NEW YORK	Interstate Highway
NY	I 490	I 490	GENESEE	Interstate Highway
NY	I 490	I 490	MONROE	Interstate Highway
NY	I 490	I 490	ONTARIO	Interstate Highway
NY	LONG ISLAND EXPY	I 495	NASSAU	Interstate Highway
NY	QUEENS-MIDTOWN TUNNEL	I 495	NEW YORK	Interstate Highway
NY	HORACE HARDING EXPY	I 495	QUEENS	Interstate Highway
NY	QUEENS-MIDTOWN EXPY	I 495	QUEENS	Interstate Highway
NY	QUEENS-MIDTOWN TUNNEL	I 495	QUEENS	Interstate Highway
NY	LONG ISLAND EXPY	I 495	SUFFOLK	Interstate Highway
NY	I 590	I 590	MONROE	Interstate Highway
NY	BRONX-WHITESTONE BRG	I 678	BRONX	Interstate Highway
NY	I 678	I 678	BRONX	Interstate Highway
NY	I 678	I 678	QUEENS	Interstate Highway
NY	BRONX-WHITESTONE BRG	I 678	QUEENS	Interstate Highway
NY	I 684	I 684	PUTNAM	Interstate Highway
NY	I 684	I 684	WESTCHESTER	Interstate Highway
NY	I 690	I 690	ONONDAGA	Interstate Highway
NY	THROGS NECK EXPY	I 695	BRONX	Interstate Highway
NY	HOLLAND TUNNEL	I 78	NEW YORK	Interstate Highway
NY	I 787	I 787	ALBANY	Interstate Highway
NY	I 81	I 81	ONONDAGA	Interstate Highway
NY	I 84	I 84	DUTCHESS	Interstate Highway
NY	I 84	I 84	ORANGE	Interstate Highway
NY	I 84	I 84	PUTNAM	Interstate Highway
NY	NEW YORK STATE THWY	I 87	ALBANY	Interstate Highway
NY	ADIRONDACK NORTHWAY	I 87	ALBANY	Interstate Highway
NY	I 87/I 90	I 87	ALBANY	Interstate Highway
NY	I 87	I 87	ALBANY	Interstate Highway

NY	I 87	I 87	BRONX	Interstate Highway
NY	MAJOR DEEGAN EXPY	I 87	BRONX	Interstate Highway
NY	NEW YORK STATE THWY	I 87	GREENE	Interstate Highway
NY	NEW YORK STATE THWY	I 87	ORANGE	Interstate Highway
NY	NEW YORK STATE THWY	I 87	ROCKLAND	Interstate Highway
NY	TAPPAN ZEE BRG	I 87	ROCKLAND	Interstate Highway
NY	ADIRONDACK NORTHWAY	I 87	SARATOGA	Interstate Highway
NY	NEW YORK STATE THWY	I 87	ULSTER	Interstate Highway
NY	NEW YORK STATE THWY	I 87	WESTCHESTER	Interstate Highway
NY	TAPPAN ZEE BRG	I 87	WESTCHESTER	Interstate Highway
NY	I 90	I 90	ALBANY	Interstate Highway
NY	NEW YORK STATE THWY	I 90	CAYUGA	Interstate Highway
NY	NEW YORK STATE THWY	I 90	ERIE	Interstate Highway
NY	NEW YORK STATE THWY	I 90	GENESEE	Interstate Highway
NY	NEW YORK STATE THWY	I 90	MONROE	Interstate Highway
NY	NEW YORK STATE THWY	I 90	ONONDAGA	Interstate Highway
NY	NEW YORK STATE THWY	I 90	ONTARIO	Interstate Highway
NY	I 90	I 90	RENSSELAER	Interstate Highway
NY	NEW YORK STATE THWY	I 90	SENECA	Interstate Highway
NY	NEW ENGLAND THWY	I 95	BRONX	Interstate Highway
NY	BRUCKNER EXPY	I 95	BRONX	Interstate Highway
NY	CROSS BRONX EXPY	I 95	BRONX	Interstate Highway
NY	ALEXANDER HAMILTON BRG	I 95	BRONX	Interstate Highway
NY	ALEXANDER HAMILTON BRG	I 95	NEW YORK	Interstate Highway
NY	I 95	I 95	NEW YORK	Interstate Highway
NY	GEORGE WASHINGTON BRIDGE - LOWER	I 95	NEW YORK	Interstate Highway
NY	GEORGE WASHINGTON BRIDGE - UPPER	I 95	NEW YORK	Interstate Highway
NY	NEW ENGLAND THWY	I 95	WESTCHESTER	Interstate Highway
NY	I 990	I 990	ERIE	Interstate Highway
NY	SHERIDAN EXPY	NY 895	BRONX	Other Controlled Access Highway

NY	EAST AVE	SR 96	MONROE	Arterial or Major Collector
NY	BRUCKNER EXPY		BRONX	Arterial or Major Collector
NY	39TH ST		KINGS	Arterial or Major Collector
OH	I 270	I 270	FRANKLIN	Interstate Highway
OH	I 271	I 271	SUMMIT	Interstate Highway
OH	I 275	I 275	HAMILTON	Interstate Highway
OH	I 471	I 471	HAMILTON	Interstate Highway
OH	I 475	I 475	LUCAS	Interstate Highway
OH	I 475	I 475	WOOD	Interstate Highway
OH	I 480	I 480	LORAIN	Interstate Highway
OH	I 670	I 670	FRANKLIN	Interstate Highway
OH	I 675	I 675	CLARK	Interstate Highway
OH	I 675	I 675	MONTGOMERY	Interstate Highway
OH	I 680	I 680	MAHONING	Interstate Highway
OH	I 70	I 70	BELMONT	Interstate Highway
OH	I 70	I 70	CLARK	Interstate Highway
OH	I 70	I 70	FAIRFIELD	Interstate Highway
OH	I 70	I 70	FRANKLIN	Interstate Highway
OH	I 70	I 70	GUERNSEY	Interstate Highway
OH	I 70	I 70	LICKING	Interstate Highway
OH	I 70	I 70	MADISON	Interstate Highway
OH	I 70	I 70	MONTGOMERY	Interstate Highway
OH	I 70	I 70	MUSKINGUM	Interstate Highway
OH	I 70	I 70	PREBLE	Interstate Highway
OH	I 71	I 71	ASHLAND	Interstate Highway
OH	I 71	I 71	DELAWARE	Interstate Highway
OH	I 71	I 71	FRANKLIN	Interstate Highway
OH	I 71	I 71	HAMILTON	Interstate Highway
OH	I 71	I 71	MORROW	Interstate Highway
OH	I 71	I 71	PICKAWAY	Interstate Highway
OH	I 71	I 71	RICHLAND	Interstate Highway

OH	I 71	I 71	WAYNE	Interstate Highway
OH	I 75	I 75	ALLEN	Interstate Highway
OH	I 75	I 75	AUGLAIZE	Interstate Highway
OH	I 75	I 75	BUTLER	Interstate Highway
OH	I 75	I 75	HAMILTON	Interstate Highway
OH	I 75	I 75	HANCOCK	Interstate Highway
OH	I 75	I 75	LUCAS	Interstate Highway
OH	I 75	I 75	MIAMI	Interstate Highway
OH	I 75	I 75	MONTGOMERY	Interstate Highway
OH	I 75	I 75	SHELBY	Interstate Highway
OH	I 75	I 75	WARREN	Interstate Highway
OH	I 75	I 75	WOOD	Interstate Highway
OH	I 76	I 76	MAHONING	Interstate Highway
OH	I 77	I 77	GUERNSEY	Interstate Highway
OH	I 80	I 80	CUYAHOGA	Interstate Highway
OH	I 80	I 80	ERIE	Interstate Highway
OH	I 80	I 80	FULTON	Interstate Highway
OH	I 80	I 80	LORAIN	Interstate Highway
OH	I 80	I 80	LUCAS	Interstate Highway
OH	I 80	I 80	MAHONING	Interstate Highway
OH	I 80	I 80	OTTAWA	Interstate Highway
OH	I 80	I 80	PORTAGE	Interstate Highway
OH	I 80	I 80	SANDUSKY	Interstate Highway
OH	I 80	I 80	SUMMIT	Interstate Highway
OH	I 80	I 80	TRUMBULL	Interstate Highway
OH	I 80	I 80	WILLIAMS	Interstate Highway
OH	I 80	I 80	WOOD	Interstate Highway
OH	I 90	I 90	CUYAHOGA	Interstate Highway
OH	I 90	I 90	LORAIN	Interstate Highway
OK	I 35	I 35	CARTER	Interstate Highway
OK	I 35	I 35	LOVE	Interstate Highway

OR	I 205	I 205	CLACKAMAS	Interstate Highway
OR	I 205	I 205	MULTNOMAH	Interstate Highway
OR	I 205	I 205	WASHINGTON	Interstate Highway
OR	I 405	I 405	MULTNOMAH	Interstate Highway
OR	I 5	I 5	CLACKAMAS	Interstate Highway
OR	I 5	I 5	LANE	Interstate Highway
OR	I 5	I 5	LINN	Interstate Highway
OR	I 5	I 5	MARION	Interstate Highway
OR	I 5	I 5	MULTNOMAH	Interstate Highway
OR	I 5	I 5	WASHINGTON	Interstate Highway
OR	I 84	I 84	MULTNOMAH	Interstate Highway
OR	US 30	US 30	MULTNOMAH	Other Controlled Access Highway
OR	BELMONT ST		MULTNOMAH	Arterial or Major Collector
PA	I 180	I 180	NORTHUMBERLAND	Interstate Highway
PA	I 276	I 276	BUCKS	Interstate Highway
PA	I 283	I 283	DAUPHIN	Interstate Highway
PA	I 376	I 376	MERCER	Interstate Highway
PA	I 380	I 380	LACKAWANNA	Interstate Highway
PA	I 476	I 476	DELAWARE	Interstate Highway
PA	I 476	I 476	LACKAWANNA	Interstate Highway
PA	I 476	I 476	LEHIGH	Interstate Highway
PA	I 476	I 476	LUZERNE	Interstate Highway
PA	I 476	I 476	MONTGOMERY	Interstate Highway
PA	I 676	I 676	PHILADELPHIA	Interstate Highway
PA	I 70	I 70	WESTMORELAND	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	ALLEGHENY	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	BUTLER	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	CUMBERLAND	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	DAUPHIN	Interstate Highway
PA	SCHUYKILL EXPY	I 76	MONTGOMERY	Interstate Highway
PA	SCHUYKILL EXPY	I 76	PHILADELPHIA	Interstate Highway

PA	WALT WHITMAN BRG	I 76	PHILADELPHIA	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	WESTMORELAND	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	YORK	Interstate Highway
PA	I 78	I 78	BERKS	Interstate Highway
PA	I 78	I 78	LEBANON	Interstate Highway
PA	I 78	I 78	LEHIGH	Interstate Highway
PA	I 78	I 78	NORTHAMPTON	Interstate Highway
PA	I 79	I 79	ALLEGHENY	Interstate Highway
PA	I 80	I 80	BUTLER	Interstate Highway
PA	I 80	I 80	CARBON	Interstate Highway
PA	I 80	I 80	CENTRE	Interstate Highway
PA	I 80	I 80	CLARION	Interstate Highway
PA	I 80	I 80	CLEARFIELD	Interstate Highway
PA	I 80	I 80	CLINTON	Interstate Highway
PA	I 80	I 80	COLUMBIA	Interstate Highway
PA	I 80	I 80	JEFFERSON	Interstate Highway
PA	I 80	I 80	LUZERNE	Interstate Highway
PA	I 80	I 80	MERCER	Interstate Highway
PA	I 80	I 80	MONROE	Interstate Highway
PA	I 80	I 80	MONTOUR	Interstate Highway
PA	I 80	I 80	NORTHUMBERLAND	Interstate Highway
PA	I 80	I 80	UNION	Interstate Highway
PA	I 80	I 80	VENANGO	Interstate Highway
PA	I 81	I 81	CUMBERLAND	Interstate Highway
PA	I 81	I 81	DAUPHIN	Interstate Highway
PA	I 81	I 81	FRANKLIN	Interstate Highway
PA	I 81	I 81	LACKAWANNA	Interstate Highway
PA	I 81	I 81	LEBANON	Interstate Highway
PA	I 81	I 81	LUZERNE	Interstate Highway
PA	I 81	I 81	SCHUYLKILL	Interstate Highway
PA	I 83	I 83	CUMBERLAND	Interstate Highway

PA	I 83	I 83	DAUPHIN	Interstate Highway
PA	I 83	I 83	YORK	Interstate Highway
PA	I 84	I 84	LACKAWANNA	Interstate Highway
PA	I 95	I 95	BUCKS	Interstate Highway
PA	I 95	I 95	DELAWARE	Interstate Highway
PA	I 95	I 95	PHILADELPHIA	Interstate Highway
PA	MARKET ST	SR 114	CUMBERLAND	Arterial or Major Collector
PA	US 1	US 1	BUCKS	Other Controlled Access Highway
PA	US 22	US 22	DAUPHIN	Other Controlled Access Highway
PA	US 30	US 30	YORK	Other Controlled Access Highway
PA	US 322	US 322	DAUPHIN	Other Controlled Access Highway
PA	BATH ST		PHILADELPHIA	Arterial or Major Collector
PA	VARE ST		PHILADELPHIA	Frontage/Service Road
PA	I 95 NB COLLECTOR/DISTRIBUTOR LANE		PHILADELPHIA	Collector/Distributor Lane
RI	I 195	I 195	PROVIDENCE	Interstate Highway
RI	I 295	I 295	KENT	Interstate Highway
RI	I 95	I 95	KENT	Interstate Highway
RI	I 95	I 95	PROVIDENCE	Interstate Highway
RI	RI 4	RI 4	KENT	Other Controlled Access Highway
SC	I 26	I 26	BERKELEY	Interstate Highway
SC	I 26	I 26	BERKELEY	Interstate Highway
SC	I 26	I 26	CHARLESTON	Interstate Highway
SC	I 26	I 26	DORCHESTER	Interstate Highway
SC	I 26	I 26	DORCHESTER	Interstate Highway
SC	I 26	I 26	ORANGEBURG	Interstate Highway
SC	I 526	I 526	BERKELEY	Interstate Highway
SC	I 526	I 526	CHARLESTON	Interstate Highway
SC	I 77	I 77	YORK	Interstate Highway

SC	I 85	I 85	CHEROKEE	Interstate Highway
SC	I 85	I 85	OCONEE	Interstate Highway
SC	I 85	I 85	SPARTANBURG	Interstate Highway
SC	I 95	I 95	CLARENDON	Interstate Highway
SC	I 95	I 95	CLARENDON	Interstate Highway
SC	I 95	I 95	COLLETON	Interstate Highway
SC	I 95	I 95	COLLETON	Interstate Highway
SC	I 95	I 95	DARLINGTON	Interstate Highway
SC	I 95	I 95	DORCHESTER	Interstate Highway
SC	I 95	I 95	FLORENCE	Interstate Highway
SC	I 95	I 95	FLORENCE	Interstate Highway
SC	I 95	I 95	HAMPTON	Interstate Highway
SC	I 95	I 95	JASPER	Interstate Highway
SC	I 95	I 95	ORANGEBURG	Interstate Highway
SC	I 95	I 95	ORANGEBURG	Interstate Highway
SC	I 95	I 95	SUMTER	Interstate Highway
SC	I 95	I 95	SUMTER	Interstate Highway
SC	SR 327	SR 327	FLORENCE	Arterial or Major Collector
TN	I 24	I 24	HAMILTON	Interstate Highway
TN	I 75	I 75	BRADLEY	Interstate Highway
TN	I 75	I 75	HAMILTON	Interstate Highway
TX	I 10	I 10	AUSTIN	Interstate Highway
TX	I 10	I 10	BEXAR	Interstate Highway
TX	I 10	I 10	CALDWELL	Interstate Highway
TX	I 10	I 10	CHAMBERS	Interstate Highway
TX	I 10	I 10	COLORADO	Interstate Highway
TX	I 10	I 10	EL PASO	Interstate Highway
TX	I 10	I 10	FAYETTE	Interstate Highway
TX	I 10	I 10	FORT BEND	Interstate Highway
TX	I 10	I 10	GONZALES	Interstate Highway
TX	I 10	I 10	GUADALUPE	Interstate Highway

TX	I 10	I 10	HARRIS	Interstate Highway
TX	I 10	I 10	HUDSPETH	Interstate Highway
TX	I 10	I 10	JEFFERSON	Interstate Highway
TX	I 10	I 10	JEFFERSON	Interstate Highway
TX	I 10	I 10	ORANGE	Interstate Highway
TX	I 10	I 10	WALLER	Interstate Highway
TX	I 110	I 110	EL PASO	Interstate Highway
TX	I 14	I 14	BELL	Interstate Highway
TX	I 20	I 20	DALLAS	Interstate Highway
TX	I 20	I 20	EASTLAND	Interstate Highway
TX	I 20	I 20	ERATH	Interstate Highway
TX	I 20	I 20	KAUFMAN	Interstate Highway
TX	I 20	I 20	KAUFMAN	Interstate Highway
TX	I 20	I 20	PALO PINTO	Interstate Highway
TX	I 20	I 20	PARKER	Interstate Highway
TX	I 20	I 20	SMITH	Interstate Highway
TX	I 20	I 20	TARRANT	Interstate Highway
TX	I 20	I 20	VAN ZANDT	Interstate Highway
TX	I 20	I 20	VAN ZANDT	Interstate Highway
TX	I 30	I 30	DALLAS	Interstate Highway
TX	TOM LANDRY FWY	I 30	DALLAS	Interstate Highway
TX	I 30	I 30	FRANKLIN	Interstate Highway
TX	I 30	I 30	FRANKLIN	Interstate Highway
TX	I 30	I 30	HOPKINS	Interstate Highway
TX	I 30	I 30	HOPKINS	Interstate Highway
TX	I 30	I 30	HUNT	Interstate Highway
TX	I 30	I 30	HUNT	Interstate Highway
TX	I 30	I 30	PARKER	Interstate Highway
TX	I 30	I 30	ROCKWALL	Interstate Highway
TX	I 30	I 30	TARRANT	Interstate Highway
TX	TOM LANDRY FWY	I 30	TARRANT	Interstate Highway

TX	I 30	I 30	TITUS	Interstate Highway
TX	I 345	I 345	DALLAS	Other Controlled Access Highway
TX	I 345	I 345	DALLAS	Interstate Highway
TX	I 35	I 35	ATASCOSA	Interstate Highway
TX	I 35	I 35	BELL	Interstate Highway
TX	I 35	I 35	BEXAR	Interstate Highway
TX	I 35 LOWER LEVEL	I 35	BEXAR	Interstate Highway
TX	I 35 UPPER LEVEL	I 35	BEXAR	Interstate Highway
TX	I 35	I 35	COMAL	Interstate Highway
TX	I 35	I 35	COOKE	Interstate Highway
TX	I 35	I 35	COOKE	Interstate Highway
TX	I 35	I 35	DENTON	Interstate Highway
TX	I 35	I 35	DENTON	Interstate Highway
TX	I 35	I 35	FALLS	Interstate Highway
TX	I 35	I 35	FRIO	Interstate Highway
TX	I 35	I 35	GUADALUPE	Interstate Highway
TX	I 35	I 35	HAYS	Interstate Highway
TX	I 35	I 35	HILL	Interstate Highway
TX	I 35	I 35	LA SALLE	Interstate Highway
TX	I 35	I 35	MCLENNAN	Interstate Highway
TX	I 35	I 35	MEDINA	Interstate Highway
TX	I 35	I 35	TRAVIS	Interstate Highway
TX	I 35	I 35	WEBB	Interstate Highway
TX	I 35	I 35	WILLIAMSON	Interstate Highway
TX	I 35E	I 35E	DALLAS	Interstate Highway
TX	I 35E	I 35E	DENTON	Interstate Highway
TX	I 35E	I 35E	ELLIS	Interstate Highway
TX	I 35E	I 35E	HILL	Interstate Highway
TX	I 35W	I 35W	DENTON	Interstate Highway
TX	I 35W	I 35W	HILL	Interstate Highway
TX	I 35W	I 35W	JOHNSON	Interstate Highway

TX	I 35W	I 35W	TARRANT	Interstate Highway
TX	I 37	I 37	BEXAR	Interstate Highway
TX	I 410	I 410	BEXAR	Interstate Highway
TX	I 45	I 45	DALLAS	Interstate Highway
TX	I 45	I 45	ELLIS	Interstate Highway
TX	I 45	I 45	FREESTONE	Interstate Highway
TX	I 45	I 45	GALVESTON	Interstate Highway
TX	I 45	I 45	HARRIS	Interstate Highway
TX	I 45	I 45	LEON	Interstate Highway
TX	I 45	I 45	MADISON	Interstate Highway
TX	I 45	I 45	MONTGOMERY	Interstate Highway
TX	I 45	I 45	NAVARRO	Interstate Highway
TX	I 45	I 45	WALKER	Interstate Highway
TX	I 610	I 610	HARRIS	Interstate Highway
TX	I 635	I 635	DALLAS	Interstate Highway
TX	I 69	I 69	FORT BEND	Interstate Highway
TX	I 69	I 69	HARRIS	Interstate Highway
TX	I 69	I 69	MONTGOMERY	Interstate Highway
TX	I 69W	I 69W	WEBB	Interstate Highway
TX	I 820	I 820	TARRANT	Interstate Highway
TX	TX 146	TX 146	HARRIS	Other Controlled Access Highway
TX	TX 183	TX 183	DALLAS	Other Controlled Access Highway
TX	AIRPORT FWY	TX 183	TARRANT	Other Controlled Access Highway
TX	TX 225	TX 225	HARRIS	Other Controlled Access Highway
TX	TX 288	TX 288	HARRIS	Other Controlled Access Highway
TX	GULF ST	TX 380	JEFFERSON	Arterial or Major Collector
TX	US 290	US 290	HARRIS	Other Controlled Access Highway
TX	US 57	US 57	FRIO	Arterial or Major Collector

TX	SAUNDERS ST	US 59	WEBB	Arterial or Major Collector
TX	US 67	US 67	DALLAS	Other Controlled Access Highway
TX	US 75	US 75	COLLIN	Other Controlled Access Highway
TX	US 75	US 75	COLLIN	Other Controlled Access Highway
TX	US 75	US 75	DALLAS	Other Controlled Access Highway
TX	US 80	US 80	DALLAS	Other Controlled Access Highway
TX	PRESIDENT GEORGE BUSH TPKE		DALLAS	Other Controlled Access Highway
TX	DALLAS NORTH TOLLWAY		DALLAS	Other Controlled Access Highway
TX	AIRWAY BLVD		EL PASO	Arterial or Major Collector
TX	TROWBRIDGE DR		EL PASO	Arterial or Major Collector
TX	HARDY TOLL RD		HARRIS	Other Controlled Access Highway
TX	LOCKWOOD DR		HARRIS	Arterial or Major Collector
TX	WILL CLAYTON PKWY		HARRIS	Arterial or Major Collector
UT	I 15	I 15	BOX ELDER	Interstate Highway
UT	I 15	I 15	DAVIS	Interstate Highway
UT	I 15	I 15	JUAB	Interstate Highway
UT	I 15	I 15	SALT LAKE	Interstate Highway
UT	I 15	I 15	UTAH	Interstate Highway
UT	I 15	I 15	WEBER	Interstate Highway
UT	I 215	I 215	DAVIS	Interstate Highway
UT	I 215	I 215	SALT LAKE	Interstate Highway
UT	I 80	I 80	SALT LAKE	Interstate Highway
UT	I 80	I 80	TOOELE	Interstate Highway
UT	I 84	I 84	BOX ELDER	Interstate Highway
UT	I 84	I 84	WEBER	Interstate Highway
UT	SR 36	SR 36	TOOELE	Arterial or Major Collector
UT	E 6200 S		SALT LAKE	Arterial or Major Collector

VA	BELTLINE EXPY	I 195	RICHMOND CITY	Interstate Highway
VA	I 295	I 295	HENRICO	Interstate Highway
VA	I 295	I 295	PRINCE GEORGE	Interstate Highway
VA	I 395	I 395	ALEXANDRIA	Interstate Highway
VA	I 395	I 395	ARLINGTON	Interstate Highway
VA	I 395	I 395	FAIRFAX	Interstate Highway
VA	I 495	I 495	FAIRFAX	Interstate Highway
VA	I 64	I 64	RICHMOND CITY	Interstate Highway
VA	I 66	I 66	ARLINGTON	Interstate Highway
VA	I 66	I 66	FAIRFAX	Interstate Highway
VA	I 85	I 85	PETERSBURG	Interstate Highway
VA	I 95	I 95	ALEXANDRIA	Interstate Highway
VA	I 95	I 95	CAROLINE	Interstate Highway
VA	I 95	I 95	CHESTERFIELD	Interstate Highway
VA	I 95	I 95	COLONIAL HEIGHTS	Interstate Highway
VA	I 95	I 95	EMPORIA	Interstate Highway
VA	I 95	I 95	FAIRFAX	Interstate Highway
VA	I 95	I 95	FREDERICKSBURG	Interstate Highway
VA	I 95	I 95	GREENSVILLE	Interstate Highway
VA	I 95	I 95	HANOVER	Interstate Highway
VA	I 95	I 95	HENRICO	Interstate Highway
VA	I 95	I 95	PETERSBURG	Interstate Highway
VA	I 95	I 95	PRINCE GEORGE	Interstate Highway
VA	I 95	I 95	PRINCE WILLIAM	Interstate Highway
VA	I 95	I 95	RICHMOND CITY	Interstate Highway
VA	I 95	I 95	SPOTSYLVANIA	Interstate Highway
VA	I 95	I 95	STAFFORD	Interstate Highway
VA	I 95	I 95	SUSSEX	Interstate Highway
WA	I 205	I 205	CLARK	Interstate Highway
WA	I 405	I 405	KING	Interstate Highway
WA	I 405	I 405	SNOHOMISH	Interstate Highway

WA	I 5	I 5	CLARK	Interstate Highway
WA	I 5	I 5	COWLITZ	Interstate Highway
WA	I 5	I 5	KING	Interstate Highway
WA	I 5	I 5	LEWIS	Interstate Highway
WA	I 5	I 5	PIERCE	Interstate Highway
WA	I 5	I 5	SNOHOMISH	Interstate Highway
WA	I 5	I 5	THURSTON	Interstate Highway
WA	I 705	I 705	PIERCE	Interstate Highway
WA	I 90	I 90	KING	Interstate Highway
WA	I 90	I 90	SPOKANE	Interstate Highway
WA	SR 167	SR 167	KING	Other Controlled Access Highway
WA	SR 18	SR 18	KING	Other Controlled Access Highway
WA	SR 518	SR 518	KING	Other Controlled Access Highway
WA	US 2	US 2	SPOKANE	Other Controlled Access Highway
WI	I 41	I 41	KENOSHA	Interstate Highway
WI	I 41	I 41	MILWAUKEE	Interstate Highway
WI	I 41	I 41	RACINE	Interstate Highway
WI	I 41	I 41	WASHINGTON	Interstate Highway
WI	I 41	I 41	WAUKESHA	Interstate Highway
WI	I 43	I 43	MILWAUKEE	Interstate Highway
WI	I 43	I 43	WAUKESHA	Interstate Highway
WI	I 94	I 94	MILWAUKEE	Interstate Highway
WI	I 94	I 94	WAUKESHA	Interstate Highway
WY	I 25	I 25	LARAMIE	Interstate Highway
WY	I 80	I 80	ALBANY	Interstate Highway
WY	I 80	I 80	LARAMIE	Interstate Highway

Appendix E: List of Zero-Emission Freight Corridors in Phase 2

State	Road Name	Route Sign	County Name	Description
AL	I 10	I 10	BALDWIN	Interstate Highway
AL	I 10	I 10	MOBILE	Interstate Highway
AL	I 165	I 165	MOBILE	Interstate Highway
AL	I 20	I 20	CALHOUN	Interstate Highway
AL	I 20	I 20	CLEBURNE	Interstate Highway
AL	I 20	I 20	ST. CLAIR	Interstate Highway
AL	I 20	I 20	TALLADEGA	Interstate Highway
AL	I 65	I 65	BALDWIN	Interstate Highway
AL	I 65	I 65	BUTLER	Interstate Highway
AL	I 65	I 65	CONECUH	Interstate Highway
AL	I 65	I 65	ESCAMBIA	Interstate Highway
AL	I 65	I 65	LOWNDES	Interstate Highway
AL	I 65	I 65	MOBILE	Interstate Highway
AL	I 65	I 65	MONTGOMERY	Interstate Highway
AL	I 85	I 85	CHAMBERS	Interstate Highway
AL	I 85	I 85	LEE	Interstate Highway
AL	I 85	I 85	MACON	Interstate Highway
AL	I 85	I 85	MONTGOMERY	Interstate Highway
AZ	I 10	I 10	COCHISE	Interstate Highway
AZ	I 10	I 10	LA PAZ	Interstate Highway
AZ	I 10	I 10	MARICOPA	Interstate Highway
AZ	I 10	I 10	PIMA	Interstate Highway
AZ	I 10	I 10	PINAL	Interstate Highway
AZ	I 15	I 15	MOHAVE	Interstate Highway
AZ	I 17	I 17	MARICOPA	Interstate Highway
AZ	I 19	I 19	PIMA	Interstate Highway

AZ	SR 51	SR 51	MARICOPA	Other Controlled Access Highway
CA	SANTA MONICA FWY	I 10	LOS ANGELES	Interstate Highway
CA	I 10	I 10	LOS ANGELES	Interstate Highway
CA	I 10	I 10	RIVERSIDE	Interstate Highway
CA	I 10	I 10	SAN BERNARDINO	Interstate Highway
CA	I 105	I 105	LOS ANGELES	Interstate Highway
CA	HARBOR FREEWAY	I 110	LOS ANGELES	Interstate Highway
CA	I 15	I 15	RIVERSIDE	Interstate Highway
CA	I 15	I 15	SAN BERNARDINO	Interstate Highway
CA	I 15	I 15	SAN DIEGO	Interstate Highway
CA	I 205	I 205	ALAMEDA	Interstate Highway
CA	I 205	I 205	SAN JOAQUIN	Interstate Highway
CA	I 210	I 210	LOS ANGELES	Interstate Highway
CA	I 215	I 215	RIVERSIDE	Interstate Highway
CA	I 215	I 215	SAN BERNARDINO	Interstate Highway
CA	I 238	I 238	ALAMEDA	Interstate Highway
CA	I 280	I 280	SAN FRANCISCO	Interstate Highway
CA	I 280	I 280	SAN MATEO	Interstate Highway
CA	I 280	I 280	SANTA CLARA	Interstate Highway
CA	I 380	I 380	SAN MATEO	Interstate Highway
CA	SAN DIEGO FWY	I 405	LOS ANGELES	Interstate Highway
CA	SAN DIEGO FWY	I 405	ORANGE	Interstate Highway
CA	I 5	I 5	COLUSA	Interstate Highway
CA	I 5	I 5	FRESNO	Interstate Highway
CA	I 5	I 5	GLENN	Interstate Highway
CA	I 5	I 5	KERN	Interstate Highway
CA	I 5	I 5	KINGS	Interstate Highway
CA	I 5	I 5	LOS ANGELES	Interstate Highway
CA	I 5	I 5	MERCED	Interstate Highway
CA	SAN DIEGO FWY	I 5	ORANGE	Interstate Highway
CA	I 5	I 5	ORANGE	Interstate Highway

CA	I 5	I 5	SACRAMENTO	Interstate Highway
CA	SAN DIEGO FWY	I 5	SAN DIEGO	Interstate Highway
CA	I 5 LOCAL BYPASS LANES	I 5	SAN DIEGO	Interstate Highway
CA	I 5	I 5	SAN DIEGO	Interstate Highway
CA	I 5	I 5	SAN JOAQUIN	Interstate Highway
CA	I 5	I 5	SHASTA	Interstate Highway
CA	I 5	I 5	SISKIYOU	Interstate Highway
CA	I 5	I 5	STANISLAUS	Interstate Highway
CA	I 5	I 5	TEHAMA	Interstate Highway
CA	I 5	I 5	YOLO	Interstate Highway
CA	I 505	I 505	SOLANO	Interstate Highway
CA	I 580	I 580	ALAMEDA	Interstate Highway
CA	I 580	I 580	CONTRA COSTA	Interstate Highway
CA	I 580	I 580	MARIN	Interstate Highway
CA	I 580	I 580	SAN JOAQUIN	Interstate Highway
CA	I 605	I 605	LOS ANGELES	Interstate Highway
CA	I 605	I 605	ORANGE	Interstate Highway
CA	I 680	I 680	ALAMEDA	Interstate Highway
CA	I 680	I 680	CONTRA COSTA	Interstate Highway
CA	I 680	I 680	SANTA CLARA	Interstate Highway
CA	I 680	I 680	SOLANO	Interstate Highway
CA	I 710	I 710	LOS ANGELES	Interstate Highway
CA	I 780	I 780	SOLANO	Interstate Highway
CA	I 8	I 8	SAN DIEGO	Interstate Highway
CA	I 80	I 80	ALAMEDA	Interstate Highway
CA	I 80	I 80	CONTRA COSTA	Interstate Highway
CA	I 80	I 80	NAPA	Interstate Highway
CA	I 80	I 80	NEVADA	Interstate Highway
CA	I 80	I 80	PLACER	Interstate Highway
CA	I 80	I 80	SACRAMENTO	Interstate Highway
CA	I 80	I 80	SAN FRANCISCO	Interstate Highway

CA	I 80	I 80	SIERRA	Interstate Highway
CA	I 80	I 80	SOLANO	Interstate Highway
CA	I 80	I 80	YOLO	Interstate Highway
CA	I 805	I 805	SAN DIEGO	Interstate Highway
CA	I 5 LOCAL BYPASS LANES	I 805	SAN DIEGO	Interstate Highway
CA	I 880	I 880	ALAMEDA	Interstate Highway
CA	I 880	I 880	SANTA CLARA	Interstate Highway
CA	I 980	I 980	ALAMEDA	Interstate Highway
CA	SR 120	SR 120	SAN JOAQUIN	Other Controlled Access Highway
CA	SR 134	SR 134	LOS ANGELES	Other Controlled Access Highway
CA	SR 14	SR 14	LOS ANGELES	Other Controlled Access Highway
CA	SR 170	SR 170	LOS ANGELES	Other Controlled Access Highway
CA	SR 22	SR 22	ORANGE	Other Controlled Access Highway
CA	SR 23	SR 23	VENTURA	Other Controlled Access Highway
CA	SR 4	SR 4	SAN JOAQUIN	Other Controlled Access Highway
CA	SR 47	SR 47	LOS ANGELES	Other Controlled Access Highway
CA	COSTA MESA FWY	SR 55	ORANGE	Other Controlled Access Highway
CA	SR 57	SR 57	LOS ANGELES	Other Controlled Access Highway
CA	SR 57	SR 57	ORANGE	Other Controlled Access Highway
CA	SR 58	SR 58	KERN	Other Controlled Access Highway
CA	POMONA FWY	SR 60	LOS ANGELES	Other Controlled Access Highway
CA	SR 60	SR 60	LOS ANGELES	Other Controlled Access Highway
CA	SR 60	SR 60	RIVERSIDE	Other Controlled Access Highway

CA	POMONA FWY	SR 60	RIVERSIDE	Other Controlled Access Highway
CA	POMONA FWY	SR 60	SAN BERNARDINO	Other Controlled Access Highway
CA	SR 71	SR 71	LOS ANGELES	Other Controlled Access Highway
CA	LONG BEACH FWY	SR 710	LOS ANGELES	Other Controlled Access Highway
CA	SR 91	SR 91	LOS ANGELES	Other Controlled Access Highway
CA	SR 91	SR 91	ORANGE	Other Controlled Access Highway
CA	SR 91	SR 91	RIVERSIDE	Other Controlled Access Highway
CA	SR 99	SR 99	KERN	Other Controlled Access Highway
CA	SR 99	SR 99	MADERA	Other Controlled Access Highway
CA	SR 99	SR 99	MERCED	Other Controlled Access Highway
CA	SR 99	SR 99	MERCED	Arterial or Major Collector
CA	SR 99	SR 99	SACRAMENTO	Other Controlled Access Highway
CA	SR 99	SR 99	SAN JOAQUIN	Other Controlled Access Highway
CA	SR 99	SR 99	STANISLAUS	Other Controlled Access Highway
CA	US 101	US 101	LOS ANGELES	Other Controlled Access Highway
CA	US 101	US 101	SAN FRANCISCO	Other Controlled Access Highway
CA	US 101	US 101	SAN MATEO	Other Controlled Access Highway
CA	US 101	US 101	SANTA CLARA	Other Controlled Access Highway
CA	US 101	US 101	VENTURA	Other Controlled Access Highway
CA	US 50	US 50	SACRAMENTO	Other Controlled Access Highway

CA	US 50	US 50	YOLO	Other Controlled Access Highway
CA	I 580 TRUCK LANE		ALAMEDA	Express Lane (Truck Only)
CA	I 5 - TRUCK ROUTE S		LOS ANGELES	Express Lane (Truck Route)
CA	I 5 - TRUCK ROUTE N		LOS ANGELES	Express Lane (Truck Route)
CA	I 215 / SR 60 TRUCK LANE		RIVERSIDE	Express Lane (Truck Route)
CA	POMERADO RD		SAN DIEGO	Arterial or Major Collector
CA	LAUREL ST		SAN DIEGO	Arterial or Major Collector
CA	GRAPE ST		SAN DIEGO	Arterial or Major Collector
CA	HAWTHORNE ST		SAN DIEGO	Arterial or Major Collector
CA	CESAR CHAVEZ ST		SAN FRANCISCO	Arterial or Major Collector
CA	ROTH RD		SAN JOAQUIN	Arterial or Major Collector
CA	LAS POSAS RD		VENTURA	Arterial or Major Collector
CO	I 225	I 225	ADAMS	Interstate Highway
CO	I 225	I 225	ARAPAHOE	Interstate Highway
CO	I 225	I 225	DENVER	Interstate Highway
CO	I 25	I 25	ADAMS	Interstate Highway
CO	I 25	I 25	ARAPAHOE	Interstate Highway
CO	I 25	I 25	BROOMFIELD	Interstate Highway
CO	I 25	I 25	DENVER	Interstate Highway
CO	I 25	I 25	DOUGLAS	Interstate Highway
CO	I 25	I 25	EL PASO	Interstate Highway
CO	I 25	I 25	LARIMER	Interstate Highway
CO	I 25	I 25	WELD	Interstate Highway
CO	I 270	I 270	ADAMS	Interstate Highway
CO	I 270	I 270	DENVER	Interstate Highway
CO	I 70	I 70	ADAMS	Interstate Highway
CO	I 70	I 70	DENVER	Interstate Highway
CO	I 70	I 70	JEFFERSON	Interstate Highway
CO	I 76	I 76	ADAMS	Interstate Highway
CO	I 76	I 76	DENVER	Interstate Highway
CO	I 76	I 76	JEFFERSON	Interstate Highway

CT	I 291	I 291	HARTFORD	Interstate Highway
CT	I 684	I 684	FAIRFIELD	Interstate Highway
CT	I 84	I 84	HARTFORD	Interstate Highway
CT	I 84	I 84	TOLLAND	Interstate Highway
CT	I 84	I 84	WINDHAM	Interstate Highway
CT	I 90	I 90	TOLLAND	Interstate Highway
CT	I 91	I 91	HARTFORD	Interstate Highway
CT	I 91	I 91	MIDDLESEX	Interstate Highway
CT	I 91	I 91	NEW HAVEN	Interstate Highway
CT	I 95	I 95	FAIRFIELD	Interstate Highway
CT	I 95	I 95	MIDDLESEX	Interstate Highway
CT	I 95	I 95	NEW HAVEN	Interstate Highway
CT	I 95	I 95	NEW LONDON	Interstate Highway
DC	I 295	I 295	DISTRICT OF COLUMBIA	Interstate Highway
DC	I 395	I 395	DISTRICT OF COLUMBIA	Interstate Highway
DC	I 66	I 66	DISTRICT OF COLUMBIA	Interstate Highway
DC	I 695	I 695	DISTRICT OF COLUMBIA	Interstate Highway
DE	I 295	I 295	NEW CASTLE	Interstate Highway
DE	I 495	I 495	NEW CASTLE	Interstate Highway
DE	I 95	I 95	NEW CASTLE	Interstate Highway
FL	I 10	I 10	BAKER	Interstate Highway
FL	I 10	I 10	COLUMBIA	Interstate Highway
FL	I 10	I 10	DUVAL	Interstate Highway
FL	I 10	I 10	ESCAMBIA	Interstate Highway
FL	I 10	I 10	GADSDEN	Interstate Highway
FL	I 10	I 10	HOLMES	Interstate Highway
FL	I 10	I 10	JACKSON	Interstate Highway
FL	I 10	I 10	JEFFERSON	Interstate Highway
FL	I 10	I 10	LEON	Interstate Highway

FL	I 10	I 10	MADISON	Interstate Highway
FL	I 10	I 10	NASSAU	Interstate Highway
FL	I 10	I 10	OKALOOSA	Interstate Highway
FL	I 10	I 10	SANTA ROSA	Interstate Highway
FL	I 10	I 10	SUWANNEE	Interstate Highway
FL	I 10	I 10	WALTON	Interstate Highway
FL	I 10	I 10	WASHINGTON	Interstate Highway
FL	I 110	I 110	ESCAMBIA	Interstate Highway
FL	I 295	I 295	DUVAL	Interstate Highway
FL	I 595	I 595	BROWARD	Interstate Highway
FL	I 75	I 75	BROWARD	Interstate Highway
FL	I 75	I 75	MIAMI-DADE	Interstate Highway
FL	I 95	I 95	BREVARD	Interstate Highway
FL	I 95	I 95	BROWARD	Interstate Highway
FL	I 95	I 95	DUVAL	Interstate Highway
FL	I 95	I 95	FLAGLER	Interstate Highway
FL	I 95	I 95	INDIAN RIVER	Interstate Highway
FL	I 95	I 95	MARTIN	Interstate Highway
FL	I 95	I 95	MIAMI-DADE	Interstate Highway
FL	I 95	I 95	NASSAU	Interstate Highway
FL	I 95	I 95	PALM BEACH	Interstate Highway
FL	I 95	I 95	ST. JOHNS	Interstate Highway
FL	I 95	I 95	ST. LUCIE	Interstate Highway
FL	I 95	I 95	VOLUSIA	Interstate Highway
GA	I 16	I 16	BIBB	Interstate Highway
GA	I 16	I 16	BLECKLEY	Interstate Highway
GA	I 16	I 16	BRYAN	Interstate Highway
GA	I 16	I 16	BULLOCH	Interstate Highway
GA	I 16	I 16	CANDLER	Interstate Highway
GA	I 16	I 16	CHATHAM	Interstate Highway
GA	I 16	I 16	EFFINGHAM	Interstate Highway

GA	I 16	I 16	EMANUEL	Interstate Highway
GA	I 16	I 16	LAURENS	Interstate Highway
GA	I 16	I 16	TREUTLEN	Interstate Highway
GA	I 16	I 16	TWIGGS	Interstate Highway
GA	I 20	I 20	CARROLL	Interstate Highway
GA	I 20	I 20	COBB	Interstate Highway
GA	I 20	I 20	DEKALB	Interstate Highway
GA	I 20	I 20	DOUGLAS	Interstate Highway
GA	I 20	I 20	FULTON	Interstate Highway
GA	I 20	I 20	HARALSON	Interstate Highway
GA	I 20	I 20	MORGAN	Interstate Highway
GA	I 20	I 20	NEWTON	Interstate Highway
GA	I 20	I 20	ROCKDALE	Interstate Highway
GA	I 20	I 20	WALTON	Interstate Highway
GA	I 285	I 285	CLAYTON	Interstate Highway
GA	I 285	I 285	COBB	Interstate Highway
GA	I 285	I 285	DEKALB	Interstate Highway
GA	I 285	I 285	FULTON	Interstate Highway
GA	I 475	I 475	BIBB	Interstate Highway
GA	I 475	I 475	MONROE	Interstate Highway
GA	I 516	I 516	CHATHAM	Interstate Highway
GA	I 575	I 575	COBB	Interstate Highway
GA	I 675	I 675	CLAYTON	Interstate Highway
GA	I 675	I 675	DEKALB	Interstate Highway
GA	I 675	I 675	HENRY	Interstate Highway
GA	I 75	I 75	BARTOW	Interstate Highway
GA	I 75	I 75	BIBB	Interstate Highway
GA	I 75	I 75	BUTTS	Interstate Highway
GA	I 75	I 75	CATOOSA	Interstate Highway
GA	I 75	I 75	CHEROKEE	Interstate Highway
GA	I 75	I 75	CLAYTON	Interstate Highway

GA	I 75	I 75	COBB	Interstate Highway
GA	I 75	I 75	FULTON	Interstate Highway
GA	I 75	I 75	GORDON	Interstate Highway
GA	I 75	I 75	HENRY	Interstate Highway
GA	I 75	I 75	LAMAR	Interstate Highway
GA	I 75	I 75	MONROE	Interstate Highway
GA	I 75	I 75	SPALDING	Interstate Highway
GA	I 75	I 75	WHITFIELD	Interstate Highway
GA	I 85	I 85	BANKS	Interstate Highway
GA	I 85	I 85	BARROW	Interstate Highway
GA	I 85	I 85	CLAYTON	Interstate Highway
GA	I 85	I 85	COWETA	Interstate Highway
GA	I 85	I 85	DEKALB	Interstate Highway
GA	I 85	I 85	FRANKLIN	Interstate Highway
GA	I 85	I 85	FULTON	Interstate Highway
GA	I 85	I 85	GWINNETT	Interstate Highway
GA	I 85	I 85	HARRIS	Interstate Highway
GA	I 85	I 85	HART	Interstate Highway
GA	I 85	I 85	JACKSON	Interstate Highway
GA	I 85	I 85	MERIWETHER	Interstate Highway
GA	I 85	I 85	TROUP	Interstate Highway
GA	I 95	I 95	BRYAN	Interstate Highway
GA	I 95	I 95	CAMDEN	Interstate Highway
GA	I 95	I 95	CHATHAM	Interstate Highway
GA	I 95	I 95	EFFINGHAM	Interstate Highway
GA	I 95	I 95	GLYNN	Interstate Highway
GA	I 95	I 95	LIBERTY	Interstate Highway
GA	I 95	I 95	MCINTOSH	Interstate Highway
GA	I 985	I 985	GWINNETT	Interstate Highway
GA	SR 16	SR 16	BUTTS	Arterial or Major Collector
IA	I 80	I 80	ADAIR	Interstate Highway

IA	I 80	I 80	CASS	Interstate Highway
IA	I 80	I 80	CEDAR	Interstate Highway
IA	I 80	I 80	DALLAS	Interstate Highway
IA	I 80	I 80	IOWA	Interstate Highway
IA	I 80	I 80	JASPER	Interstate Highway
IA	I 80	I 80	JOHNSON	Interstate Highway
IA	I 80	I 80	MADISON	Interstate Highway
IA	I 80	I 80	POLK	Interstate Highway
IA	I 80	I 80	POTTAWATTAMIE	Interstate Highway
IA	I 80	I 80	POWESHIEK	Interstate Highway
IA	I 80	I 80	SCOTT	Interstate Highway
IL	KENNEDY EXPY	I 190	COOK	Interstate Highway
IL	I 255	I 255	MONROE	Interstate Highway
IL	I 270	I 270	MADISON	Interstate Highway
IL	I 290	I 290	COOK	Interstate Highway
IL	I 290	I 290	DUPAGE	Interstate Highway
IL	I 294	I 294	COOK	Interstate Highway
IL	I 294	I 294	DUPAGE	Interstate Highway
IL	I 294	I 294	LAKE	Interstate Highway
IL	I 355	I 355	COOK	Interstate Highway
IL	I 355	I 355	DUPAGE	Interstate Highway
IL	I 355	I 355	WILL	Interstate Highway
IL	I 39	I 39	LASALLE	Interstate Highway
IL	I 55	I 55	COOK	Interstate Highway
IL	I 55	I 55	DUPAGE	Interstate Highway
IL	I 55	I 55	GRUNDY	Interstate Highway
IL	I 55	I 55	LIVINGSTON	Interstate Highway
IL	I 55	I 55	LOGAN	Interstate Highway
IL	I 55	I 55	MACOUPIN	Interstate Highway
IL	I 55	I 55	MADISON	Interstate Highway
IL	I 55	I 55	MCLEAN	Interstate Highway

IL	I 55	I 55	MONTGOMERY	Interstate Highway
IL	I 55	I 55	SANGAMON	Interstate Highway
IL	I 55	I 55	ST. CLAIR	Interstate Highway
IL	I 55	I 55	WILL	Interstate Highway
IL	I 57	I 57	COOK	Interstate Highway
IL	I 57	I 57	WILL	Interstate Highway
IL	I 70	I 70	BOND	Interstate Highway
IL	I 70	I 70	CLARK	Interstate Highway
IL	I 70	I 70	CUMBERLAND	Interstate Highway
IL	I 70	I 70	EFFINGHAM	Interstate Highway
IL	I 70	I 70	FAYETTE	Interstate Highway
IL	I 70	I 70	MADISON	Interstate Highway
IL	I 70	I 70	ST. CLAIR	Interstate Highway
IL	I 80	I 80	BUREAU	Interstate Highway
IL	I 80	I 80	COOK	Interstate Highway
IL	I 80	I 80	GRUNDY	Interstate Highway
IL	I 80	I 80	HENRY	Interstate Highway
IL	I 80	I 80	LASALLE	Interstate Highway
IL	I 80	I 80	ROCK ISLAND	Interstate Highway
IL	I 80	I 80	WILL	Interstate Highway
IL	I 88	I 88	COOK	Interstate Highway
IL	I 88	I 88	DUPAGE	Interstate Highway
IL	I 88	I 88	KANE	Interstate Highway
IL	I 90	I 90	BOONE	Interstate Highway
IL	I 90	I 90	COOK	Interstate Highway
IL	KENNEDY EXPY	I 90	COOK	Interstate Highway
IL	I 90	I 90	KANE	Interstate Highway
IL	I 90	I 90	MCHENRY	Interstate Highway
IL	KENNEDY EXPY	I 94	COOK	Interstate Highway
IL	I 94	I 94	COOK	Interstate Highway
IL	I 94	I 94	LAKE	Interstate Highway

IN	I 65	I 65	JASPER	Interstate Highway
IN	I 65	I 65	LAKE	Interstate Highway
IN	I 65	I 65	NEWTON	Interstate Highway
IN	I 65	I 65	TIPPECANOE	Interstate Highway
IN	I 65	I 65	WHITE	Interstate Highway
IN	I 70	I 70	CLAY	Interstate Highway
IN	I 70	I 70	HANCOCK	Interstate Highway
IN	I 70	I 70	HENDRICKS	Interstate Highway
IN	I 70	I 70	HENRY	Interstate Highway
IN	I 70	I 70	MARION	Interstate Highway
IN	I 70	I 70	MORGAN	Interstate Highway
IN	I 70	I 70	PUTNAM	Interstate Highway
IN	I 70	I 70	VIGO	Interstate Highway
IN	I 70	I 70	WAYNE	Interstate Highway
IN	I 80	I 80	ELKHART	Interstate Highway
IN	I 80	I 80	LAGRANGE	Interstate Highway
IN	I 80	I 80	LAKE	Interstate Highway
IN	I 80	I 80	LAPORTE	Interstate Highway
IN	I 80	I 80	PORTER	Interstate Highway
IN	I 80	I 80	ST. JOSEPH	Interstate Highway
IN	I 80	I 80	STEUBEN	Interstate Highway
IN	I 90	I 90	LAKE	Interstate Highway
IN	I 94	I 94	LAKE	Interstate Highway
IN	I 94	I 94	LAPORTE	Interstate Highway
IN	I 94	I 94	PORTER	Interstate Highway
KY	I 75	I 75	KENTON	Interstate Highway
LA	I 10	I 10	ACADIA	Interstate Highway
LA	I 10	I 10	ASCENSION	Interstate Highway
LA	I 10	I 10	CALCASIEU	Interstate Highway
LA	I 10	I 10	EAST BATON ROUGE	Interstate Highway
LA	I 10	I 10	IBERVILLE	Interstate Highway

LA	I 10	I 10	JEFFERSON	Interstate Highway
LA	I 10	I 10	JEFFERSON DAVIS	Interstate Highway
LA	I 10	I 10	LAFAYETTE	Interstate Highway
LA	I 10	I 10	ORLEANS	Interstate Highway
LA	I 10	I 10	ST. CHARLES	Interstate Highway
LA	I 10	I 10	ST. JAMES	Interstate Highway
LA	I 10	I 10	ST. JOHN THE BAPTIST	Interstate Highway
LA	I 10	I 10	ST. MARTIN	Interstate Highway
LA	I 10	I 10	ST. TAMMANY	Interstate Highway
LA	I 10	I 10	WEST BATON ROUGE	Interstate Highway
MA	I 290	I 290	MIDDLESEX	Interstate Highway
MA	I 290	I 290	WORCESTER	Interstate Highway
MA	I 291	I 291	HAMPDEN	Interstate Highway
MA	I 495	I 495	ESSEX	Interstate Highway
MA	I 495	I 495	MIDDLESEX	Interstate Highway
MA	I 495	I 495	WORCESTER	Interstate Highway
MA	I 84	I 84	WORCESTER	Interstate Highway
MA	MASSACHUSETTS TPKE	I 90	MIDDLESEX	Interstate Highway
MA	MASSACHUSETTS TPKE	I 90	SUFFOLK	Interstate Highway
MA	MASSACHUSETTS TPKE	I 90	WORCESTER	Interstate Highway
MA	I 91	I 91	HAMPDEN	Interstate Highway
MA	I 93	I 93	ESSEX	Interstate Highway
MA	I 93	I 93	MIDDLESEX	Interstate Highway
MA	I 93	I 93	NORFOLK	Interstate Highway
MA	I 93	I 93	SUFFOLK	Interstate Highway
MA	I 93 N	I 93 N	MIDDLESEX	Interstate Highway
MA	I 93 N	I 93 N	SUFFOLK	Interstate Highway
MA	I 95	I 95	BRISTOL	Interstate Highway
MA	I 95	I 95	ESSEX	Interstate Highway
MA	I 95	I 95	MIDDLESEX	Interstate Highway
MA	I 95	I 95	NORFOLK	Interstate Highway

MA	MA 1A	MA 1A	SUFFOLK	Other Controlled Access Highway
MA	MA 2	MA 2	MIDDLESEX	Other Controlled Access Highway
MA	HARBORSIDE DR		SUFFOLK	Arterial or Major Collector
MD	I 195	I 195	ANNE ARUNDEL	Interstate Highway
MD	I 195	I 195	BALTIMORE	Interstate Highway
MD	I 270	I 270	MONTGOMERY	Interstate Highway
MD	I 270 - EXPRESS LANES	I 270	MONTGOMERY	Interstate Highway
MD	I 270 S	I 270 S	MONTGOMERY	Interstate Highway
MD	I 295	I 295	PRINCE GEORGE'S	Interstate Highway
MD	I 370	I 370	MONTGOMERY	Interstate Highway
MD	I 395	I 395	BALTIMORE CITY	Interstate Highway
MD	I 495	I 495	MONTGOMERY	Interstate Highway
MD	I 495	I 495	PRINCE GEORGE'S	Interstate Highway
MD	I 695	I 695	ANNE ARUNDEL	Interstate Highway
MD	I 695	I 695	ANNE ARUNDEL	Other Controlled Access Highway
MD	I 695	I 695	BALTIMORE	Interstate Highway
MD	I 70	I 70	BALTIMORE	Interstate Highway
MD	I 70	I 70	BALTIMORE CITY	Interstate Highway
MD	I 70	I 70	CARROLL	Interstate Highway
MD	I 70	I 70	FREDERICK	Interstate Highway
MD	I 70	I 70	HOWARD	Interstate Highway
MD	I 795	I 795	BALTIMORE	Interstate Highway
MD	I 81	I 81	WASHINGTON	Interstate Highway
MD	I 83	I 83	BALTIMORE	Interstate Highway
MD	JONES FALLS EXPY	I 83	BALTIMORE	Interstate Highway
MD	I 83	I 83	BALTIMORE CITY	Interstate Highway
MD	I 895	I 895	ANNE ARUNDEL	Interstate Highway
MD	I 895	I 895	BALTIMORE	Interstate Highway
MD	I 895	I 895	BALTIMORE CITY	Interstate Highway
MD	I 895	I 895	HOWARD	Interstate Highway

MD	I 95	I 95	BALTIMORE	Interstate Highway
MD	I 95	I 95	BALTIMORE CITY	Interstate Highway
MD	I 95	I 95	CECIL	Interstate Highway
MD	I 95	I 95	HARFORD	Interstate Highway
MD	I 95	I 95	HOWARD	Interstate Highway
MD	I 95	I 95	PRINCE GEORGE'S	Interstate Highway
MD	I 97	I 97	ANNE ARUNDEL	Interstate Highway
MD	I 97	I 97	ANNE ARUNDEL	Other Controlled Access Highway
MD	MD 100	MD 100	ANNE ARUNDEL	Other Controlled Access Highway
MD	MD 100	MD 100	HOWARD	Other Controlled Access Highway
MD	WATERLOO RD	MD 175	HOWARD	Arterial or Major Collector
MD	BALTIMORE-WASHINGTON PKWY	MD 295	ANNE ARUNDEL	Other Controlled Access Highway
MD	MD 995A	MD 995A	ANNE ARUNDEL	Arterial or Major Collector
MD	US 50	US 50	ANNE ARUNDEL	Other Controlled Access Highway
MD	US 50	US 50	ANNE ARUNDEL	Interstate Highway
MD	US 50	US 50	PRINCE GEORGE'S	Interstate Highway
MD	US 50	US 50	PRINCE GEORGE'S	Other Controlled Access Highway
MD	US 50	US 50	QUEEN ANNE'S	Other Controlled Access Highway
MD	AVIATION BLVD		ANNE ARUNDEL	Arterial or Major Collector
MD	HANOVER ST		BALTIMORE CITY	Arterial or Major Collector
MD	I 270 - LOCAL LANES		MONTGOMERY	Interstate Highway
ME	I 295	I 295	CUMBERLAND	Interstate Highway
ME	I 95	I 95	CUMBERLAND	Interstate Highway
ME	I 95	I 95	YORK	Interstate Highway
MI	I 194	I 194	CALHOUN	Interstate Highway
MI	I 275	I 275	MONROE	Interstate Highway
MI	I 275	I 275	WAYNE	Interstate Highway

MI	I 69	I 69	CALHOUN	Interstate Highway
MI	I 696	I 696	MACOMB	Interstate Highway
MI	I 696	I 696	OAKLAND	Interstate Highway
MI	I 75	I 75	MONROE	Interstate Highway
MI	I 75	I 75	OAKLAND	Interstate Highway
MI	I 75	I 75	WAYNE	Interstate Highway
MI	I 94	I 94	BERRIEN	Interstate Highway
MI	I 94	I 94	CALHOUN	Interstate Highway
MI	I 94	I 94	JACKSON	Interstate Highway
MI	I 94	I 94	KALAMAZOO	Interstate Highway
MI	I 94	I 94	WASHTENAW	Interstate Highway
MI	I 94	I 94	WAYNE	Interstate Highway
MI	I 96	I 96	OAKLAND	Interstate Highway
MI	I 96	I 96	WAYNE	Interstate Highway
MO	I 170	I 170	ST. LOUIS	Interstate Highway
MO	I 255	I 255	ST. LOUIS	Interstate Highway
MO	I 270	I 270	ST. LOUIS	Interstate Highway
MO	I 270	I 270	ST. LOUIS CITY	Interstate Highway
MO	I 44	I 44	CRAWFORD	Interstate Highway
MO	I 44	I 44	FRANKLIN	Interstate Highway
MO	I 44	I 44	PHELPS	Interstate Highway
MO	I 44	I 44	ST. LOUIS	Interstate Highway
MO	I 44	I 44	ST. LOUIS CITY	Interstate Highway
MO	I 55	I 55	JEFFERSON	Interstate Highway
MO	I 55	I 55	ST. LOUIS	Interstate Highway
MO	I 55	I 55	ST. LOUIS CITY	Interstate Highway
MO	I 64	I 55	ST. LOUIS CITY	Interstate Highway
MO	I 64	I 64	ST. CHARLES	Interstate Highway
MO	I 64	I 64	ST. LOUIS	Interstate Highway
MO	I 64	I 64	ST. LOUIS CITY	Interstate Highway
MO	I 70	I 70	CALLAWAY	Interstate Highway

MO	I 70	I 70	MONTGOMERY	Interstate Highway
MO	I 70	I 70	ST. CHARLES	Interstate Highway
MO	I 70	I 70	ST. LOUIS	Interstate Highway
MO	I 70	I 70	ST. LOUIS CITY	Interstate Highway
MO	I 70	I 70	WARREN	Interstate Highway
MS	I 10	I 10	HANCOCK	Interstate Highway
MS	I 10	I 10	HARRISON	Interstate Highway
MS	I 10	I 10	JACKSON	Interstate Highway
NC	I 277	I 277	MECKLENBURG	Interstate Highway
NC	I 40	I 40	ALAMANCE	Interstate Highway
NC	I 40	I 40	GUILFORD	Interstate Highway
NC	I 40	I 40	ORANGE	Interstate Highway
NC	CHARLOTTE BELTWAY	I 485	MECKLENBURG	Interstate Highway
NC	I 77	I 77	MECKLENBURG	Interstate Highway
NC	I 85	I 85	CABARRUS	Interstate Highway
NC	I 85	I 85	CLEVELAND	Interstate Highway
NC	I 85	I 85	DAVIDSON	Interstate Highway
NC	I 85	I 85	DURHAM	Interstate Highway
NC	I 85	I 85	GASTON	Interstate Highway
NC	I 85	I 85	GRANVILLE	Interstate Highway
NC	I 85	I 85	GUILFORD	Interstate Highway
NC	I 85	I 85	MECKLENBURG	Interstate Highway
NC	I 85	I 85	ORANGE	Interstate Highway
NC	I 85	I 85	RANDOLPH	Interstate Highway
NC	I 85	I 85	ROWAN	Interstate Highway
NC	I 85	I 85	VANCE	Interstate Highway
NC	I 85	I 85	WARREN	Interstate Highway
NC	I 95	I 95	CUMBERLAND	Interstate Highway
NC	I 95	I 95	HALIFAX	Interstate Highway
NC	I 95	I 95	HARNETT	Interstate Highway
NC	I 95	I 95	JOHNSTON	Interstate Highway

NC	I 95	I 95	NASH	Interstate Highway
NC	I 95	I 95	NORTHAMPTON	Interstate Highway
NC	I 95	I 95	ROBESON	Interstate Highway
NC	I 95	I 95	WILSON	Interstate Highway
NE	I 80	I 80	BUFFALO	Interstate Highway
NE	I 80	I 80	CASS	Interstate Highway
NE	I 80	I 80	CHEYENNE	Interstate Highway
NE	I 80	I 80	DAWSON	Interstate Highway
NE	I 80	I 80	DEUEL	Interstate Highway
NE	I 80	I 80	DOUGLAS	Interstate Highway
NE	I 80	I 80	HALL	Interstate Highway
NE	I 80	I 80	HAMILTON	Interstate Highway
NE	I 80	I 80	KEITH	Interstate Highway
NE	I 80	I 80	KIMBALL	Interstate Highway
NE	I 80	I 80	LANCASTER	Interstate Highway
NE	I 80	I 80	LINCOLN	Interstate Highway
NE	I 80	I 80	SARPY	Interstate Highway
NE	I 80	I 80	SEWARD	Interstate Highway
NE	I 80	I 80	YORK	Interstate Highway
NH	I 293	I 293	HILLSBOROUGH	Interstate Highway
NH	F E EVERETT TPKE	I 293	HILLSBOROUGH	Interstate Highway
NH	F E EVERETT TPKE	I 293	MERRIMACK	Interstate Highway
NH	I 393	I 393	MERRIMACK	Interstate Highway
NH	I 89	I 89	MERRIMACK	Interstate Highway
NH	I 93	I 93	HILLSBOROUGH	Interstate Highway
NH	F E EVERETT TPKE	I 93	MERRIMACK	Interstate Highway
NH	I 93	I 93	MERRIMACK	Interstate Highway
NH	I 93	I 93	ROCKINGHAM	Interstate Highway
NH	BLUE STAR TPKE	I 95	ROCKINGHAM	Interstate Highway
NJ	I 195	I 195	MERCER	Interstate Highway
NJ	I 278	I 278	UNION	Interstate Highway

NJ	I 280	I 280	ESSEX	Interstate Highway
NJ	I 280	I 280	HUDSON	Interstate Highway
NJ	I 280	I 280	MORRIS	Interstate Highway
NJ	I 287	I 287	BERGEN	Interstate Highway
NJ	I 287	I 287	MIDDLESEX	Interstate Highway
NJ	I 287	I 287	MORRIS	Interstate Highway
NJ	I 287	I 287	PASSAIC	Interstate Highway
NJ	I 287	I 287	SOMERSET	Interstate Highway
NJ	I 295	I 295	BURLINGTON	Interstate Highway
NJ	I 295	I 295	CAMDEN	Interstate Highway
NJ	I 295	I 295	SALEM	Interstate Highway
NJ	I 676	I 676	CAMDEN	Interstate Highway
NJ	I 676 - BEN FRANKLIN BRG TOLL PLAZA	I 676	CAMDEN	Interstate Highway
NJ	NORTH-SOUTH FWY	I 76	CAMDEN	Interstate Highway
NJ	I 76	I 76	CAMDEN	Interstate Highway
NJ	I 78	I 78	ESSEX	Interstate Highway
NJ	NEWARK BAY BRIDGE	I 78	ESSEX	Interstate Highway
NJ	I 78 - NEWARK EB TOLL PLAZA	I 78	ESSEX	Interstate Highway
NJ	NEWARK BAY BRIDGE	I 78	HUDSON	Interstate Highway
NJ	I 78	I 78	HUDSON	Interstate Highway
NJ	HOLLAND TUNNEL	I 78	HUDSON	Interstate Highway
NJ	I 78	I 78	HUNTERDON	Interstate Highway
NJ	I 78	I 78	SOMERSET	Interstate Highway
NJ	I 78	I 78	UNION	Interstate Highway
NJ	I 78	I 78	WARREN	Interstate Highway
NJ	I 80	I 80	BERGEN	Interstate Highway
NJ	I 80	I 80	ESSEX	Interstate Highway
NJ	I 80	I 80	MORRIS	Interstate Highway
NJ	I 80 - LOCAL LANES	I 80	MORRIS	Interstate Highway
NJ	I 80 - EXPRESS LANES	I 80	MORRIS	Interstate Highway
NJ	I 80	I 80	PASSAIC	Interstate Highway

NJ	I 80	I 80	SUSSEX	Interstate Highway
NJ	I 80	I 80	WARREN	Interstate Highway
NJ	I 95 EXT - LOCAL LANES	I 95	BERGEN	Interstate Highway
NJ	NEW JERSEY TPKE - EASTERN SPUR	I 95	BERGEN	Interstate Highway
NJ	I 95 NB APPROACH to I 80	I 95	BERGEN	Interstate Highway
NJ	NEW JERSEY TPKE - WESTERN SPUR	I 95	BERGEN	Interstate Highway
NJ	NEW JERSEY TPKE - I 95 EXT	I 95	BERGEN	Interstate Highway
NJ	I 95 EXT - EXPRESS LANES	I 95	BERGEN	Interstate Highway
NJ	GEORGE WASHINGTON BRG - LOWER DECK APPROACH	I 95	BERGEN	Interstate Highway
NJ	GEORGE WASHINGTON BRG - LOWER DECK	I 95	BERGEN	Interstate Highway
NJ	GEORGE WASHINGTON BRG - UPPER DECK	I 95	BERGEN	Interstate Highway
NJ	GEORGE WASHINGTON BRG - UPPER DECK APPROACH	I 95	BERGEN	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	BURLINGTON	Interstate Highway
NJ	I 95	I 95	BURLINGTON	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	ESSEX	Interstate Highway
NJ	NEW JERSEY TPKE - EASTERN SPUR	I 95	ESSEX	Interstate Highway
NJ	NEW JERSEY TPKE - WESTERN SPUR	I 95	ESSEX	Interstate Highway
NJ	NEW JERSEY TPKE - EASTERN SPUR	I 95	HUDSON	Interstate Highway
NJ	NEW JERSEY TPKE - WESTERN SPUR	I 95	HUDSON	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	MERCER	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	MIDDLESEX	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	UNION	Interstate Highway
NJ	US 1 - LOCAL LANES	US 1	ESSEX	Other Controlled Access Highway
NJ	I 76 CONNECTOR		CAMDEN	Other Controlled Access Highway
NM	I 10	I 10	DOÃ'A ANA	Interstate Highway
NM	I 10	I 10	GRANT	Interstate Highway
NM	I 10	I 10	HIDALGO	Interstate Highway
NM	I 10	I 10	LUNA	Interstate Highway

NV	I 15	I 15	CLARK	Interstate Highway
NV	I 515	I 515	CLARK	Interstate Highway
NV	I 80	I 80	CHURCHILL	Interstate Highway
NV	I 80	I 80	ELKO	Interstate Highway
NV	I 80	I 80	EUREKA	Interstate Highway
NV	I 80	I 80	HUMBOLDT	Interstate Highway
NV	I 80	I 80	LANDER	Interstate Highway
NV	I 80	I 80	LYON	Interstate Highway
NV	I 80	I 80	PERSHING	Interstate Highway
NV	I 80	I 80	STOREY	Interstate Highway
NV	I 80	I 80	WASHOE	Interstate Highway
NV	US 95	US 95	CLARK	Other Controlled Access Highway
NY	I 278	I 278	BRONX	Interstate Highway
NY	RFK TRIBOROUGH BRG	I 278	BRONX	Interstate Highway
NY	GOWANUS EXPY	I 278	KINGS	Interstate Highway
NY	BROOKLYN-QUEENS EXPY	I 278	KINGS	Interstate Highway
NY	VERRAZANO-NARROWS BRG - UPPER DECK APPROACH LANE	I 278	KINGS	Interstate Highway
NY	VERRAZANO-NARROWS BRG - UPPER DECK	I 278	KINGS	Interstate Highway
NY	RFK TRIBOROUGH BRG	I 278	NEW YORK	Interstate Highway
NY	RFK TRIBOROUGH BRG	I 278	QUEENS	Interstate Highway
NY	BROOKLYN-QUEENS EXPY	I 278	QUEENS	Interstate Highway
NY	GRAND CENTRAL PKWY	I 278	QUEENS	Interstate Highway
NY	I 278	I 278	RICHMOND	Interstate Highway
NY	VERRAZANO-NARROWS BRG - UPPER DECK APPROACH LANE	I 278	RICHMOND	Interstate Highway
NY	VERRAZANO-NARROWS BRG - LOWER DECK APPROACH LANE	I 278	RICHMOND	Interstate Highway
NY	VERRAZANO-NARROWS BRG - UPPER DECK	I 278	RICHMOND	Interstate Highway
NY	I 287	I 287	ROCKLAND	Interstate Highway
NY	CROSS-WESTCHESTER EXPY	I 287	WESTCHESTER	Interstate Highway

NY	I 290	I 290	ERIE	Interstate Highway
NY	CLEARVIEW EXPY	I 295	BRONX	Interstate Highway
NY	THROGS NECK BRG	I 295	BRONX	Interstate Highway
NY	CLEARVIEW EXPY	I 295	QUEENS	Interstate Highway
NY	THROGS NECK BRG	I 295	QUEENS	Interstate Highway
NY	ROCHESTER OUTER LP	I 390	MONROE	Interstate Highway
NY	GENESEE EXPY	I 390	MONROE	Interstate Highway
NY	BROOKLYN-BATTERY TUNNEL	I 478	KINGS	Interstate Highway
NY	BROOKLYN-BATTERY TUNNEL	I 478	NEW YORK	Interstate Highway
NY	I 490	I 490	GENESEE	Interstate Highway
NY	I 490	I 490	MONROE	Interstate Highway
NY	I 490	I 490	ONTARIO	Interstate Highway
NY	LONG ISLAND EXPY	I 495	NASSAU	Interstate Highway
NY	QUEENS-MIDTOWN TUNNEL	I 495	NEW YORK	Interstate Highway
NY	HORACE HARDING EXPY	I 495	QUEENS	Interstate Highway
NY	QUEENS-MIDTOWN EXPY	I 495	QUEENS	Interstate Highway
NY	QUEENS-MIDTOWN TUNNEL	I 495	QUEENS	Interstate Highway
NY	LONG ISLAND EXPY	I 495	SUFFOLK	Interstate Highway
NY	I 590	I 590	MONROE	Interstate Highway
NY	BRONX-WHITESTONE BRG	I 678	BRONX	Interstate Highway
NY	I 678	I 678	BRONX	Interstate Highway
NY	I 678	I 678	QUEENS	Interstate Highway
NY	BRONX-WHITESTONE BRG	I 678	QUEENS	Interstate Highway
NY	I 684	I 684	PUTNAM	Interstate Highway
NY	I 684	I 684	WESTCHESTER	Interstate Highway
NY	I 690	I 690	ONONDAGA	Interstate Highway
NY	THROGS NECK EXPY	I 695	BRONX	Interstate Highway
NY	HOLLAND TUNNEL	I 78	NEW YORK	Interstate Highway
NY	I 787	I 787	ALBANY	Interstate Highway
NY	I 81	I 81	ONONDAGA	Interstate Highway
NY	I 84	I 84	DUTCHESS	Interstate Highway

NY	I 84	I 84	ORANGE	Interstate Highway
NY	I 84	I 84	PUTNAM	Interstate Highway
NY	NEW YORK STATE THWY	I 87	ALBANY	Interstate Highway
NY	ADIRONDACK NORTHWAY	I 87	ALBANY	Interstate Highway
NY	I 87/I 90	I 87	ALBANY	Interstate Highway
NY	I 87	I 87	ALBANY	Interstate Highway
NY	I 87	I 87	BRONX	Interstate Highway
NY	MAJOR DEEGAN EXPY	I 87	BRONX	Interstate Highway
NY	NEW YORK STATE THWY	I 87	GREENE	Interstate Highway
NY	NEW YORK STATE THWY	I 87	ORANGE	Interstate Highway
NY	NEW YORK STATE THWY	I 87	ROCKLAND	Interstate Highway
NY	TAPPAN ZEE BRG	I 87	ROCKLAND	Interstate Highway
NY	ADIRONDACK NORTHWAY	I 87	SARATOGA	Interstate Highway
NY	NEW YORK STATE THWY	I 87	ULSTER	Interstate Highway
NY	NEW YORK STATE THWY	I 87	WESTCHESTER	Interstate Highway
NY	TAPPAN ZEE BRG	I 87	WESTCHESTER	Interstate Highway
NY	I 90	I 90	ALBANY	Interstate Highway
NY	NEW YORK STATE THWY	I 90	CAYUGA	Interstate Highway
NY	NEW YORK STATE THWY	I 90	ERIE	Interstate Highway
NY	NEW YORK STATE THWY	I 90	GENESEE	Interstate Highway
NY	NEW YORK STATE THWY	I 90	MONROE	Interstate Highway
NY	NEW YORK STATE THWY	I 90	ONONDAGA	Interstate Highway
NY	NEW YORK STATE THWY	I 90	ONTARIO	Interstate Highway
NY	I 90	I 90	RENSSELAER	Interstate Highway
NY	NEW YORK STATE THWY	I 90	SENECA	Interstate Highway
NY	NEW ENGLAND THWY	I 95	BRONX	Interstate Highway
NY	BRUCKNER EXPY	I 95	BRONX	Interstate Highway
NY	CROSS BRONX EXPY	I 95	BRONX	Interstate Highway
NY	ALEXANDER HAMILTON BRG	I 95	BRONX	Interstate Highway
NY	ALEXANDER HAMILTON BRG	I 95	NEW YORK	Interstate Highway
NY	I 95	I 95	NEW YORK	Interstate Highway

NY	GEORGE WASHINGTON BRIDGE - LOWER	I 95	NEW YORK	Interstate Highway
NY	GEORGE WASHINGTON BRIDGE - UPPER	I 95	NEW YORK	Interstate Highway
NY	NEW ENGLAND THWY	I 95	WESTCHESTER	Interstate Highway
NY	I 990	I 990	ERIE	Interstate Highway
NY	SHERIDAN EXPY	NY 895	BRONX	Other Controlled Access Highway
NY	EAST AVE	SR 96	MONROE	Arterial or Major Collector
NY	BRUCKNER EXPY		BRONX	Arterial or Major Collector
NY	39TH ST		KINGS	Arterial or Major Collector
OH	I 270	I 270	FRANKLIN	Interstate Highway
OH	I 271	I 271	SUMMIT	Interstate Highway
OH	I 275	I 275	HAMILTON	Interstate Highway
OH	I 471	I 471	HAMILTON	Interstate Highway
OH	I 475	I 475	LUCAS	Interstate Highway
OH	I 475	I 475	WOOD	Interstate Highway
OH	I 480	I 480	LORAIN	Interstate Highway
OH	I 670	I 670	FRANKLIN	Interstate Highway
OH	I 675	I 675	CLARK	Interstate Highway
OH	I 675	I 675	MONTGOMERY	Interstate Highway
OH	I 680	I 680	MAHONING	Interstate Highway
OH	I 70	I 70	BELMONT	Interstate Highway
OH	I 70	I 70	CLARK	Interstate Highway
OH	I 70	I 70	FAIRFIELD	Interstate Highway
OH	I 70	I 70	FRANKLIN	Interstate Highway
OH	I 70	I 70	GUERNSEY	Interstate Highway
OH	I 70	I 70	LICKING	Interstate Highway
OH	I 70	I 70	MADISON	Interstate Highway
OH	I 70	I 70	MONTGOMERY	Interstate Highway
OH	I 70	I 70	MUSKINGUM	Interstate Highway
OH	I 70	I 70	PREBLE	Interstate Highway
OH	I 71	I 71	ASHLAND	Interstate Highway

OH	I 71	I 71	DELAWARE	Interstate Highway
OH	I 71	I 71	FRANKLIN	Interstate Highway
OH	I 71	I 71	HAMILTON	Interstate Highway
OH	I 71	I 71	MORROW	Interstate Highway
OH	I 71	I 71	PICKAWAY	Interstate Highway
OH	I 71	I 71	RICHLAND	Interstate Highway
OH	I 71	I 71	WAYNE	Interstate Highway
OH	I 75	I 75	ALLEN	Interstate Highway
OH	I 75	I 75	AUGLAIZE	Interstate Highway
OH	I 75	I 75	BUTLER	Interstate Highway
OH	I 75	I 75	HAMILTON	Interstate Highway
OH	I 75	I 75	HANCOCK	Interstate Highway
OH	I 75	I 75	LUCAS	Interstate Highway
OH	I 75	I 75	MIAMI	Interstate Highway
OH	I 75	I 75	MONTGOMERY	Interstate Highway
OH	I 75	I 75	SHELBY	Interstate Highway
OH	I 75	I 75	WARREN	Interstate Highway
OH	I 75	I 75	WOOD	Interstate Highway
OH	I 76	I 76	MAHONING	Interstate Highway
OH	I 77	I 77	GUERNSEY	Interstate Highway
OH	I 80	I 80	CUYAHOGA	Interstate Highway
OH	I 80	I 80	ERIE	Interstate Highway
OH	I 80	I 80	FULTON	Interstate Highway
OH	I 80	I 80	LORAIN	Interstate Highway
OH	I 80	I 80	LUCAS	Interstate Highway
OH	I 80	I 80	MAHONING	Interstate Highway
OH	I 80	I 80	OTTAWA	Interstate Highway
OH	I 80	I 80	PORTAGE	Interstate Highway
OH	I 80	I 80	SANDUSKY	Interstate Highway
OH	I 80	I 80	SUMMIT	Interstate Highway
OH	I 80	I 80	TRUMBULL	Interstate Highway

OH	I 80	I 80	WILLIAMS	Interstate Highway
OH	I 80	I 80	WOOD	Interstate Highway
OH	I 90	I 90	CUYAHOGA	Interstate Highway
OH	I 90	I 90	LORAIN	Interstate Highway
OK	I 35	I 35	CARTER	Interstate Highway
OK	I 35	I 35	LOVE	Interstate Highway
OR	I 205	I 205	CLACKAMAS	Interstate Highway
OR	I 205	I 205	MULTNOMAH	Interstate Highway
OR	I 205	I 205	WASHINGTON	Interstate Highway
OR	I 405	I 405	MULTNOMAH	Interstate Highway
OR	I 5	I 5	CLACKAMAS	Interstate Highway
OR	I 5	I 5	DOUGLAS	Interstate Highway
OR	I 5	I 5	JACKSON	Interstate Highway
OR	I 5	I 5	JOSEPHINE	Interstate Highway
OR	I 5	I 5	LANE	Interstate Highway
OR	I 5	I 5	LINN	Interstate Highway
OR	I 5	I 5	MARION	Interstate Highway
OR	I 5	I 5	MULTNOMAH	Interstate Highway
OR	I 5	I 5	WASHINGTON	Interstate Highway
OR	I 84	I 84	MULTNOMAH	Interstate Highway
OR	US 30	US 30	MULTNOMAH	Other Controlled Access Highway
OR	BELMONT ST		MULTNOMAH	Arterial or Major Collector
PA	I 180	I 180	NORTHUMBERLAND	Interstate Highway
PA	I 276	I 276	BUCKS	Interstate Highway
PA	I 283	I 283	DAUPHIN	Interstate Highway
PA	I 376	I 376	MERCER	Interstate Highway
PA	I 380	I 380	LACKAWANNA	Interstate Highway
PA	I 476	I 476	DELAWARE	Interstate Highway
PA	I 476	I 476	LACKAWANNA	Interstate Highway
PA	I 476	I 476	LEHIGH	Interstate Highway
PA	I 476	I 476	LUZERNE	Interstate Highway

PA	I 476	I 476	MONTGOMERY	Interstate Highway
PA	I 676	I 676	PHILADELPHIA	Interstate Highway
PA	I 70	I 70	BEDFORD	Interstate Highway
PA	I 70	I 70	FULTON	Interstate Highway
PA	I 70	I 70	WASHINGTON	Interstate Highway
PA	I 70	I 70	WESTMORELAND	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	ALLEGHENY	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	BEDFORD	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	BUTLER	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	CUMBERLAND	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	DAUPHIN	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	FRANKLIN	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	FULTON	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	HUNTINGDON	Interstate Highway
PA	SCHUYKILL EXPY	I 76	MONTGOMERY	Interstate Highway
PA	SCHUYKILL EXPY	I 76	PHILADELPHIA	Interstate Highway
PA	WALT WHITMAN BRG	I 76	PHILADELPHIA	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	SOMERSET	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	WESTMORELAND	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	YORK	Interstate Highway
PA	I 78	I 78	BERKS	Interstate Highway
PA	I 78	I 78	LEBANON	Interstate Highway
PA	I 78	I 78	LEHIGH	Interstate Highway
PA	I 78	I 78	NORTHAMPTON	Interstate Highway
PA	I 79	I 79	ALLEGHENY	Interstate Highway
PA	I 80	I 80	BUTLER	Interstate Highway
PA	I 80	I 80	CARBON	Interstate Highway
PA	I 80	I 80	CENTRE	Interstate Highway
PA	I 80	I 80	CLARION	Interstate Highway
PA	I 80	I 80	CLEARFIELD	Interstate Highway
PA	I 80	I 80	CLINTON	Interstate Highway

PA	I 80	I 80	COLUMBIA	Interstate Highway
PA	I 80	I 80	JEFFERSON	Interstate Highway
PA	I 80	I 80	LUZERNE	Interstate Highway
PA	I 80	I 80	MERCER	Interstate Highway
PA	I 80	I 80	MONROE	Interstate Highway
PA	I 80	I 80	MONTOUR	Interstate Highway
PA	I 80	I 80	NORTHUMBERLAND	Interstate Highway
PA	I 80	I 80	UNION	Interstate Highway
PA	I 80	I 80	VENANGO	Interstate Highway
PA	I 81	I 81	CUMBERLAND	Interstate Highway
PA	I 81	I 81	DAUPHIN	Interstate Highway
PA	I 81	I 81	FRANKLIN	Interstate Highway
PA	I 81	I 81	LACKAWANNA	Interstate Highway
PA	I 81	I 81	LEBANON	Interstate Highway
PA	I 81	I 81	LUZERNE	Interstate Highway
PA	I 81	I 81	SCHUYLKILL	Interstate Highway
PA	I 83	I 83	CUMBERLAND	Interstate Highway
PA	I 83	I 83	DAUPHIN	Interstate Highway
PA	I 83	I 83	YORK	Interstate Highway
PA	I 84	I 84	LACKAWANNA	Interstate Highway
PA	I 95	I 95	BUCKS	Interstate Highway
PA	I 95	I 95	DELAWARE	Interstate Highway
PA	I 95	I 95	PHILADELPHIA	Interstate Highway
PA	MARKET ST	SR 114	CUMBERLAND	Arterial or Major Collector
PA	US 1	US 1	BUCKS	Other Controlled Access Highway
PA	US 22	US 22	DAUPHIN	Other Controlled Access Highway
PA	US 30	US 30	YORK	Other Controlled Access Highway
PA	US 322	US 322	DAUPHIN	Other Controlled Access Highway
PA	BATH ST		PHILADELPHIA	Arterial or Major Collector

PA	VARE ST		PHILADELPHIA	Frontage/Service Road
PA	I 95 NB COLLECTOR/DISTRIBUTOR LANE		PHILADELPHIA	Collector/Distributor Lane
RI	I 195	I 195	PROVIDENCE	Interstate Highway
RI	I 295	I 295	KENT	Interstate Highway
RI	I 95	I 95	KENT	Interstate Highway
RI	I 95	I 95	PROVIDENCE	Interstate Highway
RI	I 95	I 95	WASHINGTON	Interstate Highway
RI	RI 4	RI 4	KENT	Other Controlled Access Highway
SC	I 26	I 26	BERKELEY	Interstate Highway
SC	I 26	I 26	CALHOUN	Interstate Highway
SC	I 26	I 26	CHARLESTON	Interstate Highway
SC	I 26	I 26	DORCHESTER	Interstate Highway
SC	I 26	I 26	LAURENS	Interstate Highway
SC	I 26	I 26	LEXINGTON	Interstate Highway
SC	I 26	I 26	NEWBERRY	Interstate Highway
SC	I 26	I 26	ORANGEBURG	Interstate Highway
SC	I 26	I 26	RICHLAND	Interstate Highway
SC	I 26	I 26	SPARTANBURG	Interstate Highway
SC	I 526	I 526	BERKELEY	Interstate Highway
SC	I 526	I 526	CHARLESTON	Interstate Highway
SC	I 77	I 77	YORK	Interstate Highway
SC	I 85	I 85	ANDERSON	Interstate Highway
SC	I 85	I 85	CHEROKEE	Interstate Highway
SC	I 85	I 85	GREENVILLE	Interstate Highway
SC	I 85	I 85	OCONEE	Interstate Highway
SC	I 85	I 85	SPARTANBURG	Interstate Highway
SC	I 95	I 95	CLARENDON	Interstate Highway
SC	I 95	I 95	COLLETON	Interstate Highway
SC	I 95	I 95	DARLINGTON	Interstate Highway
SC	I 95	I 95	DILLON	Interstate Highway

SC	I 95	I 95	DORCHESTER	Interstate Highway
SC	I 95	I 95	FLORENCE	Interstate Highway
SC	I 95	I 95	HAMPTON	Interstate Highway
SC	I 95	I 95	JASPER	Interstate Highway
SC	I 95	I 95	MARLBORO	Interstate Highway
SC	I 95	I 95	ORANGEBURG	Interstate Highway
SC	I 95	I 95	SUMTER	Interstate Highway
SC	SR 327	SR 327	FLORENCE	Arterial or Major Collector
TN	I 24	I 24	HAMILTON	Interstate Highway
TN	I 75	I 75	BRADLEY	Interstate Highway
TN	I 75	I 75	HAMILTON	Interstate Highway
TX	I 10	I 10	AUSTIN	Interstate Highway
TX	I 10	I 10	BEXAR	Interstate Highway
TX	I 10	I 10	CALDWELL	Interstate Highway
TX	I 10	I 10	CHAMBERS	Interstate Highway
TX	I 10	I 10	COLORADO	Interstate Highway
TX	I 10	I 10	CROCKETT	Interstate Highway
TX	I 10	I 10	CULBERSON	Interstate Highway
TX	I 10	I 10	EL PASO	Interstate Highway
TX	I 10	I 10	FAYETTE	Interstate Highway
TX	I 10	I 10	FORT BEND	Interstate Highway
TX	I 10	I 10	GILLESPIE	Interstate Highway
TX	I 10	I 10	GONZALES	Interstate Highway
TX	I 10	I 10	GUADALUPE	Interstate Highway
TX	I 10	I 10	HARRIS	Interstate Highway
TX	I 10	I 10	HUDSPETH	Interstate Highway
TX	I 10	I 10	JEFF DAVIS	Interstate Highway
TX	I 10	I 10	JEFFERSON	Interstate Highway
TX	I 10	I 10	KENDALL	Interstate Highway
TX	I 10	I 10	KERR	Interstate Highway
TX	I 10	I 10	KIMBLE	Interstate Highway

TX	I 10	I 10	ORANGE	Interstate Highway
TX	I 10	I 10	PECOS	Interstate Highway
TX	I 10	I 10	REEVES	Interstate Highway
TX	I 10	I 10	SUTTON	Interstate Highway
TX	I 10	I 10	WALLER	Interstate Highway
TX	I 110	I 110	EL PASO	Interstate Highway
TX	I 14	I 14	BELL	Interstate Highway
TX	I 20	I 20	DALLAS	Interstate Highway
TX	I 20	I 20	EASTLAND	Interstate Highway
TX	I 20	I 20	ERATH	Interstate Highway
TX	I 20	I 20	KAUFMAN	Interstate Highway
TX	I 20	I 20	PALO PINTO	Interstate Highway
TX	I 20	I 20	PARKER	Interstate Highway
TX	I 20	I 20	SMITH	Interstate Highway
TX	I 20	I 20	TARRANT	Interstate Highway
TX	I 20	I 20	VAN ZANDT	Interstate Highway
TX	I 30	I 30	DALLAS	Interstate Highway
TX	TOM LANDRY FWY	I 30	DALLAS	Interstate Highway
TX	I 30	I 30	FRANKLIN	Interstate Highway
TX	I 30	I 30	HOPKINS	Interstate Highway
TX	I 30	I 30	HUNT	Interstate Highway
TX	I 30	I 30	PARKER	Interstate Highway
TX	I 30	I 30	ROCKWALL	Interstate Highway
TX	I 30	I 30	TARRANT	Interstate Highway
TX	TOM LANDRY FWY	I 30	TARRANT	Interstate Highway
TX	I 30	I 30	TITUS	Interstate Highway
TX	I 345	I 345	DALLAS	Other Controlled Access Highway
TX	I 345	I 345	DALLAS	Interstate Highway
TX	I 35	I 35	ATASCOSA	Interstate Highway
TX	I 35	I 35	BELL	Interstate Highway
TX	I 35	I 35	BEXAR	Interstate Highway

TX	I 35 LOWER LEVEL	I 35	BEXAR	Interstate Highway
TX	I 35 UPPER LEVEL	I 35	BEXAR	Interstate Highway
TX	I 35	I 35	COMAL	Interstate Highway
TX	I 35	I 35	COOKE	Interstate Highway
TX	I 35	I 35	DENTON	Interstate Highway
TX	I 35	I 35	FALLS	Interstate Highway
TX	I 35	I 35	FRIO	Interstate Highway
TX	I 35	I 35	GUADALUPE	Interstate Highway
TX	I 35	I 35	HAYS	Interstate Highway
TX	I 35	I 35	HILL	Interstate Highway
TX	I 35	I 35	LA SALLE	Interstate Highway
TX	I 35	I 35	MCLENNAN	Interstate Highway
TX	I 35	I 35	MEDINA	Interstate Highway
TX	I 35	I 35	TRAVIS	Interstate Highway
TX	I 35	I 35	WEBB	Interstate Highway
TX	I 35	I 35	WILLIAMSON	Interstate Highway
TX	I 35E	I 35E	DALLAS	Interstate Highway
TX	I 35E	I 35E	DENTON	Interstate Highway
TX	I 35E	I 35E	ELLIS	Interstate Highway
TX	I 35E	I 35E	HILL	Interstate Highway
TX	I 35W	I 35W	DENTON	Interstate Highway
TX	I 35W	I 35W	HILL	Interstate Highway
TX	I 35W	I 35W	JOHNSON	Interstate Highway
TX	I 35W	I 35W	TARRANT	Interstate Highway
TX	I 37	I 37	BEXAR	Interstate Highway
TX	I 410	I 410	BEXAR	Interstate Highway
TX	I 45	I 45	DALLAS	Interstate Highway
TX	I 45	I 45	ELLIS	Interstate Highway
TX	I 45	I 45	FREESTONE	Interstate Highway
TX	I 45	I 45	GALVESTON	Interstate Highway
TX	I 45	I 45	HARRIS	Interstate Highway

TX	I 45	I 45	LEON	Interstate Highway
TX	I 45	I 45	MADISON	Interstate Highway
TX	I 45	I 45	MONTGOMERY	Interstate Highway
TX	I 45	I 45	NAVARRO	Interstate Highway
TX	I 45	I 45	WALKER	Interstate Highway
TX	I 610	I 610	HARRIS	Interstate Highway
TX	I 635	I 635	DALLAS	Interstate Highway
TX	I 69	I 69	FORT BEND	Interstate Highway
TX	I 69	I 69	HARRIS	Interstate Highway
TX	I 69	I 69	MONTGOMERY	Interstate Highway
TX	I 69W	I 69W	WEBB	Interstate Highway
TX	I 820	I 820	TARRANT	Interstate Highway
TX	TX 146	TX 146	HARRIS	Other Controlled Access Highway
TX	TX 183	TX 183	DALLAS	Other Controlled Access Highway
TX	AIRPORT FWY	TX 183	TARRANT	Other Controlled Access Highway
TX	TX 225	TX 225	HARRIS	Other Controlled Access Highway
TX	TX 288	TX 288	HARRIS	Other Controlled Access Highway
TX	GULF ST	TX 380	JEFFERSON	Arterial or Major Collector
TX	US 290	US 290	HARRIS	Other Controlled Access Highway
TX	US 57	US 57	FRIO	Arterial or Major Collector
TX	SAUNDERS ST	US 59	WEBB	Arterial or Major Collector
TX	US 67	US 67	DALLAS	Other Controlled Access Highway
TX	US 75	US 75	COLLIN	Other Controlled Access Highway
TX	US 75	US 75	DALLAS	Other Controlled Access Highway
TX	US 80	US 80	DALLAS	Other Controlled Access Highway

TX	PRESIDENT GEORGE BUSH TPKE		DALLAS	Other Controlled Access Highway
TX	DALLAS NORTH TOLLWAY		DALLAS	Other Controlled Access Highway
TX	AIRWAY BLVD		EL PASO	Arterial or Major Collector
TX	TROWBRIDGE DR		EL PASO	Arterial or Major Collector
TX	HARDY TOLL RD		HARRIS	Other Controlled Access Highway
TX	LOCKWOOD DR		HARRIS	Arterial or Major Collector
TX	WILL CLAYTON PKWY		HARRIS	Arterial or Major Collector
UT	I 15	I 15	BEAVER	Interstate Highway
UT	I 15	I 15	BOX ELDER	Interstate Highway
UT	I 15	I 15	DAVIS	Interstate Highway
UT	I 15	I 15	IRON	Interstate Highway
UT	I 15	I 15	JUAB	Interstate Highway
UT	I 15	I 15	MILLARD	Interstate Highway
UT	I 15	I 15	SALT LAKE	Interstate Highway
UT	I 15	I 15	UTAH	Interstate Highway
UT	I 15	I 15	WASHINGTON	Interstate Highway
UT	I 15	I 15	WEBER	Interstate Highway
UT	I 215	I 215	DAVIS	Interstate Highway
UT	I 215	I 215	SALT LAKE	Interstate Highway
UT	I 80	I 80	SALT LAKE	Interstate Highway
UT	I 80	I 80	SUMMIT	Interstate Highway
UT	I 80	I 80	TOOELE	Interstate Highway
UT	I 84	I 84	BOX ELDER	Interstate Highway
UT	I 84	I 84	WEBER	Interstate Highway
UT	SR 36	SR 36	TOOELE	Arterial or Major Collector
UT	E 6200 S		SALT LAKE	Arterial or Major Collector
VA	BELTLINE EXPY	I 195	RICHMOND CITY	Interstate Highway
VA	I 295	I 295	HENRICO	Interstate Highway
VA	I 295	I 295	PRINCE GEORGE	Interstate Highway
VA	I 395	I 395	ALEXANDRIA	Interstate Highway

VA	I 395	I 395	ARLINGTON	Interstate Highway
VA	I 395	I 395	FAIRFAX	Interstate Highway
VA	I 495	I 495	FAIRFAX	Interstate Highway
VA	I 64	I 64	RICHMOND CITY	Interstate Highway
VA	I 66	I 66	ARLINGTON	Interstate Highway
VA	I 66	I 66	FAIRFAX	Interstate Highway
VA	I 85	I 85	BRUNSWICK	Interstate Highway
VA	I 85	I 85	DINWIDDIE	Interstate Highway
VA	I 85	I 85	MECKLENBURG	Interstate Highway
VA	I 85	I 85	PETERSBURG	Interstate Highway
VA	I 95	I 95	ALEXANDRIA	Interstate Highway
VA	I 95	I 95	CAROLINE	Interstate Highway
VA	I 95	I 95	CHESTERFIELD	Interstate Highway
VA	I 95	I 95	COLONIAL HEIGHTS	Interstate Highway
VA	I 95	I 95	EMPORIA	Interstate Highway
VA	I 95	I 95	FAIRFAX	Interstate Highway
VA	I 95	I 95	FREDERICKSBURG	Interstate Highway
VA	I 95	I 95	GREENSVILLE	Interstate Highway
VA	I 95	I 95	HANOVER	Interstate Highway
VA	I 95	I 95	HENRICO	Interstate Highway
VA	I 95	I 95	PETERSBURG	Interstate Highway
VA	I 95	I 95	PRINCE GEORGE	Interstate Highway
VA	I 95	I 95	PRINCE WILLIAM	Interstate Highway
VA	I 95	I 95	RICHMOND CITY	Interstate Highway
VA	I 95	I 95	SPOTSYLVANIA	Interstate Highway
VA	I 95	I 95	STAFFORD	Interstate Highway
VA	I 95	I 95	SUSSEX	Interstate Highway
WA	I 205	I 205	CLARK	Interstate Highway
WA	I 405	I 405	KING	Interstate Highway
WA	I 405	I 405	SNOHOMISH	Interstate Highway
WA	I 5	I 5	CLARK	Interstate Highway

WA	I 5	I 5	COWLITZ	Interstate Highway
WA	I 5	I 5	KING	Interstate Highway
WA	I 5	I 5	LEWIS	Interstate Highway
WA	I 5	I 5	PIERCE	Interstate Highway
WA	I 5	I 5	SKAGIT	Interstate Highway
WA	I 5	I 5	SNOHOMISH	Interstate Highway
WA	I 5	I 5	THURSTON	Interstate Highway
WA	I 5	I 5	WHATCOM	Interstate Highway
WA	I 705	I 705	PIERCE	Interstate Highway
WA	I 90	I 90	KING	Interstate Highway
WA	I 90	I 90	SPOKANE	Interstate Highway
WA	SR 167	SR 167	KING	Other Controlled Access Highway
WA	SR 18	SR 18	KING	Other Controlled Access Highway
WA	SR 518	SR 518	KING	Other Controlled Access Highway
WA	US 2	US 2	SPOKANE	Other Controlled Access Highway
WI	I 41	I 41	KENOSHA	Interstate Highway
WI	I 41	I 41	MILWAUKEE	Interstate Highway
WI	I 41	I 41	RACINE	Interstate Highway
WI	I 41	I 41	WASHINGTON	Interstate Highway
WI	I 41	I 41	WAUKESHA	Interstate Highway
WI	I 43	I 43	MILWAUKEE	Interstate Highway
WI	I 43	I 43	WAUKESHA	Interstate Highway
WI	I 94	I 94	MILWAUKEE	Interstate Highway
WI	I 94	I 94	WAUKESHA	Interstate Highway
WV	I 70	I 70	OHIO	Interstate Highway
WY	I 25	I 25	LARAMIE	Interstate Highway
WY	I 80	I 80	ALBANY	Interstate Highway
WY	I 80	I 80	CARBON	Interstate Highway
WY	I 80	I 80	LARAMIE	Interstate Highway

WY	I 80	I 80	SWEETWATER	Interstate Highway
WY	I 80	I 80	UINTA	Interstate Highway

Appendix F: List of Zero-Emission Freight Corridors in Phase 3

State	Road Name	Route Sign	County Name	Description
AK	GLENN HWY	I A1	ANCHORAGE	Interstate Highway
AK	E 6TH AVE	I A1	ANCHORAGE	Arterial or Major Collector
AK	E 5TH AVE	I A1	ANCHORAGE	Arterial or Major Collector
AK	GLENN HWY	I A1	MATANUSKA-SUSITNA	Interstate Highway
AK	GLENN HWY	I A1	VALDEZ-CORDOVA	Non-Freeway Interstate (Alaska)
AK	RICHARDSON HWY	I A1	VALDEZ-CORDOVA	Non-Freeway Interstate (Alaska)
AK	TOK CUT-OFF HWY	I A1	VALDEZ-CORDOVA	Non-Freeway Interstate (Alaska)
AK	SEWARD HWY	I A3	ANCHORAGE	Non-Freeway Interstate (Alaska)
AK	SEWARD HWY	I A3	KENAI PENINSULA	Non-Freeway Interstate (Alaska)
AK	PARKS HWY	I A4	MATANUSKA-SUSITNA	Interstate Highway
AL	I 10	I 10	BALDWIN	Interstate Highway
AL	I 10	I 10	MOBILE	Interstate Highway
AL	I 165	I 165	MOBILE	Interstate Highway
AL	I 20	I 20	CALHOUN	Interstate Highway
AL	I 20	I 20	CLEBURNE	Interstate Highway
AL	I 20	I 20	GREENE	Interstate Highway
AL	I 20	I 20	JEFFERSON	Interstate Highway
AL	I 20	I 20	ST. CLAIR	Interstate Highway
AL	I 20	I 20	SUMTER	Interstate Highway
AL	I 20	I 20	TALLADEGA	Interstate Highway
AL	I 20	I 20	TUSCALOOSA	Interstate Highway
AL	I 22	I 22	JEFFERSON	Interstate Highway
AL	I 22	I 22	MARION	Interstate Highway
AL	I 22	I 22	WALKER	Interstate Highway

AL	I 359	I 359	TUSCALOOSA	Interstate Highway
AL	I 459	I 459	JEFFERSON	Interstate Highway
AL	I 565	I 565	LIMESTONE	Interstate Highway
AL	I 565	I 565	MADISON	Interstate Highway
AL	I 59	I 59	DEKALB	Interstate Highway
AL	I 59	I 59	ETOWAH	Interstate Highway
AL	I 59	I 59	JEFFERSON	Interstate Highway
AL	I 59	I 59	ST. CLAIR	Interstate Highway
AL	I 65	I 65	AUTAUGA	Interstate Highway
AL	I 65	I 65	BALDWIN	Interstate Highway
AL	I 65	I 65	BLOUNT	Interstate Highway
AL	I 65	I 65	BUTLER	Interstate Highway
AL	I 65	I 65	CHILTON	Interstate Highway
AL	I 65	I 65	CONECUH	Interstate Highway
AL	I 65	I 65	CULLMAN	Interstate Highway
AL	I 65	I 65	ELMORE	Interstate Highway
AL	I 65	I 65	ESCAMBIA	Interstate Highway
AL	I 65	I 65	JEFFERSON	Interstate Highway
AL	I 65	I 65	LIMESTONE	Interstate Highway
AL	I 65	I 65	LOWNDES	Interstate Highway
AL	I 65	I 65	MOBILE	Interstate Highway
AL	I 65	I 65	MONTGOMERY	Interstate Highway
AL	I 65	I 65	MORGAN	Interstate Highway
AL	I 65	I 65	SHELBY	Interstate Highway
AL	I 759	I 759	ETOWAH	Interstate Highway
AL	I 85	I 85	CHAMBERS	Interstate Highway
AL	I 85	I 85	LEE	Interstate Highway
AL	I 85	I 85	MACON	Interstate Highway
AL	I 85	I 85	MONTGOMERY	Interstate Highway
AL	ANDREW JACKSON WY	US 72	MADISON	Arterial or Major Collector
AL	CRESTWOOD BLVD	US 78	JEFFERSON	Arterial or Major Collector

AR	I 30	I 30	CLARK	Interstate Highway
AR	I 30	I 30	HEMPSTEAD	Interstate Highway
AR	I 30	I 30	HOT SPRING	Interstate Highway
AR	I 30	I 30	MILLER	Interstate Highway
AR	I 30	I 30	NEVADA	Interstate Highway
AR	I 30	I 30	PULASKI	Interstate Highway
AR	I 30	I 30	SALINE	Interstate Highway
AR	I 40	I 40	CRITTENDEN	Interstate Highway
AR	I 40	I 40	LONOKE	Interstate Highway
AR	I 40	I 40	MONROE	Interstate Highway
AR	I 40	I 40	PRAIRIE	Interstate Highway
AR	I 40	I 40	PULASKI	Interstate Highway
AR	I 40	I 40	ST. FRANCIS	Interstate Highway
AR	I 440	I 440	PULASKI	Interstate Highway
AR	I 55	I 55	CRITTENDEN	Interstate Highway
AR	I 55	I 55	MISSISSIPPI	Interstate Highway
AR	I 555	I 555	CRAIGHEAD	Interstate Highway
AR	I 555	I 555	CRITTENDEN	Interstate Highway
AR	I 555	I 555	POINSETT	Interstate Highway
AZ	I 10	I 10	COCHISE	Interstate Highway
AZ	I 10	I 10	LA PAZ	Interstate Highway
AZ	I 10	I 10	MARICOPA	Interstate Highway
AZ	I 10	I 10	PIMA	Interstate Highway
AZ	I 10	I 10	PINAL	Interstate Highway
AZ	I 15	I 15	MOHAVE	Interstate Highway
AZ	I 17	I 17	COCONINO	Interstate Highway
AZ	I 17	I 17	MARICOPA	Interstate Highway
AZ	I 17	I 17	YAVAPAI	Interstate Highway
AZ	I 19	I 19	PIMA	Interstate Highway
AZ	I 19	I 19	SANTA CRUZ	Interstate Highway
AZ	I 40	I 40	MOHAVE	Interstate Highway

AZ	I 40 BUSINESS	I 40 B	MOHAVE	Arterial or Major Collector
AZ	I 8	I 8	MARICOPA	Interstate Highway
AZ	I 8	I 8	PINAL	Interstate Highway
AZ	I 8	I 8	YUMA	Interstate Highway
AZ	LOOP 101	SR 101	MARICOPA	Other Controlled Access Highway
AZ	LOOP 202	SR 202	MARICOPA	Other Controlled Access Highway
AZ	SR 51	SR 51	MARICOPA	Other Controlled Access Highway
AZ	US 60	US 60	MARICOPA	Other Controlled Access Highway
AZ	US 93	US 93	MOHAVE	Arterial or Major Collector
CA	SANTA MONICA FWY	I 10	LOS ANGELES	Interstate Highway
CA	I 10	I 10	LOS ANGELES	Interstate Highway
CA	I 10	I 10	RIVERSIDE	Interstate Highway
CA	I 10	I 10	SAN BERNARDINO	Interstate Highway
CA	I 105	I 105	LOS ANGELES	Interstate Highway
CA	HARBOR FREEWAY	I 110	LOS ANGELES	Interstate Highway
CA	I 15	I 15	RIVERSIDE	Interstate Highway
CA	I 15	I 15	SAN BERNARDINO	Interstate Highway
CA	I 15	I 15	SAN DIEGO	Interstate Highway
CA	I 205	I 205	ALAMEDA	Interstate Highway
CA	I 205	I 205	SAN JOAQUIN	Interstate Highway
CA	I 210	I 210	LOS ANGELES	Interstate Highway
CA	I 215	I 215	RIVERSIDE	Interstate Highway
CA	I 215	I 215	SAN BERNARDINO	Interstate Highway
CA	I 238	I 238	ALAMEDA	Interstate Highway
CA	I 280	I 280	SAN FRANCISCO	Interstate Highway
CA	I 280	I 280	SAN MATEO	Interstate Highway
CA	I 280	I 280	SANTA CLARA	Interstate Highway
CA	I 380	I 380	SAN MATEO	Interstate Highway
CA	I 40	I 40	SAN BERNARDINO	Interstate Highway

CA	SAN DIEGO FWY	I 405	LOS ANGELES	Interstate Highway
CA	SAN DIEGO FWY	I 405	ORANGE	Interstate Highway
CA	I 5	I 5	COLUSA	Interstate Highway
CA	I 5	I 5	FRESNO	Interstate Highway
CA	I 5	I 5	GLENN	Interstate Highway
CA	I 5	I 5	KERN	Interstate Highway
CA	I 5	I 5	KINGS	Interstate Highway
CA	I 5	I 5	LOS ANGELES	Interstate Highway
CA	I 5	I 5	MERCED	Interstate Highway
CA	SAN DIEGO FWY	I 5	ORANGE	Interstate Highway
CA	I 5	I 5	ORANGE	Interstate Highway
CA	I 5	I 5	SACRAMENTO	Interstate Highway
CA	SAN DIEGO FWY	I 5	SAN DIEGO	Interstate Highway
CA	I 5 LOCAL BYPASS LANES	I 5	SAN DIEGO	Interstate Highway
CA	I 5	I 5	SAN DIEGO	Interstate Highway
CA	I 5	I 5	SAN JOAQUIN	Interstate Highway
CA	I 5	I 5	SHASTA	Interstate Highway
CA	I 5	I 5	SISKIYOU	Interstate Highway
CA	I 5	I 5	STANISLAUS	Interstate Highway
CA	I 5	I 5	TEHAMA	Interstate Highway
CA	I 5	I 5	YOLO	Interstate Highway
CA	I 505	I 505	SOLANO	Interstate Highway
CA	I 505	I 505	YOLO	Interstate Highway
CA	I 580	I 580	ALAMEDA	Interstate Highway
CA	I 580	I 580	CONTRA COSTA	Interstate Highway
CA	I 580	I 580	MARIN	Interstate Highway
CA	I 580	I 580	SAN JOAQUIN	Interstate Highway
CA	I 605	I 605	LOS ANGELES	Interstate Highway
CA	I 605	I 605	ORANGE	Interstate Highway
CA	I 680	I 680	ALAMEDA	Interstate Highway
CA	I 680	I 680	CONTRA COSTA	Interstate Highway

CA	I 680	I 680	SANTA CLARA	Interstate Highway
CA	I 680	I 680	SOLANO	Interstate Highway
CA	I 710	I 710	LOS ANGELES	Interstate Highway
CA	I 780	I 780	SOLANO	Interstate Highway
CA	I 8	I 8	IMPERIAL	Interstate Highway
CA	I 8	I 8	SAN DIEGO	Interstate Highway
CA	I 80	I 80	ALAMEDA	Interstate Highway
CA	I 80	I 80	CONTRA COSTA	Interstate Highway
CA	I 80	I 80	NAPA	Interstate Highway
CA	I 80	I 80	NEVADA	Interstate Highway
CA	I 80	I 80	PLACER	Interstate Highway
CA	I 80	I 80	SACRAMENTO	Interstate Highway
CA	I 80	I 80	SAN FRANCISCO	Interstate Highway
CA	I 80	I 80	SIERRA	Interstate Highway
CA	I 80	I 80	SOLANO	Interstate Highway
CA	I 80	I 80	YOLO	Interstate Highway
CA	I 805	I 805	SAN DIEGO	Interstate Highway
CA	I 5 LOCAL BYPASS LANES	I 805	SAN DIEGO	Interstate Highway
CA	I 880	I 880	ALAMEDA	Interstate Highway
CA	I 880	I 880	SANTA CLARA	Interstate Highway
CA	I 980	I 980	ALAMEDA	Interstate Highway
CA	SR 120	SR 120	SAN JOAQUIN	Other Controlled Access Highway
CA	SR 134	SR 134	LOS ANGELES	Other Controlled Access Highway
CA	SR 14	SR 14	LOS ANGELES	Other Controlled Access Highway
CA	SR 170	SR 170	LOS ANGELES	Other Controlled Access Highway
CA	SR 198	SR 198	FRESNO	Arterial or Major Collector
CA	SR 22	SR 22	ORANGE	Other Controlled Access Highway
CA	SR 23	SR 23	VENTURA	Other Controlled Access Highway

CA	SR 4	SR 4	SAN JOAQUIN	Other Controlled Access Highway
CA	SR 47	SR 47	LOS ANGELES	Other Controlled Access Highway
CA	COSTA MESA FWY	SR 55	ORANGE	Other Controlled Access Highway
CA	SR 57	SR 57	LOS ANGELES	Other Controlled Access Highway
CA	SR 57	SR 57	ORANGE	Other Controlled Access Highway
CA	SR 58	SR 58	KERN	Other Controlled Access Highway
CA	SR 58	SR 58	SAN BERNARDINO	Other Controlled Access Highway
CA	POMONA FWY	SR 60	LOS ANGELES	Other Controlled Access Highway
CA	SR 60	SR 60	LOS ANGELES	Other Controlled Access Highway
CA	SR 60	SR 60	RIVERSIDE	Other Controlled Access Highway
CA	POMONA FWY	SR 60	RIVERSIDE	Other Controlled Access Highway
CA	POMONA FWY	SR 60	SAN BERNARDINO	Other Controlled Access Highway
CA	SR 71	SR 71	LOS ANGELES	Other Controlled Access Highway
CA	LONG BEACH FWY	SR 710	LOS ANGELES	Other Controlled Access Highway
CA	SR 91	SR 91	LOS ANGELES	Other Controlled Access Highway
CA	SR 91	SR 91	ORANGE	Other Controlled Access Highway
CA	SR 91	SR 91	RIVERSIDE	Other Controlled Access Highway
CA	SR 99	SR 99	FRESNO	Other Controlled Access Highway
CA	SR 99	SR 99	KERN	Other Controlled Access Highway
CA	SR 99	SR 99	MADERA	Other Controlled Access Highway

CA	SR 99	SR 99	MERCED	Other Controlled Access Highway
CA	SR 99	SR 99	SACRAMENTO	Other Controlled Access Highway
CA	SR 99	SR 99	SAN JOAQUIN	Other Controlled Access Highway
CA	SR 99	SR 99	STANISLAUS	Other Controlled Access Highway
CA	SR 99	SR 99	TULARE	Other Controlled Access Highway
CA	US 101	US 101	LOS ANGELES	Other Controlled Access Highway
CA	US 101	US 101	SAN FRANCISCO	Other Controlled Access Highway
CA	US 101	US 101	SAN MATEO	Other Controlled Access Highway
CA	US 101	US 101	SANTA CLARA	Other Controlled Access Highway
CA	US 101	US 101	VENTURA	Other Controlled Access Highway
CA	US 50	US 50	SACRAMENTO	Other Controlled Access Highway
CA	US 50	US 50	YOLO	Other Controlled Access Highway
CA	I 580 TRUCK LANE		ALAMEDA	Express Lane (Truck Only)
CA	I 5 - TRUCK ROUTE S		LOS ANGELES	Express Lane (Truck Route)
CA	I 5 - TRUCK ROUTE N		LOS ANGELES	Express Lane (Truck Route)
CA	I 215 / SR 60 TRUCK LANE		RIVERSIDE	Express Lane (Truck Route)
CA	OLD BAKERSFIELD HWY		SAN BERNARDINO	Arterial or Major Collector
CA	POMERADO RD		SAN DIEGO	Arterial or Major Collector
CA	LAUREL ST		SAN DIEGO	Arterial or Major Collector
CA	GRAPE ST		SAN DIEGO	Arterial or Major Collector
CA	HAWTHORNE ST		SAN DIEGO	Arterial or Major Collector
CA	CESAR CHAVEZ ST		SAN FRANCISCO	Arterial or Major Collector
CA	ROTH RD		SAN JOAQUIN	Arterial or Major Collector
CA	LAS POSAS RD		VENTURA	Arterial or Major Collector

CO	I 225	I 225	ADAMS	Interstate Highway
CO	I 225	I 225	ARAPAHOE	Interstate Highway
CO	I 225	I 225	DENVER	Interstate Highway
CO	I 25	I 25	ADAMS	Interstate Highway
CO	I 25	I 25	ARAPAHOE	Interstate Highway
CO	I 25	I 25	BROOMFIELD	Interstate Highway
CO	I 25	I 25	DENVER	Interstate Highway
CO	I 25	I 25	DOUGLAS	Interstate Highway
CO	I 25	I 25	EL PASO	Interstate Highway
CO	I 25	I 25	LARIMER	Interstate Highway
CO	I 25	I 25	PUEBLO	Interstate Highway
CO	I 25	I 25	WELD	Interstate Highway
CO	I 270	I 270	ADAMS	Interstate Highway
CO	I 270	I 270	DENVER	Interstate Highway
CO	I 70	I 70	ADAMS	Interstate Highway
CO	I 70	I 70	ARAPAHOE	Interstate Highway
CO	I 70	I 70	CLEAR CREEK	Interstate Highway
CO	I 70	I 70	DENVER	Interstate Highway
CO	I 70	I 70	EAGLE	Interstate Highway
CO	I 70	I 70	ELBERT	Interstate Highway
CO	I 70	I 70	GARFIELD	Interstate Highway
CO	I 70	I 70	JEFFERSON	Interstate Highway
CO	I 70	I 70	KIT CARSON	Interstate Highway
CO	I 70	I 70	LINCOLN	Interstate Highway
CO	I 70	I 70	MESA	Interstate Highway
CO	I 70	I 70	SUMMIT	Interstate Highway
CO	I 76	I 76	ADAMS	Interstate Highway
CO	I 76	I 76	DENVER	Interstate Highway
CO	I 76	I 76	JEFFERSON	Interstate Highway
CO	I 76	I 76	LOGAN	Interstate Highway
CO	I 76	I 76	MORGAN	Interstate Highway

CO	I 76	I 76	SEDGWICK	Interstate Highway
CO	I 76	I 76	WASHINGTON	Interstate Highway
CO	I 76	I 76	WELD	Interstate Highway
CO	E 470	SR 470	ADAMS	Other Controlled Access Highway
CO	E 470	SR 470	DENVER	Other Controlled Access Highway
CO	US 24	US 24	LINCOLN	Arterial or Major Collector
CO	BRIGHTON RD		ADAMS	Arterial or Major Collector
CO	PENA BLVD		DENVER	Other Controlled Access Highway
CT	CT 32	CT 32	NEW LONDON	Arterial or Major Collector
CT	I 291	I 291	HARTFORD	Interstate Highway
CT	I 384	I 384	HARTFORD	Interstate Highway
CT	I 384	I 384	TOLLAND	Interstate Highway
CT	I 395	I 395	NEW LONDON	Interstate Highway
CT	I 395	I 395	WINDHAM	Interstate Highway
CT	I 684	I 684	FAIRFIELD	Interstate Highway
CT	I 691	I 691	HARTFORD	Interstate Highway
CT	I 691	I 691	NEW HAVEN	Interstate Highway
CT	I 84	I 84	FAIRFIELD	Interstate Highway
CT	I 84	I 84	HARTFORD	Interstate Highway
CT	I 84	I 84	NEW HAVEN	Interstate Highway
CT	I 84	I 84	TOLLAND	Interstate Highway
CT	I 84	I 84	WINDHAM	Interstate Highway
CT	I 90	I 90	TOLLAND	Interstate Highway
CT	I 91	I 91	HARTFORD	Interstate Highway
CT	I 91	I 91	MIDDLESEX	Interstate Highway
CT	I 91	I 91	NEW HAVEN	Interstate Highway
CT	I 95	I 95	FAIRFIELD	Interstate Highway
CT	I 95	I 95	MIDDLESEX	Interstate Highway
CT	I 95	I 95	NEW HAVEN	Interstate Highway
CT	I 95	I 95	NEW LONDON	Interstate Highway

CT	SR 159	SR 159	HARTFORD	Arterial or Major Collector
DC	I 295	I 295	DISTRICT OF COLUMBIA	Interstate Highway
DC	I 395	I 395	DISTRICT OF COLUMBIA	Interstate Highway
DC	I 66	I 66	DISTRICT OF COLUMBIA	Interstate Highway
DC	I 695	I 695	DISTRICT OF COLUMBIA	Interstate Highway
DE	I 295	I 295	NEW CASTLE	Interstate Highway
DE	I 495	I 495	NEW CASTLE	Interstate Highway
DE	I 95	I 95	NEW CASTLE	Interstate Highway
FL	I 10	I 10	BAKER	Interstate Highway
FL	I 10	I 10	COLUMBIA	Interstate Highway
FL	I 10	I 10	DUVAL	Interstate Highway
FL	I 10	I 10	ESCAMBIA	Interstate Highway
FL	I 10	I 10	GADSDEN	Interstate Highway
FL	I 10	I 10	HOLMES	Interstate Highway
FL	I 10	I 10	JACKSON	Interstate Highway
FL	I 10	I 10	JEFFERSON	Interstate Highway
FL	I 10	I 10	LEON	Interstate Highway
FL	I 10	I 10	MADISON	Interstate Highway
FL	I 10	I 10	NASSAU	Interstate Highway
FL	I 10	I 10	OKALOOSA	Interstate Highway
FL	I 10	I 10	SANTA ROSA	Interstate Highway
FL	I 10	I 10	SUWANNEE	Interstate Highway
FL	I 10	I 10	WALTON	Interstate Highway
FL	I 10	I 10	WASHINGTON	Interstate Highway
FL	I 110	I 110	ESCAMBIA	Interstate Highway
FL	I 175	I 175	PINELLAS	Interstate Highway
FL	I 195	I 195	MIAMI-DADE	Interstate Highway
FL	I 275	I 275	HILLSBOROUGH	Interstate Highway
FL	I 275	I 275	MANATEE	Interstate Highway

FL	I 275	I 275	PASCO	Interstate Highway
FL	I 275	I 275	PINELLAS	Interstate Highway
FL	I 295	I 295	DUVAL	Interstate Highway
FL	I 375	I 375	PINELLAS	Interstate Highway
FL	DOLPHIN EXPY	I 395	MIAMI-DADE	Interstate Highway
FL	I 4	I 4	HILLSBOROUGH	Interstate Highway
FL	I 4	I 4	ORANGE	Interstate Highway
FL	I 4	I 4	OSCEOLA	Interstate Highway
FL	I 4	I 4	POLK	Interstate Highway
FL	I 4	I 4	SEMINOLE	Interstate Highway
FL	I 4	I 4	VOLUSIA	Interstate Highway
FL	I 595	I 595	BROWARD	Interstate Highway
FL	I 75	I 75	ALACHUA	Interstate Highway
FL	I 75	I 75	BROWARD	Interstate Highway
FL	I 75	I 75	CHARLOTTE	Interstate Highway
FL	I 75	I 75	COLLIER	Interstate Highway
FL	I 75	I 75	COLUMBIA	Interstate Highway
FL	I 75	I 75	DESOTO	Interstate Highway
FL	I 75	I 75	HAMILTON	Interstate Highway
FL	I 75	I 75	HERNANDO	Interstate Highway
FL	I 75	I 75	HILLSBOROUGH	Interstate Highway
FL	I 75	I 75	LEE	Interstate Highway
FL	I 75	I 75	MANATEE	Interstate Highway
FL	I 75	I 75	MARION	Interstate Highway
FL	I 75	I 75	MIAMI-DADE	Interstate Highway
FL	I 75	I 75	PASCO	Interstate Highway
FL	I 75	I 75	SARASOTA	Interstate Highway
FL	I 75	I 75	SUMTER	Interstate Highway
FL	I 75	I 75	SUWANNEE	Interstate Highway
FL	I 95	I 95	BREVARD	Interstate Highway
FL	I 95	I 95	BROWARD	Interstate Highway

FL	I 95	I 95	DUVAL	Interstate Highway
FL	I 95	I 95	FLAGLER	Interstate Highway
FL	I 95	I 95	INDIAN RIVER	Interstate Highway
FL	I 95	I 95	MARTIN	Interstate Highway
FL	I 95	I 95	MIAMI-DADE	Interstate Highway
FL	I 95	I 95	NASSAU	Interstate Highway
FL	I 95	I 95	PALM BEACH	Interstate Highway
FL	I 95	I 95	ST. JOHNS	Interstate Highway
FL	I 95	I 95	ST. LUCIE	Interstate Highway
FL	I 95	I 95	VOLUSIA	Interstate Highway
FL	NE 1ST AVE		MIAMI-DADE	Arterial or Major Collector
FL	NE 2ND AVE		MIAMI-DADE	Arterial or Major Collector
FL	NW 3RD AVE		MIAMI-DADE	Arterial or Major Collector
GA	I 16	I 16	BIBB	Interstate Highway
GA	I 16	I 16	BLECKLEY	Interstate Highway
GA	I 16	I 16	BRYAN	Interstate Highway
GA	I 16	I 16	BULLOCH	Interstate Highway
GA	I 16	I 16	CANDLER	Interstate Highway
GA	I 16	I 16	CHATHAM	Interstate Highway
GA	I 16	I 16	EFFINGHAM	Interstate Highway
GA	I 16	I 16	EMANUEL	Interstate Highway
GA	I 16	I 16	LAURENS	Interstate Highway
GA	I 16	I 16	TREUTLEN	Interstate Highway
GA	I 16	I 16	TWIGGS	Interstate Highway
GA	I 185	I 185	HARRIS	Interstate Highway
GA	I 185	I 185	MUSCOGEE	Interstate Highway
GA	I 185	I 185	TROUP	Interstate Highway
GA	I 20	I 20	CARROLL	Interstate Highway
GA	I 20	I 20	COBB	Interstate Highway
GA	I 20	I 20	COLUMBIA	Interstate Highway
GA	I 20	I 20	DEKALB	Interstate Highway

GA	I 20	I 20	DOUGLAS	Interstate Highway
GA	I 20	I 20	FULTON	Interstate Highway
GA	I 20	I 20	GREENE	Interstate Highway
GA	I 20	I 20	HARALSON	Interstate Highway
GA	I 20	I 20	MCDUFFIE	Interstate Highway
GA	I 20	I 20	MORGAN	Interstate Highway
GA	I 20	I 20	NEWTON	Interstate Highway
GA	I 20	I 20	RICHMOND	Interstate Highway
GA	I 20	I 20	ROCKDALE	Interstate Highway
GA	I 20	I 20	TALIAFERRO	Interstate Highway
GA	I 20	I 20	WALTON	Interstate Highway
GA	I 20	I 20	WARREN	Interstate Highway
GA	I 24	I 24	DADE	Interstate Highway
GA	I 285	I 285	CLAYTON	Interstate Highway
GA	I 285	I 285	COBB	Interstate Highway
GA	I 285	I 285	DEKALB	Interstate Highway
GA	I 285	I 285	FULTON	Interstate Highway
GA	I 475	I 475	BIBB	Interstate Highway
GA	I 475	I 475	MONROE	Interstate Highway
GA	I 516	I 516	CHATHAM	Interstate Highway
GA	I 520	I 520	RICHMOND	Interstate Highway
GA	I 575	I 575	CHEROKEE	Interstate Highway
GA	I 575	I 575	COBB	Interstate Highway
GA	I 575	I 575	PICKENS	Interstate Highway
GA	I 59	I 59	DADE	Interstate Highway
GA	I 675	I 675	CLAYTON	Interstate Highway
GA	I 675	I 675	DEKALB	Interstate Highway
GA	I 675	I 675	HENRY	Interstate Highway
GA	I 75	I 75	BARTOW	Interstate Highway
GA	I 75	I 75	BIBB	Interstate Highway
GA	I 75	I 75	BUTTS	Interstate Highway

GA	I 75	I 75	CATOOSA	Interstate Highway
GA	I 75	I 75	CHEROKEE	Interstate Highway
GA	I 75	I 75	CLAYTON	Interstate Highway
GA	I 75	I 75	COBB	Interstate Highway
GA	I 75	I 75	COOK	Interstate Highway
GA	I 75	I 75	CRAWFORD	Interstate Highway
GA	I 75	I 75	CRISP	Interstate Highway
GA	I 75	I 75	DOOLY	Interstate Highway
GA	I 75	I 75	FULTON	Interstate Highway
GA	I 75	I 75	GORDON	Interstate Highway
GA	I 75	I 75	HENRY	Interstate Highway
GA	I 75	I 75	HOUSTON	Interstate Highway
GA	I 75	I 75	LAMAR	Interstate Highway
GA	I 75	I 75	LOWNDES	Interstate Highway
GA	I 75	I 75	MONROE	Interstate Highway
GA	I 75	I 75	PEACH	Interstate Highway
GA	I 75	I 75	SPALDING	Interstate Highway
GA	I 75	I 75	TIFT	Interstate Highway
GA	I 75	I 75	TURNER	Interstate Highway
GA	I 75	I 75	WHITFIELD	Interstate Highway
GA	I 85	I 85	BANKS	Interstate Highway
GA	I 85	I 85	BARROW	Interstate Highway
GA	I 85	I 85	CLAYTON	Interstate Highway
GA	I 85	I 85	COWETA	Interstate Highway
GA	I 85	I 85	DEKALB	Interstate Highway
GA	I 85	I 85	FRANKLIN	Interstate Highway
GA	I 85	I 85	FULTON	Interstate Highway
GA	I 85	I 85	GWINNETT	Interstate Highway
GA	I 85	I 85	HARRIS	Interstate Highway
GA	I 85	I 85	HART	Interstate Highway
GA	I 85	I 85	JACKSON	Interstate Highway

GA	I 85	I 85	MERIWETHER	Interstate Highway
GA	I 85	I 85	TROUP	Interstate Highway
GA	I 95	I 95	BRYAN	Interstate Highway
GA	I 95	I 95	CAMDEN	Interstate Highway
GA	I 95	I 95	CHATHAM	Interstate Highway
GA	I 95	I 95	EFFINGHAM	Interstate Highway
GA	I 95	I 95	GLYNN	Interstate Highway
GA	I 95	I 95	LIBERTY	Interstate Highway
GA	I 95	I 95	MCINTOSH	Interstate Highway
GA	I 985	I 985	GWINNETT	Interstate Highway
GA	I 985	I 985	HALL	Interstate Highway
GA	SR 16	SR 16	BUTTS	Arterial or Major Collector
GA	US 82	US 82	TIFT	Arterial or Major Collector
HI	I H1	I H1	HONOLULU	Interstate Highway
HI	QUEEN LILIUOKALANI FWY	I H1	HONOLULU	Interstate Highway
HI	I H2	I H2	HONOLULU	Interstate Highway
HI	I H201	I H201	HONOLULU	Interstate Highway
HI	I H3	I H3	HONOLULU	Interstate Highway
HI	ATKINSON DR		HONOLULU	Arterial or Major Collector
HI	AHUA ST		HONOLULU	Arterial or Major Collector
IA	I 280	I 280	SCOTT	Interstate Highway
IA	I 380	I 380	BENTON	Interstate Highway
IA	I 380	I 380	BUCHANAN	Interstate Highway
IA	I 380	I 380	JOHNSON	Interstate Highway
IA	I 380	I 380	LINN	Interstate Highway
IA	I 74	I 74	SCOTT	Interstate Highway
IA	I 80	I 80	ADAIR	Interstate Highway
IA	I 80	I 80	CASS	Interstate Highway
IA	I 80	I 80	CEDAR	Interstate Highway
IA	I 80	I 80	DALLAS	Interstate Highway
IA	I 80	I 80	IOWA	Interstate Highway

IA	I 80	I 80	JASPER	Interstate Highway
IA	I 80	I 80	JOHNSON	Interstate Highway
IA	I 80	I 80	MADISON	Interstate Highway
IA	I 80	I 80	POLK	Interstate Highway
IA	I 80	I 80	POTTAWATTAMIE	Interstate Highway
IA	I 80	I 80	POWESHIEK	Interstate Highway
IA	I 80	I 80	SCOTT	Interstate Highway
ID	I 15	I 15	ONEIDA	Interstate Highway
ID	I 84	I 84	ONEIDA	Interstate Highway
ID	I 90	I 90	KOOTENAI	Interstate Highway
ID	I 90	I 90	SHOSHONE	Interstate Highway
IL	I 155	I 155	LOGAN	Interstate Highway
IL	I 155	I 155	TAZEWELL	Interstate Highway
IL	I 172	I 172	ADAMS	Interstate Highway
IL	I 172	I 172	PIKE	Interstate Highway
IL	I 180	I 180	BUREAU	Interstate Highway
IL	I 180	I 180	PUTNAM	Interstate Highway
IL	KENNEDY EXPY	I 190	COOK	Interstate Highway
IL	I 24	I 24	JOHNSON	Interstate Highway
IL	I 24	I 24	MASSAC	Interstate Highway
IL	I 24	I 24	WILLIAMSON	Interstate Highway
IL	I 255	I 255	MADISON	Interstate Highway
IL	I 255	I 255	MONROE	Interstate Highway
IL	I 255	I 255	ST. CLAIR	Interstate Highway
IL	I 270	I 270	MADISON	Interstate Highway
IL	I 280	I 280	ROCK ISLAND	Interstate Highway
IL	I 290	I 290	COOK	Interstate Highway
IL	I 290	I 290	DUPAGE	Interstate Highway
IL	I 294	I 294	COOK	Interstate Highway
IL	I 294	I 294	DUPAGE	Interstate Highway
IL	I 294	I 294	LAKE	Interstate Highway

IL	I 355	I 355	COOK	Interstate Highway
IL	I 355	I 355	DUPAGE	Interstate Highway
IL	I 355	I 355	WILL	Interstate Highway
IL	I 39	I 39	LASALLE	Interstate Highway
IL	I 39	I 39	LEE	Interstate Highway
IL	I 39	I 39	MARSHALL	Interstate Highway
IL	I 39	I 39	MCLEAN	Interstate Highway
IL	I 39	I 39	OGLE	Interstate Highway
IL	I 39	I 39	WINNEBAGO	Interstate Highway
IL	I 39	I 39	WOODFORD	Interstate Highway
IL	I 474	I 474	PEORIA	Interstate Highway
IL	I 474	I 474	TAZEWELL	Interstate Highway
IL	I 55	I 55	COOK	Interstate Highway
IL	I 55	I 55	DUPAGE	Interstate Highway
IL	I 55	I 55	GRUNDY	Interstate Highway
IL	I 55	I 55	LIVINGSTON	Interstate Highway
IL	I 55	I 55	LOGAN	Interstate Highway
IL	I 55	I 55	MACOUPIN	Interstate Highway
IL	I 55	I 55	MADISON	Interstate Highway
IL	I 55	I 55	MCLEAN	Interstate Highway
IL	I 55	I 55	MONTGOMERY	Interstate Highway
IL	I 55	I 55	SANGAMON	Interstate Highway
IL	I 55	I 55	ST. CLAIR	Interstate Highway
IL	I 55	I 55	WILL	Interstate Highway
IL	I 57	I 57	ALEXANDER	Interstate Highway
IL	I 57	I 57	CHAMPAIGN	Interstate Highway
IL	I 57	I 57	CLAY	Interstate Highway
IL	I 57	I 57	COLES	Interstate Highway
IL	I 57	I 57	COOK	Interstate Highway
IL	I 57	I 57	CUMBERLAND	Interstate Highway
IL	I 57	I 57	DOUGLAS	Interstate Highway

IL	I 57	I 57	EFFINGHAM	Interstate Highway
IL	I 57	I 57	FAYETTE	Interstate Highway
IL	I 57	I 57	FORD	Interstate Highway
IL	I 57	I 57	FRANKLIN	Interstate Highway
IL	I 57	I 57	IROQUOIS	Interstate Highway
IL	I 57	I 57	JEFFERSON	Interstate Highway
IL	I 57	I 57	JOHNSON	Interstate Highway
IL	I 57	I 57	KANKAKEE	Interstate Highway
IL	I 57	I 57	MARION	Interstate Highway
IL	I 57	I 57	PULASKI	Interstate Highway
IL	I 57	I 57	UNION	Interstate Highway
IL	I 57	I 57	WILL	Interstate Highway
IL	I 57	I 57	WILLIAMSON	Interstate Highway
IL	I 64	I 64	CLINTON	Interstate Highway
IL	I 64	I 64	JEFFERSON	Interstate Highway
IL	I 64	I 64	ST. CLAIR	Interstate Highway
IL	I 64	I 64	WASHINGTON	Interstate Highway
IL	I 64	I 64	WAYNE	Interstate Highway
IL	I 64	I 64	WHITE	Interstate Highway
IL	I 70	I 70	BOND	Interstate Highway
IL	I 70	I 70	CLARK	Interstate Highway
IL	I 70	I 70	CUMBERLAND	Interstate Highway
IL	I 70	I 70	EFFINGHAM	Interstate Highway
IL	I 70	I 70	FAYETTE	Interstate Highway
IL	I 70	I 70	MADISON	Interstate Highway
IL	I 70	I 70	ST. CLAIR	Interstate Highway
IL	I 72	I 72	CHAMPAIGN	Interstate Highway
IL	I 72	I 72	MACON	Interstate Highway
IL	I 72	I 72	MORGAN	Interstate Highway
IL	I 72	I 72	PIATT	Interstate Highway
IL	I 72	I 72	PIKE	Interstate Highway

IL	I 72	I 72	SANGAMON	Interstate Highway
IL	I 72	I 72	SCOTT	Interstate Highway
IL	I 74	I 74	CHAMPAIGN	Interstate Highway
IL	I 74	I 74	DEWITT	Interstate Highway
IL	I 74	I 74	HENRY	Interstate Highway
IL	I 74	I 74	KNOX	Interstate Highway
IL	I 74	I 74	MCLEAN	Interstate Highway
IL	I 74	I 74	PEORIA	Interstate Highway
IL	I 74	I 74	PIATT	Interstate Highway
IL	I 74	I 74	ROCK ISLAND	Interstate Highway
IL	I 74	I 74	TAZEWELL	Interstate Highway
IL	I 74	I 74	VERMILION	Interstate Highway
IL	I 74	I 74	WOODFORD	Interstate Highway
IL	I 80	I 80	BUREAU	Interstate Highway
IL	I 80	I 80	COOK	Interstate Highway
IL	I 80	I 80	GRUNDY	Interstate Highway
IL	I 80	I 80	HENRY	Interstate Highway
IL	I 80	I 80	LASALLE	Interstate Highway
IL	I 80	I 80	ROCK ISLAND	Interstate Highway
IL	I 80	I 80	WILL	Interstate Highway
IL	I 88	I 88	COOK	Interstate Highway
IL	I 88	I 88	DEKALB	Interstate Highway
IL	I 88	I 88	DUPAGE	Interstate Highway
IL	I 88	I 88	KANE	Interstate Highway
IL	I 88	I 88	LEE	Interstate Highway
IL	I 88	I 88	OGLE	Interstate Highway
IL	I 88	I 88	ROCK ISLAND	Interstate Highway
IL	I 88	I 88	WHITESIDE	Interstate Highway
IL	I 90	I 90	BOONE	Interstate Highway
IL	I 90	I 90	COOK	Interstate Highway
IL	KENNEDY EXPY	I 90	COOK	Interstate Highway

IL	I 90	I 90	KANE	Interstate Highway
IL	I 90	I 90	MCHENRY	Interstate Highway
IL	I 90	I 90	WINNEBAGO	Interstate Highway
IL	KENNEDY EXPY	I 94	COOK	Interstate Highway
IL	I 94	I 94	COOK	Interstate Highway
IL	I 94	I 94	LAKE	Interstate Highway
IN	I 265	I 265	CLARK	Interstate Highway
IN	I 265	I 265	FLOYD	Interstate Highway
IN	I 275	I 275	DEARBORN	Interstate Highway
IN	I 465	I 465	BOONE	Interstate Highway
IN	I 465	I 465	HAMILTON	Interstate Highway
IN	I 465	I 465	MARION	Interstate Highway
IN	I 469	I 469	ALLEN	Interstate Highway
IN	I 64	I 64	CRAWFORD	Interstate Highway
IN	I 64	I 64	DUBOIS	Interstate Highway
IN	I 64	I 64	FLOYD	Interstate Highway
IN	I 64	I 64	GIBSON	Interstate Highway
IN	I 64	I 64	HARRISON	Interstate Highway
IN	I 64	I 64	PERRY	Interstate Highway
IN	I 64	I 64	POSEY	Interstate Highway
IN	I 64	I 64	SPENCER	Interstate Highway
IN	I 64	I 64	VANDERBURGH	Interstate Highway
IN	I 64	I 64	WARRICK	Interstate Highway
IN	I 65	I 65	BARTHOLOMEW	Interstate Highway
IN	I 65	I 65	BOONE	Interstate Highway
IN	I 65	I 65	CLARK	Interstate Highway
IN	I 65	I 65	CLINTON	Interstate Highway
IN	I 65	I 65	HENDRICKS	Interstate Highway
IN	I 65	I 65	JACKSON	Interstate Highway
IN	I 65	I 65	JASPER	Interstate Highway
IN	I 65	I 65	JOHNSON	Interstate Highway

IN	I 65	I 65	LAKE	Interstate Highway
IN	I 65	I 65	MARION	Interstate Highway
IN	I 65	I 65	NEWTON	Interstate Highway
IN	I 65	I 65	SCOTT	Interstate Highway
IN	I 65	I 65	SHELBY	Interstate Highway
IN	I 65	I 65	TIPPECANOE	Interstate Highway
IN	I 65	I 65	WHITE	Interstate Highway
IN	I 69	I 69	ALLEN	Interstate Highway
IN	I 69	I 69	DAVIESS	Interstate Highway
IN	I 69	I 69	DEKALB	Interstate Highway
IN	I 69	I 69	DELAWARE	Interstate Highway
IN	I 69	I 69	GIBSON	Interstate Highway
IN	I 69	I 69	GRANT	Interstate Highway
IN	I 69	I 69	GREENE	Interstate Highway
IN	I 69	I 69	HAMILTON	Interstate Highway
IN	I 69	I 69	HUNTINGTON	Interstate Highway
IN	I 69	I 69	MADISON	Interstate Highway
IN	I 69	I 69	MARION	Interstate Highway
IN	I 69	I 69	MONROE	Interstate Highway
IN	I 69	I 69	PIKE	Interstate Highway
IN	I 69	I 69	STEUBEN	Interstate Highway
IN	I 69	I 69	VANDERBURGH	Interstate Highway
IN	I 69	I 69	WARRICK	Interstate Highway
IN	I 69	I 69	WELLS	Interstate Highway
IN	I 70	I 70	CLAY	Interstate Highway
IN	I 70	I 70	HANCOCK	Interstate Highway
IN	I 70	I 70	HENDRICKS	Interstate Highway
IN	I 70	I 70	HENRY	Interstate Highway
IN	I 70	I 70	MARION	Interstate Highway
IN	I 70	I 70	MORGAN	Interstate Highway
IN	I 70	I 70	PUTNAM	Interstate Highway

IN	I 70	I 70	VIGO	Interstate Highway
IN	I 70	I 70	WAYNE	Interstate Highway
IN	I 74	I 74	BOONE	Interstate Highway
IN	I 74	I 74	DEARBORN	Interstate Highway
IN	I 74	I 74	DECATUR	Interstate Highway
IN	I 74	I 74	FOUNTAIN	Interstate Highway
IN	I 74	I 74	FRANKLIN	Interstate Highway
IN	I 74	I 74	HENDRICKS	Interstate Highway
IN	I 74	I 74	MARION	Interstate Highway
IN	I 74	I 74	MONTGOMERY	Interstate Highway
IN	I 74	I 74	RIPLEY	Interstate Highway
IN	I 74	I 74	RUSH	Interstate Highway
IN	I 74	I 74	SHELBY	Interstate Highway
IN	I 74	I 74	VERMILLION	Interstate Highway
IN	I 80	I 80	ELKHART	Interstate Highway
IN	I 80	I 80	LAGRANGE	Interstate Highway
IN	I 80	I 80	LAKE	Interstate Highway
IN	I 80	I 80	LAPORTE	Interstate Highway
IN	I 80	I 80	PORTER	Interstate Highway
IN	I 80	I 80	ST. JOSEPH	Interstate Highway
IN	I 80	I 80	STEUBEN	Interstate Highway
IN	I 865	I 865	BOONE	Interstate Highway
IN	I 90	I 90	LAKE	Interstate Highway
IN	I 94	I 94	LAKE	Interstate Highway
IN	I 94	I 94	LAPORTE	Interstate Highway
IN	I 94	I 94	PORTER	Interstate Highway
IN	BINFORD BLVD		MARION	Interstate Highway
KS	I 70	I 70	DICKINSON	Interstate Highway
KS	I 70	I 70	DOUGLAS	Interstate Highway
KS	I 70	I 70	ELLIS	Interstate Highway
KS	I 70	I 70	ELLSWORTH	Interstate Highway

KS	I 70	I 70	GEARY	Interstate Highway
KS	I 70	I 70	GOVE	Interstate Highway
KS	I 70	I 70	LEAVENWORTH	Interstate Highway
KS	I 70	I 70	LINCOLN	Interstate Highway
KS	I 70	I 70	LOGAN	Interstate Highway
KS	I 70	I 70	RILEY	Interstate Highway
KS	I 70	I 70	RUSSELL	Interstate Highway
KS	I 70	I 70	SALINE	Interstate Highway
KS	I 70	I 70	SHAWNEE	Interstate Highway
KS	I 70	I 70	SHERMAN	Interstate Highway
KS	I 70	I 70	THOMAS	Interstate Highway
KS	I 70	I 70	TREGO	Interstate Highway
KS	I 70	I 70	WABAUNSEE	Interstate Highway
KS	I 70	I 70	WYANDOTTE	Interstate Highway
KY	I 165	I 165	BUTLER	Interstate Highway
KY	I 165	I 165	DAVIESS	Interstate Highway
KY	I 165	I 165	OHIO	Interstate Highway
KY	I 165	I 165	WARREN	Interstate Highway
KY	I 169	I 169	CHRISTIAN	Interstate Highway
KY	I 169	I 169	HOPKINS	Interstate Highway
KY	I 24	I 24	CALDWELL	Interstate Highway
KY	I 24	I 24	CHRISTIAN	Interstate Highway
KY	I 24	I 24	LIVINGSTON	Interstate Highway
KY	I 24	I 24	LYON	Interstate Highway
KY	I 24	I 24	MARSHALL	Interstate Highway
KY	I 24	I 24	MCCRACKEN	Interstate Highway
KY	I 24	I 24	TRIGG	Interstate Highway
KY	I 264	I 264	JEFFERSON	Interstate Highway
KY	I 265	I 265	JEFFERSON	Interstate Highway
KY	I 275	I 275	BOONE	Interstate Highway
KY	I 275	I 275	CAMPBELL	Interstate Highway

KY	I 275	I 275	KENTON	Interstate Highway
KY	I 471	I 471	CAMPBELL	Interstate Highway
KY	I 64	I 64	BATH	Interstate Highway
KY	I 64	I 64	BOYD	Interstate Highway
KY	I 64	I 64	CARTER	Interstate Highway
KY	I 64	I 64	CLARK	Interstate Highway
KY	I 64	I 64	FAYETTE	Interstate Highway
KY	I 64	I 64	FRANKLIN	Interstate Highway
KY	I 64	I 64	JEFFERSON	Interstate Highway
KY	I 64	I 64	MONTGOMERY	Interstate Highway
KY	I 64	I 64	ROWAN	Interstate Highway
KY	I 64	I 64	SCOTT	Interstate Highway
KY	I 64	I 64	SHELBY	Interstate Highway
KY	I 64	I 64	WOODFORD	Interstate Highway
KY	I 65	I 65	BARREN	Interstate Highway
KY	I 65	I 65	BULLITT	Interstate Highway
KY	I 65	I 65	EDMONSON	Interstate Highway
KY	I 65	I 65	HARDIN	Interstate Highway
KY	I 65	I 65	HART	Interstate Highway
KY	I 65	I 65	JEFFERSON	Interstate Highway
KY	I 65	I 65	LARUE	Interstate Highway
KY	I 65	I 65	SIMPSON	Interstate Highway
KY	I 65	I 65	WARREN	Interstate Highway
KY	I 69	I 69	CALDWELL	Interstate Highway
KY	PENNYRILE PKWY	I 69	HENDERSON	Other Controlled Access Highway
KY	PENNYRILE PKWY	I 69	HOPKINS	Interstate Highway
KY	I 69	I 69	HOPKINS	Interstate Highway
KY	I 69 NB	I 69	LYON	Interstate Highway
KY	I 69	I 69	LYON	Interstate Highway
KY	JULIAN M CARROLL PURCHASE PKWY	I 69	MARSHALL	Other Controlled Access Highway

KY	PENNYRILE PKWY	I 69	WEBSTER	Interstate Highway
KY	I 71	I 71	BOONE	Interstate Highway
KY	I 71	I 71	CARROLL	Interstate Highway
KY	I 71	I 71	GALLATIN	Interstate Highway
KY	I 71	I 71	HENRY	Interstate Highway
KY	I 71	I 71	JEFFERSON	Interstate Highway
KY	I 71	I 71	OLDHAM	Interstate Highway
KY	I 71	I 71	TRIMBLE	Interstate Highway
KY	I 75	I 75	BOONE	Interstate Highway
KY	I 75	I 75	FAYETTE	Interstate Highway
KY	I 75	I 75	GRANT	Interstate Highway
KY	I 75	I 75	KENTON	Interstate Highway
KY	I 75	I 75	MADISON	Interstate Highway
KY	I 75	I 75	ROCKCASTLE	Interstate Highway
KY	I 75	I 75	SCOTT	Interstate Highway
KY	SR 53	SR 53	OLDHAM	Arterial or Major Collector
LA	I 10	I 10	ACADIA	Interstate Highway
LA	I 10	I 10	ASCENSION	Interstate Highway
LA	I 10	I 10	CALCASIEU	Interstate Highway
LA	I 10	I 10	EAST BATON ROUGE	Interstate Highway
LA	I 10	I 10	IBERVILLE	Interstate Highway
LA	I 10	I 10	JEFFERSON	Interstate Highway
LA	I 10	I 10	JEFFERSON DAVIS	Interstate Highway
LA	I 10	I 10	LAFAYETTE	Interstate Highway
LA	I 10	I 10	ORLEANS	Interstate Highway
LA	I 10	I 10	ST. CHARLES	Interstate Highway
LA	I 10	I 10	ST. JAMES	Interstate Highway
LA	I 10	I 10	ST. JOHN THE BAPTIST	Interstate Highway
LA	I 10	I 10	ST. MARTIN	Interstate Highway
LA	I 10	I 10	ST. TAMMANY	Interstate Highway
LA	I 10	I 10	WEST BATON ROUGE	Interstate Highway

LA	I 110	I 110	EAST BATON ROUGE	Interstate Highway
LA	I 12	I 12	EAST BATON ROUGE	Interstate Highway
LA	I 12	I 12	LIVINGSTON	Interstate Highway
LA	I 12	I 12	ST. TAMMANY	Interstate Highway
LA	I 12	I 12	TANGIPAHOA	Interstate Highway
LA	I 210	I 210	CALCASIEU	Interstate Highway
LA	I 310	I 310	ST. CHARLES	Interstate Highway
LA	I 49	I 49	AVOYELLES	Interstate Highway
LA	I 49	I 49	EVANGELINE	Interstate Highway
LA	I 49	I 49	LAFAYETTE	Interstate Highway
LA	I 49	I 49	NATCHITOCHES	Interstate Highway
LA	I 49	I 49	RAPIDES	Interstate Highway
LA	I 49	I 49	ST. LANDRY	Interstate Highway
LA	I 510	I 510	ORLEANS	Interstate Highway
LA	I 55	I 55	ORLEANS	Interstate Highway
LA	I 55	I 55	ST. JOHN THE BAPTIST	Interstate Highway
LA	I 55	I 55	ST. TAMMANY	Interstate Highway
LA	I 55	I 55	TANGIPAHOA	Interstate Highway
LA	I 59	I 59	ST. TAMMANY	Interstate Highway
LA	I 610	I 610	ORLEANS	Interstate Highway
LA	SR 21	SR 21	ST. TAMMANY	Arterial or Major Collector
LA	US 190 B	US 190 B	ST. TAMMANY	Arterial or Major Collector
LA	E BOSTON	US 190 B	ST. TAMMANY	Arterial or Major Collector
LA	US 90 BUSINESS	US 90 B	JEFFERSON	Other Controlled Access Highway
LA	US 90 BUSINESS	US 90 B	ORLEANS	Other Controlled Access Highway
LA	PONCHARTRAIN EXPY	US 90 B	ORLEANS	Other Controlled Access Highway
LA	S FIREHOUSE RD		JEFFERSON	Local Road
LA	SERVICE RD		JEFFERSON	Local Road
LA	AIRLINE DR		JEFFERSON	Local Road
LA	AVONDALE GARDEN RD		JEFFERSON	Arterial or Major Collector

LA	N CAUSEWAY BLVD		JEFFERSON	Arterial or Major Collector
LA	ELYSIAN FIELDS RD		ORLEANS	Arterial or Major Collector
LA	RAMP		ORLEANS	Arterial or Major Collector
LA	TCHOUPITOULAS ST		ORLEANS	Arterial or Major Collector
MA	I 190	I 190	WORCESTER	Interstate Highway
MA	I 195	I 195	BRISTOL	Interstate Highway
MA	I 195	I 195	PLYMOUTH	Interstate Highway
MA	I 290	I 290	MIDDLESEX	Interstate Highway
MA	I 290	I 290	WORCESTER	Interstate Highway
MA	I 291	I 291	HAMPDEN	Interstate Highway
MA	I 295	I 295	BRISTOL	Interstate Highway
MA	I 391	I 391	HAMPDEN	Interstate Highway
MA	I 395	I 395	WORCESTER	Interstate Highway
MA	I 495	I 495	BRISTOL	Interstate Highway
MA	I 495	I 495	ESSEX	Interstate Highway
MA	I 495	I 495	MIDDLESEX	Interstate Highway
MA	I 495	I 495	NORFOLK	Interstate Highway
MA	I 495	I 495	PLYMOUTH	Interstate Highway
MA	I 495	I 495	WORCESTER	Interstate Highway
MA	I 84	I 84	WORCESTER	Interstate Highway
MA	MASSACHUSETTS TPKE	I 90	BERKSHIRE	Interstate Highway
MA	MASSACHUSETTS TPKE	I 90	HAMPDEN	Interstate Highway
MA	MASSACHUSETTS TPKE	I 90	MIDDLESEX	Interstate Highway
MA	MASSACHUSETTS TPKE	I 90	SUFFOLK	Interstate Highway
MA	MASSACHUSETTS TPKE	I 90	WORCESTER	Interstate Highway
MA	I 91	I 91	FRANKLIN	Interstate Highway
MA	I 91	I 91	HAMPDEN	Interstate Highway
MA	I 91	I 91	HAMPSHIRE	Interstate Highway
MA	I 93	I 93	ESSEX	Interstate Highway
MA	I 93	I 93	MIDDLESEX	Interstate Highway
MA	I 93	I 93	NORFOLK	Interstate Highway

MA	I 93	I 93	SUFFOLK	Interstate Highway
MA	I 93 N	I 93 N	MIDDLESEX	Interstate Highway
MA	I 93 N	I 93 N	SUFFOLK	Interstate Highway
MA	I 95	I 95	BRISTOL	Interstate Highway
MA	I 95	I 95	ESSEX	Interstate Highway
MA	I 95	I 95	MIDDLESEX	Interstate Highway
MA	I 95	I 95	NORFOLK	Interstate Highway
MA	MA 146	MA 146	WORCESTER	Other Controlled Access Highway
MA	MA 1A	MA 1A	SUFFOLK	Other Controlled Access Highway
MA	MA 2	MA 2	MIDDLESEX	Other Controlled Access Highway
MA	MA 2	MA 2	WORCESTER	Other Controlled Access Highway
MA	HARBORSIDE DR		SUFFOLK	Arterial or Major Collector
MD	I 195	I 195	ANNE ARUNDEL	Interstate Highway
MD	I 195	I 195	BALTIMORE	Interstate Highway
MD	I 270	I 270	FREDERICK	Interstate Highway
MD	I 270	I 270	MONTGOMERY	Interstate Highway
MD	I 270 - EXPRESS LANES	I 270	MONTGOMERY	Interstate Highway
MD	I 270 S	I 270 S	MONTGOMERY	Interstate Highway
MD	I 295	I 295	PRINCE GEORGE'S	Interstate Highway
MD	I 370	I 370	MONTGOMERY	Interstate Highway
MD	I 395	I 395	BALTIMORE CITY	Interstate Highway
MD	I 495	I 495	MONTGOMERY	Interstate Highway
MD	I 495	I 495	PRINCE GEORGE'S	Interstate Highway
MD	I 68	I 68	ALLEGANY	Interstate Highway
MD	I 68	I 68	GARRETT	Interstate Highway
MD	I 68	I 68	WASHINGTON	Interstate Highway
MD	I 695	I 695	ANNE ARUNDEL	Interstate Highway
MD	I 695	I 695	BALTIMORE	Interstate Highway
MD	I 70	I 70	BALTIMORE	Interstate Highway

MD	I 70	I 70	BALTIMORE CITY	Interstate Highway
MD	I 70	I 70	CARROLL	Interstate Highway
MD	I 70	I 70	FREDERICK	Interstate Highway
MD	I 70	I 70	HOWARD	Interstate Highway
MD	I 70	I 70	WASHINGTON	Interstate Highway
MD	I 795	I 795	BALTIMORE	Interstate Highway
MD	I 81	I 81	WASHINGTON	Interstate Highway
MD	I 83	I 83	BALTIMORE	Interstate Highway
MD	JONES FALLS EXPY	I 83	BALTIMORE	Interstate Highway
MD	I 83	I 83	BALTIMORE CITY	Interstate Highway
MD	I 895	I 895	ANNE ARUNDEL	Interstate Highway
MD	I 895	I 895	BALTIMORE	Interstate Highway
MD	I 895	I 895	BALTIMORE CITY	Interstate Highway
MD	I 895	I 895	HOWARD	Interstate Highway
MD	I 95	I 95	BALTIMORE	Interstate Highway
MD	I 95	I 95	BALTIMORE CITY	Interstate Highway
MD	I 95	I 95	CECIL	Interstate Highway
MD	I 95	I 95	HARFORD	Interstate Highway
MD	I 95	I 95	HOWARD	Interstate Highway
MD	I 95	I 95	PRINCE GEORGE'S	Interstate Highway
MD	I 97	I 97	ANNE ARUNDEL	Interstate Highway
MD	MD 100	MD 100	ANNE ARUNDEL	Other Controlled Access Highway
MD	MD 100	MD 100	HOWARD	Other Controlled Access Highway
MD	WATERLOO RD	MD 175	HOWARD	Arterial or Major Collector
MD	BALTIMORE-WASHINGTON PKWY	MD 295	ANNE ARUNDEL	Other Controlled Access Highway
MD	MD 995A	MD 995A	ANNE ARUNDEL	Arterial or Major Collector
MD	US 50	US 50	ANNE ARUNDEL	Other Controlled Access Highway
MD	US 50	US 50	PRINCE GEORGE'S	Interstate Highway

MD	US 50	US 50	QUEEN ANNE'S	Other Controlled Access Highway
MD	AVIATION BLVD		ANNE ARUNDEL	Arterial or Major Collector
MD	HANOVER ST		BALTIMORE CITY	Arterial or Major Collector
MD	I 270 - LOCAL LANES		MONTGOMERY	Interstate Highway
ME	I 195	I 195	YORK	Interstate Highway
ME	I 295	I 295	CUMBERLAND	Interstate Highway
ME	I 95	I 95	ANDROSCOGGIN	Interstate Highway
ME	I 95	I 95	CUMBERLAND	Interstate Highway
ME	I 95	I 95	YORK	Interstate Highway
ME	VETERANS MEMORIAL BRG		CUMBERLAND	Arterial or Major Collector
ME	MAINE MALL RD		CUMBERLAND	Arterial or Major Collector
ME	MAINE TURNPIKE APPROACH RD		CUMBERLAND	Other Controlled Access Highway
MI	I 194	I 194	CALHOUN	Interstate Highway
MI	I 196	I 196	ALLEGAN	Interstate Highway
MI	I 196	I 196	BERRIEN	Interstate Highway
MI	I 196	I 196	KENT	Interstate Highway
MI	I 196	I 196	OTTAWA	Interstate Highway
MI	I 196	I 196	VAN BUREN	Interstate Highway
MI	I 275	I 275	MONROE	Interstate Highway
MI	I 275	I 275	WAYNE	Interstate Highway
MI	I 375	I 375	WAYNE	Interstate Highway
MI	I 475	I 475	GENESEE	Interstate Highway
MI	I 496	I 496	EATON	Interstate Highway
MI	I 496	I 496	INGHAM	Interstate Highway
MI	I 675	I 675	SAGINAW	Interstate Highway
MI	I 69	I 69	BRANCH	Interstate Highway
MI	I 69	I 69	CALHOUN	Interstate Highway
MI	I 69	I 69	CLINTON	Interstate Highway
MI	I 69	I 69	EATON	Interstate Highway
MI	I 69	I 69	GENESEE	Interstate Highway

MI	I 69	I 69	LAPEER	Interstate Highway
MI	I 69	I 69	SHIAWASSEE	Interstate Highway
MI	I 69	I 69	ST. CLAIR	Interstate Highway
MI	I 696	I 696	MACOMB	Interstate Highway
MI	I 696	I 696	OAKLAND	Interstate Highway
MI	I 75	I 75	BAY	Interstate Highway
MI	I 75	I 75	GENESEE	Interstate Highway
MI	I 75	I 75	MONROE	Interstate Highway
MI	I 75	I 75	OAKLAND	Interstate Highway
MI	I 75	I 75	SAGINAW	Interstate Highway
MI	I 75	I 75	WAYNE	Interstate Highway
MI	I 94	I 94	BERRIEN	Interstate Highway
MI	I 94	I 94	CALHOUN	Interstate Highway
MI	I 94	I 94	JACKSON	Interstate Highway
MI	I 94	I 94	KALAMAZOO	Interstate Highway
MI	I 94	I 94	MACOMB	Interstate Highway
MI	I 94	I 94	ST. CLAIR	Interstate Highway
MI	I 94	I 94	VAN BUREN	Interstate Highway
MI	I 94	I 94	WASHTENAW	Interstate Highway
MI	I 94	I 94	WAYNE	Interstate Highway
MI	I 96	I 96	CLINTON	Interstate Highway
MI	I 96	I 96	EATON	Interstate Highway
MI	I 96	I 96	INGHAM	Interstate Highway
MI	I 96	I 96	IONIA	Interstate Highway
MI	I 96	I 96	KENT	Interstate Highway
MI	I 96	I 96	LIVINGSTON	Interstate Highway
MI	I 96	I 96	MUSKEGON	Interstate Highway
MI	I 96	I 96	OAKLAND	Interstate Highway
MI	I 96	I 96	OTTAWA	Interstate Highway
MI	I 96	I 96	WAYNE	Interstate Highway
MI	I 296	US 131	KENT	Interstate Highway

MN	I 35	I 35	ANOKA	Interstate Highway
MN	I 35	I 35	CARLTON	Interstate Highway
MN	I 35	I 35	CHISAGO	Interstate Highway
MN	I 35	I 35	PINE	Interstate Highway
MN	I 35	I 35	ST. LOUIS	Interstate Highway
MN	I 35	I 35	WASHINGTON	Interstate Highway
MN	I 35E	I 35E	ANOKA	Interstate Highway
MN	I 35E	I 35E	RAMSEY	Interstate Highway
MN	I 35W	I 35W	ANOKA	Interstate Highway
MN	I 494	I 494	WASHINGTON	Interstate Highway
MN	I 535	I 535	ST. LOUIS	Interstate Highway
MN	I 694	I 694	RAMSEY	Interstate Highway
MN	I 694	I 694	WASHINGTON	Interstate Highway
MN	I 94	I 94	RAMSEY	Interstate Highway
MN	I 94	I 94	WASHINGTON	Interstate Highway
MO	I 155	I 155	PEMISCOT	Interstate Highway
MO	I 170	I 170	ST. LOUIS	Interstate Highway
MO	I 255	I 255	ST. LOUIS	Interstate Highway
MO	I 270	I 270	ST. LOUIS	Interstate Highway
MO	I 270	I 270	ST. LOUIS CITY	Interstate Highway
MO	I 44	I 44	CRAWFORD	Interstate Highway
MO	I 44	I 44	FRANKLIN	Interstate Highway
MO	I 44	I 44	PHELPS	Interstate Highway
MO	I 44	I 44	ST. LOUIS	Interstate Highway
MO	I 44	I 44	ST. LOUIS CITY	Interstate Highway
MO	I 55	I 55	CAPE GIRARDEAU	Interstate Highway
MO	I 55	I 55	JEFFERSON	Interstate Highway
MO	I 55	I 55	NEW MADRID	Interstate Highway
MO	I 55	I 55	PEMISCOT	Interstate Highway
MO	I 55	I 55	PERRY	Interstate Highway
MO	I 55	I 55	SCOTT	Interstate Highway

MO	I 55	I 55	ST. LOUIS	Interstate Highway
MO	I 55	I 55	ST. LOUIS CITY	Interstate Highway
MO	I 64	I 55	ST. LOUIS CITY	Interstate Highway
MO	I 55	I 55	STE. GENEVIEVE	Interstate Highway
MO	I 57	I 57	MISSISSIPPI	Interstate Highway
MO	I 57	I 57	SCOTT	Interstate Highway
MO	I 64	I 64	ST. CHARLES	Interstate Highway
MO	I 64	I 64	ST. LOUIS	Interstate Highway
MO	I 64	I 64	ST. LOUIS CITY	Interstate Highway
MO	I 70	I 70	BOONE	Interstate Highway
MO	I 70	I 70	CALLAWAY	Interstate Highway
MO	I 70	I 70	COOPER	Interstate Highway
MO	I 70	I 70	JACKSON	Interstate Highway
MO	I 70	I 70	LAFAYETTE	Interstate Highway
MO	I 70	I 70	MONTGOMERY	Interstate Highway
MO	I 70	I 70	SALINE	Interstate Highway
MO	I 70	I 70	ST. CHARLES	Interstate Highway
MO	I 70	I 70	ST. LOUIS	Interstate Highway
MO	I 70	I 70	ST. LOUIS CITY	Interstate Highway
MO	I 70	I 70	WARREN	Interstate Highway
MO	I 72	I 72	MARION	Interstate Highway
MO	JAMES RD		MARION	Arterial or Major Collector
MS	I 10	I 10	HANCOCK	Interstate Highway
MS	I 10	I 10	HARRISON	Interstate Highway
MS	I 10	I 10	JACKSON	Interstate Highway
MS	I 110	I 110	HARRISON	Interstate Highway
MS	I 20	I 20	HINDS	Interstate Highway
MS	I 20	I 20	LAUDERDALE	Interstate Highway
MS	I 20	I 20	RANKIN	Interstate Highway
MS	I 22	I 22	BENTON	Interstate Highway
MS	I 22	I 22	ITAWAMBA	Interstate Highway

MS	I 22	I 22	LEE	Interstate Highway
MS	I 22	I 22	MARSHALL	Interstate Highway
MS	I 22	I 22	PONTOTOC	Interstate Highway
MS	I 22	I 22	UNION	Interstate Highway
MS	I 269	I 269	DESOTO	Interstate Highway
MS	I 269	I 269	MARSHALL	Interstate Highway
MS	I 55	I 55	CARROLL	Interstate Highway
MS	I 55	I 55	COPIAH	Interstate Highway
MS	I 55	I 55	DESOTO	Interstate Highway
MS	I 55	I 55	GRENADA	Interstate Highway
MS	I 55	I 55	HINDS	Interstate Highway
MS	I 55	I 55	HOLMES	Interstate Highway
MS	I 55	I 55	LINCOLN	Interstate Highway
MS	I 55	I 55	MADISON	Interstate Highway
MS	I 55	I 55	MONTGOMERY	Interstate Highway
MS	I 55	I 55	PANOLA	Interstate Highway
MS	I 55	I 55	PIKE	Interstate Highway
MS	I 55	I 55	RANKIN	Interstate Highway
MS	I 55	I 55	TATE	Interstate Highway
MS	I 55	I 55	YALOBUSHA	Interstate Highway
MS	I 55	I 55	YAZOO	Interstate Highway
MS	I 59	I 59	CLARKE	Interstate Highway
MS	I 59	I 59	FORREST	Interstate Highway
MS	I 59	I 59	JASPER	Interstate Highway
MS	I 59	I 59	JONES	Interstate Highway
MS	I 59	I 59	LAMAR	Interstate Highway
MS	I 59	I 59	LAUDERDALE	Interstate Highway
MS	I 59	I 59	PEARL RIVER	Interstate Highway
MS	I 65	I 65	HINDS	Interstate Highway
MS	I 69	I 69	DESOTO	Interstate Highway
MS	CANAL RD		HARRISON	Arterial or Major Collector

MS	FORTIFICATION ST		HINDS	Arterial or Major Collector
MT	I 90	I 90	MINERAL	Interstate Highway
NC	JOHN JAY BURNEY JR FWY	I 140	BRUNSWICK	Interstate Highway
NC	JOHN JAY BURNEY JR FWY	I 140	NEW HANOVER	Interstate Highway
NC	I 240	I 240	BUNCOMBE	Interstate Highway
NC	I 26	I 26	BUNCOMBE	Interstate Highway
NC	I 26	I 26	HENDERSON	Interstate Highway
NC	I 26	I 26	MADISON	Interstate Highway
NC	I 26	I 26	POLK	Interstate Highway
NC	I 277	I 277	MECKLENBURG	Interstate Highway
NC	I 285	I 285	FORSYTH	Interstate Highway
NC	I 295	I 295	CUMBERLAND	Interstate Highway
NC	I 40	I 40	ALAMANCE	Interstate Highway
NC	I 40	I 40	BUNCOMBE	Interstate Highway
NC	I 40	I 40	BURKE	Interstate Highway
NC	I 40	I 40	CATAWBA	Interstate Highway
NC	I 40	I 40	DAVIE	Interstate Highway
NC	I 40	I 40	DUPLIN	Interstate Highway
NC	I 40	I 40	DURHAM	Interstate Highway
NC	I 40	I 40	FORSYTH	Interstate Highway
NC	I 40	I 40	GUILFORD	Interstate Highway
NC	I 40	I 40	IREDELL	Interstate Highway
NC	I 40	I 40	JOHNSTON	Interstate Highway
NC	I 40	I 40	MCDOWELL	Interstate Highway
NC	I 40	I 40	NEW HANOVER	Interstate Highway
NC	I 40	I 40	ORANGE	Interstate Highway
NC	I 40	I 40	PENDER	Interstate Highway
NC	I 40	I 40	SAMPSON	Interstate Highway
NC	I 40	I 40	WAKE	Interstate Highway
NC	I 40 BUSINESS	I 40 B	FORSYTH	Other Controlled Access Highway
NC	I 440	I 440	WAKE	Interstate Highway

NC	CHARLOTTE BELTWAY	I 485	MECKLENBURG	Interstate Highway
NC	I 540	I 540	DURHAM	Interstate Highway
NC	I 540	I 540	WAKE	Interstate Highway
NC	I 73	I 73	GUILFORD	Interstate Highway
NC	I 73	I 73	MONTGOMERY	Interstate Highway
NC	I 73	I 73	RANDOLPH	Interstate Highway
NC	I 73	I 73	RICHMOND	Interstate Highway
NC	I 73	I 73	ROCKINGHAM	Interstate Highway
NC	I 74	I 74	FORSYTH	Interstate Highway
NC	I 74	I 74	GUILFORD	Interstate Highway
NC	I 74	I 74	RANDOLPH	Interstate Highway
NC	I 74	I 74	ROBESON	Interstate Highway
NC	I 74	I 74	SURRY	Interstate Highway
NC	I 77	I 77	IREDELL	Interstate Highway
NC	I 77	I 77	MECKLENBURG	Interstate Highway
NC	I 77	I 77	SURRY	Interstate Highway
NC	I 77	I 77	YADKIN	Interstate Highway
NC	I 785	I 785	GUILFORD	Interstate Highway
NC	I 795	I 795	WAYNE	Interstate Highway
NC	I 795	I 795	WILSON	Interstate Highway
NC	I 840	I 840	GUILFORD	Interstate Highway
NC	I 85	I 85	CABARRUS	Interstate Highway
NC	I 85	I 85	CLEVELAND	Interstate Highway
NC	I 85	I 85	DAVIDSON	Interstate Highway
NC	I 85	I 85	DURHAM	Interstate Highway
NC	I 85	I 85	GASTON	Interstate Highway
NC	I 85	I 85	GRANVILLE	Interstate Highway
NC	I 85	I 85	GUILFORD	Interstate Highway
NC	I 85	I 85	MECKLENBURG	Interstate Highway
NC	I 85	I 85	ORANGE	Interstate Highway
NC	I 85	I 85	RANDOLPH	Interstate Highway

NC	I 85	I 85	ROWAN	Interstate Highway
NC	I 85	I 85	VANCE	Interstate Highway
NC	I 85	I 85	WARREN	Interstate Highway
NC	I 87	I 87	WAKE	Interstate Highway
NC	I 95	I 95	CUMBERLAND	Interstate Highway
NC	I 95	I 95	HALIFAX	Interstate Highway
NC	I 95	I 95	HARNETT	Interstate Highway
NC	I 95	I 95	JOHNSTON	Interstate Highway
NC	I 95	I 95	NASH	Interstate Highway
NC	I 95	I 95	NORTHAMPTON	Interstate Highway
NC	I 95	I 95	ROBESON	Interstate Highway
NC	I 95	I 95	WILSON	Interstate Highway
NC	WEST MARKET ST	NC 1008	GUILFORD	Arterial or Major Collector
NC	GALLIMORE DAIRY RD	NC 1556	GUILFORD	Arterial or Major Collector
NC	BRAGG BLVD	NC 24	CUMBERLAND	Arterial or Major Collector
NC	NC 24	NC 24	CUMBERLAND	Other Controlled Access Highway
NC	NC 68	NC 68	GUILFORD	Arterial or Major Collector
NC	BRAGG BLVD	SR 24	CUMBERLAND	Arterial or Major Collector
NC	US 1	US 1	WAKE	Other Controlled Access Highway
NC	US 17	US 17	BRUNSWICK	Arterial or Major Collector
NC	US 17	US 17	NEW HANOVER	Interstate Highway
NC	US 19	US 19	BUNCOMBE	Other Controlled Access Highway
NC	FREEMAN MILL RD	US 220	GUILFORD	Other Controlled Access Highway
NC	US 220	US 220	GUILFORD	Other Controlled Access Highway
NC	US 29	US 29	GUILFORD	Other Controlled Access Highway
NC	O HENRY BLVD	US 29	GUILFORD	Other Controlled Access Highway
NC	MLK JR DR	US 311	FORSYTH	Arterial or Major Collector

NC	US 421	US 421	NEW HANOVER	Arterial or Major Collector
NC	CAROLINA BEACH RD	US 421	NEW HANOVER	Arterial or Major Collector
NC	US 52	US 52	FORSYTH	Other Controlled Access Highway
NC	US 70	US 70	JOHNSTON	Arterial or Major Collector
NC	US 70 BYPASS	US 70 P	JOHNSTON	Arterial or Major Collector
NC	INDEPENDENCE BLVD	US 74	MECKLENBURG	Arterial or Major Collector
NC	US 74	US 74	ROBESON	Interstate Highway
NC	US 74 ALTERNATE	US 74 A	BUNCOMBE	Arterial or Major Collector
NC	US 76	US 76	BRUNSWICK	Other Controlled Access Highway
NC	US 76	US 76	NEW HANOVER	Other Controlled Access Highway
NC	RANDOLPH ST		CUMBERLAND	Arterial or Major Collector
NC	N BREVARD ST		MECKLENBURG	Arterial or Major Collector
NC	FRONT ST		NEW HANOVER	Arterial or Major Collector
NE	I 76	I 76	DEUEL	Interstate Highway
NE	I 80	I 80	BUFFALO	Interstate Highway
NE	I 80	I 80	CASS	Interstate Highway
NE	I 80	I 80	CHEYENNE	Interstate Highway
NE	I 80	I 80	DAWSON	Interstate Highway
NE	I 80	I 80	DEUEL	Interstate Highway
NE	I 80	I 80	DOUGLAS	Interstate Highway
NE	I 80	I 80	HALL	Interstate Highway
NE	I 80	I 80	HAMILTON	Interstate Highway
NE	I 80	I 80	KEITH	Interstate Highway
NE	I 80	I 80	KIMBALL	Interstate Highway
NE	I 80	I 80	LANCASTER	Interstate Highway
NE	I 80	I 80	LINCOLN	Interstate Highway
NE	I 80	I 80	SARPY	Interstate Highway
NE	I 80	I 80	SEWARD	Interstate Highway
NE	I 80	I 80	YORK	Interstate Highway
NH	I 293	I 293	HILLSBOROUGH	Interstate Highway

NH	F E EVERETT TPKE	I 293	HILLSBOROUGH	Interstate Highway
NH	F E EVERETT TPKE	I 293	MERRIMACK	Interstate Highway
NH	I 393	I 393	MERRIMACK	Interstate Highway
NH	I 89	I 89	GRAFTON	Interstate Highway
NH	I 89	I 89	MERRIMACK	Interstate Highway
NH	I 89	I 89	SULLIVAN	Interstate Highway
NH	I 93	I 93	BELKNAP	Interstate Highway
NH	I 93	I 93	GRAFTON	Interstate Highway
NH	I 93	I 93	HILLSBOROUGH	Interstate Highway
NH	F E EVERETT TPKE	I 93	MERRIMACK	Interstate Highway
NH	I 93	I 93	MERRIMACK	Interstate Highway
NH	I 93	I 93	ROCKINGHAM	Interstate Highway
NH	BLUE STAR TPKE	I 95	ROCKINGHAM	Interstate Highway
NJ	I 195	I 195	MERCER	Interstate Highway
NJ	I 195	I 195	MONMOUTH	Interstate Highway
NJ	I 195	I 195	OCEAN	Interstate Highway
NJ	I 278	I 278	UNION	Interstate Highway
NJ	I 280	I 280	ESSEX	Interstate Highway
NJ	I 280	I 280	HUDSON	Interstate Highway
NJ	I 280	I 280	MORRIS	Interstate Highway
NJ	I 287	I 287	BERGEN	Interstate Highway
NJ	I 287	I 287	MIDDLESEX	Interstate Highway
NJ	I 287	I 287	MORRIS	Interstate Highway
NJ	I 287	I 287	PASSAIC	Interstate Highway
NJ	I 287	I 287	SOMERSET	Interstate Highway
NJ	I 295	I 295	BURLINGTON	Interstate Highway
NJ	I 295	I 295	CAMDEN	Interstate Highway
NJ	I 295	I 295	GLOUCESTER	Interstate Highway
NJ	I 295	I 295	MERCER	Interstate Highway
NJ	I 295	I 295	SALEM	Interstate Highway
NJ	I 676	I 676	CAMDEN	Interstate Highway

NJ	I 676 - BEN FRANKLIN BRG TOLL PLAZA	I 676	CAMDEN	Interstate Highway
NJ	NORTH-SOUTH FWY	I 76	CAMDEN	Interstate Highway
NJ	I 76	I 76	CAMDEN	Interstate Highway
NJ	I 78	I 78	ESSEX	Interstate Highway
NJ	NEWARK BAY BRIDGE	I 78	ESSEX	Interstate Highway
NJ	I 78 - NEWARK EB TOLL PLAZA	I 78	ESSEX	Interstate Highway
NJ	NEWARK BAY BRIDGE	I 78	HUDSON	Interstate Highway
NJ	I 78	I 78	HUDSON	Interstate Highway
NJ	HOLLAND TUNNEL	I 78	HUDSON	Interstate Highway
NJ	I 78	I 78	HUNTERDON	Interstate Highway
NJ	I 78	I 78	SOMERSET	Interstate Highway
NJ	I 78	I 78	UNION	Interstate Highway
NJ	I 78	I 78	WARREN	Interstate Highway
NJ	I 80	I 80	BERGEN	Interstate Highway
NJ	I 80	I 80	ESSEX	Interstate Highway
NJ	I 80	I 80	MORRIS	Interstate Highway
NJ	I 80 - LOCAL LANES	I 80	MORRIS	Interstate Highway
NJ	I 80 - EXPRESS LANES	I 80	MORRIS	Interstate Highway
NJ	I 80	I 80	PASSAIC	Interstate Highway
NJ	I 80	I 80	SUSSEX	Interstate Highway
NJ	I 80	I 80	WARREN	Interstate Highway
NJ	I 95 EXT - LOCAL LANES	I 95	BERGEN	Interstate Highway
NJ	NEW JERSEY TPKE - EASTERN SPUR	I 95	BERGEN	Interstate Highway
NJ	I 95 NB APPROACH to I 80	I 95	BERGEN	Interstate Highway
NJ	NEW JERSEY TPKE - WESTERN SPUR	I 95	BERGEN	Interstate Highway
NJ	NEW JERSEY TPKE - I 95 EXT	I 95	BERGEN	Interstate Highway
NJ	I 95 EXT - EXPRESS LANES	I 95	BERGEN	Interstate Highway
NJ	GEORGE WASHINGTON BRG - LOWER DECK APPROACH	I 95	BERGEN	Interstate Highway
NJ	GEORGE WASHINGTON BRG - LOWER DECK	I 95	BERGEN	Interstate Highway

NJ	GEORGE WASHINGTON BRG - UPPER DECK	I 95	BERGEN	Interstate Highway
NJ	GEORGE WASHINGTON BRG - UPPER DECK APPROACH	I 95	BERGEN	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	BURLINGTON	Interstate Highway
NJ	I 95	I 95	BURLINGTON	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	ESSEX	Interstate Highway
NJ	NEW JERSEY TPKE - EASTERN SPUR	I 95	ESSEX	Interstate Highway
NJ	NEW JERSEY TPKE - WESTERN SPUR	I 95	ESSEX	Interstate Highway
NJ	NEW JERSEY TPKE - EASTERN SPUR	I 95	HUDSON	Interstate Highway
NJ	NEW JERSEY TPKE - WESTERN SPUR	I 95	HUDSON	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	MERCER	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	MIDDLESEX	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	UNION	Interstate Highway
NJ	NJ 29	NJ 29	MERCER	Other Controlled Access Highway
NJ	US 1 - LOCAL LANES	US 1	ESSEX	Other Controlled Access Highway
NJ	US 1	US 1	MERCER	Other Controlled Access Highway
NJ	I 76 CONNECTOR		CAMDEN	Other Controlled Access Highway
NM	I 10	I 10	DOÃ'A ANA	Interstate Highway
NM	I 10	I 10	GRANT	Interstate Highway
NM	I 10	I 10	HIDALGO	Interstate Highway
NM	I 10	I 10	LUNA	Interstate Highway
NM	I 25	I 25	DOÃ'A ANA	Interstate Highway
NM	I 25	I 25	SIERRA	Interstate Highway
NV	I 11	I 11	CLARK	Interstate Highway
NV	I 15	I 15	CLARK	Interstate Highway
NV	I 215	I 215	CLARK	Interstate Highway
NV	I 515	I 515	CLARK	Interstate Highway
NV	I 580	I 580	CARSON CITY	Interstate Highway
NV	I 580	I 580	WASHOE	Interstate Highway

NV	I 80	I 80	CHURCHILL	Interstate Highway
NV	I 80	I 80	ELKO	Interstate Highway
NV	I 80	I 80	EUREKA	Interstate Highway
NV	I 80	I 80	HUMBOLDT	Interstate Highway
NV	I 80	I 80	LANDER	Interstate Highway
NV	I 80	I 80	LYON	Interstate Highway
NV	I 80	I 80	PERSHING	Interstate Highway
NV	I 80	I 80	STOREY	Interstate Highway
NV	I 80	I 80	WASHOE	Interstate Highway
NV	US 93	US 93	CLARK	Interstate Highway
NV	US 95	US 95	CLARK	Other Controlled Access Highway
NY	NIAGARA THWY	I 190	ERIE	Interstate Highway
NY	NIAGARA EXPY	I 190	NIAGARA	Interstate Highway
NY	I 278	I 278	BRONX	Interstate Highway
NY	RFK TRIBOROUGH BRG	I 278	BRONX	Interstate Highway
NY	GOWANUS EXPY	I 278	KINGS	Interstate Highway
NY	BROOKLYN-QUEENS EXPY	I 278	KINGS	Interstate Highway
NY	VERRAZANO-NARROWS BRG - UPPER DECK APPROACH LANE	I 278	KINGS	Interstate Highway
NY	VERRAZANO-NARROWS BRG - UPPER DECK	I 278	KINGS	Interstate Highway
NY	RFK TRIBOROUGH BRG	I 278	NEW YORK	Interstate Highway
NY	RFK TRIBOROUGH BRG	I 278	QUEENS	Interstate Highway
NY	BROOKLYN-QUEENS EXPY	I 278	QUEENS	Interstate Highway
NY	GRAND CENTRAL PKWY	I 278	QUEENS	Interstate Highway
NY	I 278	I 278	RICHMOND	Interstate Highway
NY	VERRAZANO-NARROWS BRG - UPPER DECK APPROACH LANE	I 278	RICHMOND	Interstate Highway
NY	VERRAZANO-NARROWS BRG - LOWER DECK APPROACH LANE	I 278	RICHMOND	Interstate Highway
NY	VERRAZANO-NARROWS BRG - UPPER DECK	I 278	RICHMOND	Interstate Highway
NY	I 287	I 287	ROCKLAND	Interstate Highway

NY	CROSS-WESTCHESTER EXPY	I 287	WESTCHESTER	Interstate Highway
NY	I 290	I 290	ERIE	Interstate Highway
NY	CLEARVIEW EXPY	I 295	BRONX	Interstate Highway
NY	THROGS NECK BRG	I 295	BRONX	Interstate Highway
NY	CLEARVIEW EXPY	I 295	QUEENS	Interstate Highway
NY	THROGS NECK BRG	I 295	QUEENS	Interstate Highway
NY	GENESEE EXPY	I 390	LIVINGSTON	Interstate Highway
NY	GENESEE EXPY	I 390	MONROE	Interstate Highway
NY	ROCHESTER OUTER LP	I 390	MONROE	Interstate Highway
NY	GENESEE EXPY	I 390	STEUBEN	Interstate Highway
NY	BROOKLYN-BATTERY TUNNEL	I 478	KINGS	Interstate Highway
NY	BROOKLYN-BATTERY TUNNEL	I 478	NEW YORK	Interstate Highway
NY	I 481	I 481	ONONDAGA	Interstate Highway
NY	I 490	I 490	GENESEE	Interstate Highway
NY	I 490	I 490	MONROE	Interstate Highway
NY	I 490	I 490	ONTARIO	Interstate Highway
NY	LONG ISLAND EXPY	I 495	NASSAU	Interstate Highway
NY	QUEENS-MIDTOWN TUNNEL	I 495	NEW YORK	Interstate Highway
NY	HORACE HARDING EXPY	I 495	QUEENS	Interstate Highway
NY	QUEENS-MIDTOWN EXPY	I 495	QUEENS	Interstate Highway
NY	QUEENS-MIDTOWN TUNNEL	I 495	QUEENS	Interstate Highway
NY	LONG ISLAND EXPY	I 495	SUFFOLK	Interstate Highway
NY	I 590	I 590	MONROE	Interstate Highway
NY	BRONX-WHITESTONE BRG	I 678	BRONX	Interstate Highway
NY	I 678	I 678	BRONX	Interstate Highway
NY	I 678	I 678	QUEENS	Interstate Highway
NY	BRONX-WHITESTONE BRG	I 678	QUEENS	Interstate Highway
NY	I 684	I 684	PUTNAM	Interstate Highway
NY	I 684	I 684	WESTCHESTER	Interstate Highway
NY	I 690	I 690	ONONDAGA	Interstate Highway
NY	THROGS NECK EXPY	I 695	BRONX	Interstate Highway

NY	HOLLAND TUNNEL	I 78	NEW YORK	Interstate Highway
NY	I 781	I 781	JEFFERSON	Interstate Highway
NY	I 787	I 787	ALBANY	Interstate Highway
NY	I 787	I 787	RENSSELAER	Other Controlled Access Highway
NY	I 790	I 790	ONEIDA	Interstate Highway
NY	I 81	I 81	BROOME	Interstate Highway
NY	I 81	I 81	CORTLAND	Interstate Highway
NY	I 81	I 81	JEFFERSON	Interstate Highway
NY	I 81	I 81	ONONDAGA	Interstate Highway
NY	I 81	I 81	OSWEGO	Interstate Highway
NY	I 84	I 84	DUTCHESS	Interstate Highway
NY	I 84	I 84	ORANGE	Interstate Highway
NY	I 84	I 84	PUTNAM	Interstate Highway
NY	SOUTHERN TIER EXPY	I 86	ALLEGANY	Interstate Highway
NY	QUICKWAY	I 86	BROOME	Interstate Highway
NY	SOUTHERN TIER EXPY	I 86	CATTARAUGUS	Interstate Highway
NY	SOUTHERN TIER EXPY	I 86	CHAUTAUQUA	Interstate Highway
NY	SOUTHERN TIER EXPY	I 86	CHEMUNG	Other Controlled Access Highway
NY	SOUTHERN TIER EXPY	I 86	STEUBEN	Interstate Highway
NY	SOUTHERN TIER EXPY	I 86	TIOGA	Other Controlled Access Highway
NY	NEW YORK STATE THWY	I 87	ALBANY	Interstate Highway
NY	ADIRONDACK NORTHWAY	I 87	ALBANY	Interstate Highway
NY	I 87/I 90	I 87	ALBANY	Interstate Highway
NY	I 87	I 87	ALBANY	Interstate Highway
NY	I 87	I 87	BRONX	Interstate Highway
NY	MAJOR DEEGAN EXPY	I 87	BRONX	Interstate Highway
NY	ADIRONDACK NORTHWAY	I 87	ESSEX	Interstate Highway
NY	NEW YORK STATE THWY	I 87	GREENE	Interstate Highway
NY	NEW YORK STATE THWY	I 87	ORANGE	Interstate Highway
NY	NEW YORK STATE THWY	I 87	ROCKLAND	Interstate Highway

NY	TAPPAN ZEE BRG	I 87	ROCKLAND	Interstate Highway
NY	ADIRONDACK NORTHWAY	I 87	SARATOGA	Interstate Highway
NY	NEW YORK STATE THWY	I 87	ULSTER	Interstate Highway
NY	ADIRONDACK NORTHWAY	I 87	WARREN	Interstate Highway
NY	NEW YORK STATE THWY	I 87	WESTCHESTER	Interstate Highway
NY	TAPPAN ZEE BRG	I 87	WESTCHESTER	Interstate Highway
NY	I 88	I 88	BROOME	Interstate Highway
NY	I 88	I 88	CHENANGO	Interstate Highway
NY	I 88	I 88	DELAWARE	Interstate Highway
NY	I 88	I 88	OTSEGO	Interstate Highway
NY	I 88	I 88	SCHENECTADY	Interstate Highway
NY	I 88	I 88	SCHOHARIE	Interstate Highway
NY	I 890	I 890	ALBANY	Interstate Highway
NY	I 890	I 890	SCHENECTADY	Interstate Highway
NY	NEW YORK STATE THWY	I 90	ALBANY	Interstate Highway
NY	I 90	I 90	ALBANY	Interstate Highway
NY	NEW YORK STATE THWY	I 90	CAYUGA	Interstate Highway
NY	NEW YORK STATE THWY	I 90	CHAUTAUQUA	Interstate Highway
NY	BERKSHIRE CONNECTOR	I 90	COLUMBIA	Interstate Highway
NY	NEW YORK STATE THWY	I 90	ERIE	Interstate Highway
NY	NEW YORK STATE THWY	I 90	GENESEE	Interstate Highway
NY	NEW YORK STATE THWY	I 90	HERKIMER	Interstate Highway
NY	NEW YORK STATE THWY	I 90	MADISON	Interstate Highway
NY	NEW YORK STATE THWY	I 90	MONROE	Interstate Highway
NY	NEW YORK STATE THWY	I 90	MONTGOMERY	Interstate Highway
NY	NEW YORK STATE THWY	I 90	ONEIDA	Interstate Highway
NY	NEW YORK STATE THWY	I 90	ONONDAGA	Interstate Highway
NY	NEW YORK STATE THWY	I 90	ONTARIO	Interstate Highway
NY	I 90	I 90	RENSSELAER	Interstate Highway
NY	BERKSHIRE CONNECTOR	I 90	RENSSELAER	Interstate Highway
NY	NEW YORK STATE THWY	I 90	SCHENECTADY	Interstate Highway

NY	NEW YORK STATE THWY	I 90	SENECA	Interstate Highway
NY	NEW ENGLAND THWY	I 95	BRONX	Interstate Highway
NY	BRUCKNER EXPY	I 95	BRONX	Interstate Highway
NY	CROSS BRONX EXPY	I 95	BRONX	Interstate Highway
NY	ALEXANDER HAMILTON BRG	I 95	BRONX	Interstate Highway
NY	ALEXANDER HAMILTON BRG	I 95	NEW YORK	Interstate Highway
NY	I 95	I 95	NEW YORK	Interstate Highway
NY	GEORGE WASHINGTON BRIDGE - LOWER	I 95	NEW YORK	Interstate Highway
NY	GEORGE WASHINGTON BRIDGE - UPPER	I 95	NEW YORK	Interstate Highway
NY	NEW ENGLAND THWY	I 95	WESTCHESTER	Interstate Highway
NY	I 99	I 99	STEUBEN	Interstate Highway
NY	I 990	I 990	ERIE	Interstate Highway
NY	W VESTAL PKWY	NY 434	TIOGA	Arterial or Major Collector
NY	SHERIDAN EXPY	NY 895	BRONX	Other Controlled Access Highway
NY	SR 434	SR 434	TIOGA	Arterial or Major Collector
NY	EAST AVE	SR 96	MONROE	Arterial or Major Collector
NY	BRUCKNER EXPY		BRONX	Arterial or Major Collector
NY	I 81/I 86 ACCESS RD		BROOME	Arterial or Major Collector
NY	SHERIDAN DR		ERIE	Arterial or Major Collector
NY	IRAQI FREEDOM DR		JEFFERSON	Facility Access/Circulator Road
NY	39TH ST		KINGS	Arterial or Major Collector
OH	I 270	I 270	FRANKLIN	Interstate Highway
OH	I 271	I 271	CUYAHOGA	Interstate Highway
OH	I 271 - LOCAL LANES	I 271	CUYAHOGA	Interstate Highway
OH	I 271 - LOCAL LANES	I 271	LAKE	Interstate Highway
OH	I 271	I 271	MEDINA	Interstate Highway
OH	I 271	I 271	SUMMIT	Interstate Highway
OH	I 275	I 275	CLERMONT	Interstate Highway
OH	I 275	I 275	HAMILTON	Interstate Highway

OH	I 277	I 277	SUMMIT	Interstate Highway
OH	I 280	I 280	LUCAS	Interstate Highway
OH	I 280	I 280	WOOD	Interstate Highway
OH	I 470	I 470	BELMONT	Interstate Highway
OH	I 471	I 471	HAMILTON	Interstate Highway
OH	I 475	I 475	LUCAS	Interstate Highway
OH	I 475	I 475	WOOD	Interstate Highway
OH	I 480	I 480	CUYAHOGA	Interstate Highway
OH	I 480	I 480	LORAIN	Interstate Highway
OH	I 480	I 480	PORTAGE	Interstate Highway
OH	I 480	I 480	SUMMIT	Interstate Highway
OH	I 480N	I 480N	CUYAHOGA	Interstate Highway
OH	I 490	I 490	CUYAHOGA	Interstate Highway
OH	I 670	I 670	FRANKLIN	Interstate Highway
OH	I 675	I 675	CLARK	Interstate Highway
OH	I 675	I 675	GREENE	Interstate Highway
OH	I 675	I 675	MONTGOMERY	Interstate Highway
OH	I 680	I 680	MAHONING	Interstate Highway
OH	I 70	I 70	BELMONT	Interstate Highway
OH	I 70	I 70	CLARK	Interstate Highway
OH	I 70	I 70	FAIRFIELD	Interstate Highway
OH	I 70	I 70	FRANKLIN	Interstate Highway
OH	I 70	I 70	GUERNSEY	Interstate Highway
OH	I 70	I 70	LICKING	Interstate Highway
OH	I 70	I 70	MADISON	Interstate Highway
OH	I 70	I 70	MONTGOMERY	Interstate Highway
OH	I 70	I 70	MUSKINGUM	Interstate Highway
OH	I 70	I 70	PREBLE	Interstate Highway
OH	I 71	I 71	ASHLAND	Interstate Highway
OH	I 71	I 71	CLINTON	Interstate Highway
OH	I 71	I 71	CUYAHOGA	Interstate Highway

OH	I 71	I 71	DELAWARE	Interstate Highway
OH	I 71	I 71	FAYETTE	Interstate Highway
OH	I 71	I 71	FRANKLIN	Interstate Highway
OH	I 71	I 71	GREENE	Interstate Highway
OH	I 71	I 71	HAMILTON	Interstate Highway
OH	I 71	I 71	MADISON	Interstate Highway
OH	I 71	I 71	MEDINA	Interstate Highway
OH	I 71	I 71	MORROW	Interstate Highway
OH	I 71	I 71	PICKAWAY	Interstate Highway
OH	I 71	I 71	RICHLAND	Interstate Highway
OH	I 71	I 71	WARREN	Interstate Highway
OH	I 71	I 71	WAYNE	Interstate Highway
OH	I 74	I 74	HAMILTON	Interstate Highway
OH	I 75	I 75	ALLEN	Interstate Highway
OH	I 75	I 75	AUGLAIZE	Interstate Highway
OH	I 75	I 75	BUTLER	Interstate Highway
OH	I 75	I 75	HAMILTON	Interstate Highway
OH	I 75	I 75	HANCOCK	Interstate Highway
OH	I 75	I 75	LUCAS	Interstate Highway
OH	I 75	I 75	MIAMI	Interstate Highway
OH	I 75	I 75	MONTGOMERY	Interstate Highway
OH	I 75	I 75	SHELBY	Interstate Highway
OH	I 75	I 75	WARREN	Interstate Highway
OH	I 75	I 75	WOOD	Interstate Highway
OH	I 76	I 76	MAHONING	Interstate Highway
OH	I 76	I 76	MEDINA	Interstate Highway
OH	I 76	I 76	PORTAGE	Interstate Highway
OH	I 76	I 76	SUMMIT	Interstate Highway
OH	I 77	I 77	CUYAHOGA	Interstate Highway
OH	I 77	I 77	GUERNSEY	Interstate Highway
OH	I 77	I 77	NOBLE	Interstate Highway

OH	I 77	I 77	STARK	Interstate Highway
OH	I 77	I 77	SUMMIT	Interstate Highway
OH	I 77	I 77	TUSCARAWAS	Interstate Highway
OH	I 77	I 77	WASHINGTON	Interstate Highway
OH	I 80	I 80	CUYAHOGA	Interstate Highway
OH	I 80	I 80	ERIE	Interstate Highway
OH	I 80	I 80	FULTON	Interstate Highway
OH	I 80	I 80	LORAIN	Interstate Highway
OH	I 80	I 80	LUCAS	Interstate Highway
OH	I 80	I 80	MAHONING	Interstate Highway
OH	I 80	I 80	OTTAWA	Interstate Highway
OH	I 80	I 80	PORTAGE	Interstate Highway
OH	I 80	I 80	SANDUSKY	Interstate Highway
OH	I 80	I 80	SUMMIT	Interstate Highway
OH	I 80	I 80	TRUMBULL	Interstate Highway
OH	I 80	I 80	WILLIAMS	Interstate Highway
OH	I 80	I 80	WOOD	Interstate Highway
OH	I 90	I 90	ASHTABULA	Interstate Highway
OH	I 90	I 90	CUYAHOGA	Interstate Highway
OH	I 90	I 90	LAKE	Interstate Highway
OH	I 90	I 90	LORAIN	Interstate Highway
OH	ORANGE AVE	US 422	CUYAHOGA	Arterial or Major Collector
OH	W 3RD ST		CUYAHOGA	Arterial or Major Collector
OK	I 35	I 35	CARTER	Interstate Highway
OK	I 35	I 35	LOVE	Interstate Highway
OK	I 35	I 35	MURRAY	Interstate Highway
OR	I 105	I 105	LANE	Interstate Highway
OR	I 205	I 205	CLACKAMAS	Interstate Highway
OR	I 205	I 205	MULTNOMAH	Interstate Highway
OR	I 205	I 205	WASHINGTON	Interstate Highway
OR	I 405	I 405	MULTNOMAH	Interstate Highway

OR	I 5	I 5	CLACKAMAS	Interstate Highway
OR	I 5	I 5	DOUGLAS	Interstate Highway
OR	I 5	I 5	JACKSON	Interstate Highway
OR	I 5	I 5	JOSEPHINE	Interstate Highway
OR	I 5	I 5	LANE	Interstate Highway
OR	I 5	I 5	LINN	Interstate Highway
OR	I 5	I 5	MARION	Interstate Highway
OR	I 5	I 5	MULTNOMAH	Interstate Highway
OR	I 5	I 5	WASHINGTON	Interstate Highway
OR	I 84	I 84	GILLIAM	Interstate Highway
OR	I 84	I 84	HOOD RIVER	Interstate Highway
OR	I 84	I 84	MULTNOMAH	Interstate Highway
OR	I 84	I 84	SHERMAN	Interstate Highway
OR	I 84	I 84	WASCO	Interstate Highway
OR	US 30	US 30	MULTNOMAH	Other Controlled Access Highway
OR	BELMONT ST		MULTNOMAH	Arterial or Major Collector
PA	I 176	I 176	BERKS	Interstate Highway
PA	I 180	I 180	LYCOMING	Interstate Highway
PA	I 180	I 180	NORTHUMBERLAND	Interstate Highway
PA	I 276	I 276	BUCKS	Interstate Highway
PA	I 276	I 276	MONTGOMERY	Interstate Highway
PA	I 279	I 279	ALLEGHENY	Interstate Highway
PA	I 283	I 283	DAUPHIN	Interstate Highway
PA	I 376	I 376	ALLEGHENY	Interstate Highway
PA	I 376	I 376	BEAVER	Interstate Highway
PA	I 376	I 376	LAWRENCE	Interstate Highway
PA	I 376	I 376	MERCER	Interstate Highway
PA	I 380	I 380	LACKAWANNA	Interstate Highway
PA	I 380	I 380	MONROE	Interstate Highway
PA	I 380	I 380	WAYNE	Interstate Highway
PA	I 476	I 476	BUCKS	Interstate Highway

PA	I 476	I 476	CARBON	Interstate Highway
PA	I 476	I 476	DELAWARE	Interstate Highway
PA	I 476	I 476	LACKAWANNA	Interstate Highway
PA	I 476	I 476	LEHIGH	Interstate Highway
PA	I 476	I 476	LUZERNE	Interstate Highway
PA	I 476	I 476	MONTGOMERY	Interstate Highway
PA	I 579	I 579	ALLEGHENY	Interstate Highway
PA	I 676	I 676	PHILADELPHIA	Interstate Highway
PA	I 70	I 70	BEDFORD	Interstate Highway
PA	I 70	I 70	FULTON	Interstate Highway
PA	I 70	I 70	WASHINGTON	Interstate Highway
PA	I 70	I 70	WESTMORELAND	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	ALLEGHENY	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	BEAVER	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	BEDFORD	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	BERKS	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	BUTLER	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	CHESTER	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	CUMBERLAND	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	DAUPHIN	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	FRANKLIN	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	FULTON	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	HUNTINGDON	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	LANCASTER	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	LAWRENCE	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	LEBANON	Interstate Highway
PA	SCHUYKILL EXPY	I 76	MONTGOMERY	Interstate Highway
PA	SCHUYKILL EXPY	I 76	PHILADELPHIA	Interstate Highway
PA	WALT WHITMAN BRG	I 76	PHILADELPHIA	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	SOMERSET	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	WESTMORELAND	Interstate Highway

PA	PENNSYLVANIA TPKE	I 76	YORK	Interstate Highway
PA	I 78	I 78	BERKS	Interstate Highway
PA	I 78	I 78	LEBANON	Interstate Highway
PA	I 78	I 78	LEHIGH	Interstate Highway
PA	I 78	I 78	NORTHAMPTON	Interstate Highway
PA	I 79	I 79	ALLEGHENY	Interstate Highway
PA	I 79	I 79	BUTLER	Interstate Highway
PA	I 79	I 79	CRAWFORD	Interstate Highway
PA	I 79	I 79	ERIE	Interstate Highway
PA	I 79	I 79	GREENE	Interstate Highway
PA	I 79	I 79	LAWRENCE	Interstate Highway
PA	I 79	I 79	MERCER	Interstate Highway
PA	I 79	I 79	WASHINGTON	Interstate Highway
PA	I 80	I 80	BUTLER	Interstate Highway
PA	I 80	I 80	CARBON	Interstate Highway
PA	I 80	I 80	CENTRE	Interstate Highway
PA	I 80	I 80	CLARION	Interstate Highway
PA	I 80	I 80	CLEARFIELD	Interstate Highway
PA	I 80	I 80	CLINTON	Interstate Highway
PA	I 80	I 80	COLUMBIA	Interstate Highway
PA	I 80	I 80	JEFFERSON	Interstate Highway
PA	I 80	I 80	LUZERNE	Interstate Highway
PA	I 80	I 80	MERCER	Interstate Highway
PA	I 80	I 80	MONROE	Interstate Highway
PA	I 80	I 80	MONTOUR	Interstate Highway
PA	I 80	I 80	NORTHUMBERLAND	Interstate Highway
PA	I 80	I 80	UNION	Interstate Highway
PA	I 80	I 80	VENANGO	Interstate Highway
PA	I 81	I 81	CUMBERLAND	Interstate Highway
PA	I 81	I 81	DAUPHIN	Interstate Highway
PA	I 81	I 81	FRANKLIN	Interstate Highway

PA	I 81	I 81	LACKAWANNA	Interstate Highway
PA	I 81	I 81	LEBANON	Interstate Highway
PA	I 81	I 81	LUZERNE	Interstate Highway
PA	I 81	I 81	SCHUYLKILL	Interstate Highway
PA	I 81	I 81	SUSQUEHANNA	Interstate Highway
PA	I 83	I 83	CUMBERLAND	Interstate Highway
PA	I 83	I 83	DAUPHIN	Interstate Highway
PA	I 83	I 83	YORK	Interstate Highway
PA	I 84	I 84	LACKAWANNA	Interstate Highway
PA	I 84	I 84	PIKE	Interstate Highway
PA	I 84	I 84	WAYNE	Interstate Highway
PA	I 86	I 86	ERIE	Interstate Highway
PA	I 90	I 90	ERIE	Interstate Highway
PA	I 95	I 95	BUCKS	Interstate Highway
PA	I 95	I 95	DELAWARE	Interstate Highway
PA	I 95	I 95	PHILADELPHIA	Interstate Highway
PA	I 99	I 99	BEDFORD	Interstate Highway
PA	I 99	I 99	BLAIR	Interstate Highway
PA	I 99	I 99	CENTRE	Interstate Highway
PA	PA 423	PA 423	MONROE	Arterial or Major Collector
PA	CLAIRTON BLVD	PA 51	ALLEGHENY	Arterial or Major Collector
PA	MARKET ST	SR 114	CUMBERLAND	Arterial or Major Collector
PA	US 1	US 1	BUCKS	Other Controlled Access Highway
PA	US 15	US 15	LYCOMING	Arterial or Major Collector
PA	US 22	US 22	DAUPHIN	Other Controlled Access Highway
PA	US 30	US 30	YORK	Other Controlled Access Highway
PA	US 322	US 322	DAUPHIN	Other Controlled Access Highway
PA	US 422 BYPASS	US 422 P	BERKS	Other Controlled Access Highway

PA	MONROEVILLE RD		ALLEGHENY	Arterial or Major Collector
PA	BATH ST		PHILADELPHIA	Arterial or Major Collector
PA	VARE ST		PHILADELPHIA	Frontage/Service Road
PA	I 95 NB COLLECTOR/DISTRIBUTOR LANE		PHILADELPHIA	Collector/Distributor Lane
RI	I 195	I 195	PROVIDENCE	Interstate Highway
RI	I 295	I 295	KENT	Interstate Highway
RI	I 295	I 295	PROVIDENCE	Interstate Highway
RI	I 95	I 95	KENT	Interstate Highway
RI	I 95	I 95	PROVIDENCE	Interstate Highway
RI	I 95	I 95	WASHINGTON	Interstate Highway
RI	RI 4	RI 4	KENT	Other Controlled Access Highway
RI	RI 403	RI 403	WASHINGTON	Other Controlled Access Highway
RI	TF GREEN AIRPORT CONNECTOR RD		KENT	Facility Access/Circulator Road
SC	I 126	I 126	RICHLAND	Interstate Highway
SC	SOUTHERN CONNECTOR	I 185	GREENVILLE	Interstate Highway
SC	I 185	I 185	GREENVILLE	Interstate Highway
SC	I 20	I 20	AIKEN	Interstate Highway
SC	I 20	I 20	DARLINGTON	Interstate Highway
SC	I 20	I 20	FLORENCE	Interstate Highway
SC	I 20	I 20	KERSHAW	Interstate Highway
SC	I 20	I 20	LEE	Interstate Highway
SC	I 20	I 20	LEXINGTON	Interstate Highway
SC	I 20	I 20	RICHLAND	Interstate Highway
SC	I 26	I 26	BERKELEY	Interstate Highway
SC	I 26	I 26	CALHOUN	Interstate Highway
SC	I 26	I 26	CHARLESTON	Interstate Highway
SC	I 26	I 26	DORCHESTER	Interstate Highway
SC	I 26	I 26	LAURENS	Interstate Highway
SC	I 26	I 26	LEXINGTON	Interstate Highway

SC	I 26	I 26	NEWBERRY	Interstate Highway
SC	I 26	I 26	ORANGEBURG	Interstate Highway
SC	I 26	I 26	RICHLAND	Interstate Highway
SC	I 26	I 26	SPARTANBURG	Interstate Highway
SC	I 385	I 385	GREENVILLE	Interstate Highway
SC	I 385	I 385	LAURENS	Interstate Highway
SC	I 520	I 520	AIKEN	Interstate Highway
SC	I 526	I 526	BERKELEY	Interstate Highway
SC	I 526	I 526	CHARLESTON	Interstate Highway
SC	I 585	I 585	SPARTANBURG	Interstate Highway
SC	I 77	I 77	CHESTER	Interstate Highway
SC	I 77	I 77	FAIRFIELD	Interstate Highway
SC	I 77	I 77	LEXINGTON	Interstate Highway
SC	I 77	I 77	RICHLAND	Interstate Highway
SC	I 77	I 77	YORK	Interstate Highway
SC	I 85	I 85	ANDERSON	Interstate Highway
SC	I 85	I 85	CHEROKEE	Interstate Highway
SC	I 85	I 85	GREENVILLE	Interstate Highway
SC	I 85	I 85	OCONEE	Interstate Highway
SC	I 85	I 85	SPARTANBURG	Interstate Highway
SC	I 95	I 95	CLARENDON	Interstate Highway
SC	I 95	I 95	COLLETON	Interstate Highway
SC	I 95	I 95	DARLINGTON	Interstate Highway
SC	I 95	I 95	DILLON	Interstate Highway
SC	I 95	I 95	DORCHESTER	Interstate Highway
SC	I 95	I 95	FLORENCE	Interstate Highway
SC	I 95	I 95	HAMPTON	Interstate Highway
SC	I 95	I 95	JASPER	Interstate Highway
SC	I 95	I 95	MARLBORO	Interstate Highway
SC	I 95	I 95	ORANGEBURG	Interstate Highway
SC	I 95	I 95	SUMTER	Interstate Highway

SC	SR 327	SR 327	FLORENCE	Arterial or Major Collector
TN	I 155	I 155	DYER	Interstate Highway
TN	I 24	I 24	BEDFORD	Interstate Highway
TN	I 24	I 24	CHEATHAM	Interstate Highway
TN	I 24	I 24	COFFEE	Interstate Highway
TN	I 24	I 24	DAVIDSON	Interstate Highway
TN	I 24	I 24	GRUNDY	Interstate Highway
TN	I 24	I 24	HAMILTON	Interstate Highway
TN	I 24	I 24	MARION	Interstate Highway
TN	I 24	I 24	MONTGOMERY	Interstate Highway
TN	I 24	I 24	ROBERTSON	Interstate Highway
TN	I 24	I 24	RUTHERFORD	Interstate Highway
TN	I 240	I 240	SHELBY	Interstate Highway
TN	I 269	I 269	FAYETTE	Interstate Highway
TN	I 269	I 269	SHELBY	Interstate Highway
TN	I 40	I 40	BENTON	Interstate Highway
TN	I 40	I 40	CARROLL	Interstate Highway
TN	I 40	I 40	CHEATHAM	Interstate Highway
TN	I 40	I 40	CUMBERLAND	Interstate Highway
TN	I 40	I 40	DAVIDSON	Interstate Highway
TN	I 40	I 40	DECATUR	Interstate Highway
TN	I 40	I 40	DICKSON	Interstate Highway
TN	I 40	I 40	FAYETTE	Interstate Highway
TN	I 40	I 40	HAYWOOD	Interstate Highway
TN	I 40	I 40	HENDERSON	Interstate Highway
TN	I 40	I 40	HICKMAN	Interstate Highway
TN	I 40	I 40	HUMPHREYS	Interstate Highway
TN	I 40	I 40	MADISON	Interstate Highway
TN	I 40	I 40	PUTNAM	Interstate Highway
TN	I 40	I 40	SHELBY	Interstate Highway
TN	I 40	I 40	SMITH	Interstate Highway

TN	I 40	I 40	WILLIAMSON	Interstate Highway
TN	I 40	I 40	WILSON	Interstate Highway
TN	I 440	I 440	DAVIDSON	Interstate Highway
TN	I 55	I 55	SHELBY	Interstate Highway
TN	I 65	I 65	DAVIDSON	Interstate Highway
TN	I 65	I 65	GILES	Interstate Highway
TN	I 65	I 65	MARSHALL	Interstate Highway
TN	I 65	I 65	MAURY	Interstate Highway
TN	I 65	I 65	ROBERTSON	Interstate Highway
TN	I 65	I 65	SUMNER	Interstate Highway
TN	I 65	I 65	WILLIAMSON	Interstate Highway
TN	I 75	I 75	BRADLEY	Interstate Highway
TN	I 75	I 75	HAMILTON	Interstate Highway
TN	I 840	I 840	DICKSON	Interstate Highway
TN	I 840	I 840	HICKMAN	Interstate Highway
TN	I 840	I 840	RUTHERFORD	Interstate Highway
TN	I 840	I 840	WILLIAMSON	Interstate Highway
TN	I 840	I 840	WILSON	Interstate Highway
TX	C1314	C1314	MONTGOMERY	Arterial or Major Collector
TX	E CARLOS TRUAN BLVD	CR 425	KLEBERG	Arterial or Major Collector
TX	I 10	I 10	AUSTIN	Interstate Highway
TX	I 10	I 10	BEXAR	Interstate Highway
TX	I 10	I 10	CALDWELL	Interstate Highway
TX	I 10	I 10	CHAMBERS	Interstate Highway
TX	I 10	I 10	COLORADO	Interstate Highway
TX	I 10	I 10	CROCKETT	Interstate Highway
TX	I 10	I 10	CULBERSON	Interstate Highway
TX	I 10	I 10	EL PASO	Interstate Highway
TX	I 10	I 10	FAYETTE	Interstate Highway
TX	I 10	I 10	FORT BEND	Interstate Highway
TX	I 10	I 10	GILLESPIE	Interstate Highway

TX	I 10	I 10	GONZALES	Interstate Highway
TX	I 10	I 10	GUADALUPE	Interstate Highway
TX	I 10	I 10	HARRIS	Interstate Highway
TX	I 10	I 10	HUDSPETH	Interstate Highway
TX	I 10	I 10	JEFF DAVIS	Interstate Highway
TX	I 10	I 10	JEFFERSON	Interstate Highway
TX	I 10	I 10	KENDALL	Interstate Highway
TX	I 10	I 10	KERR	Interstate Highway
TX	I 10	I 10	KIMBLE	Interstate Highway
TX	I 10	I 10	ORANGE	Interstate Highway
TX	I 10	I 10	PECOS	Interstate Highway
TX	I 10	I 10	REEVES	Interstate Highway
TX	I 10	I 10	SUTTON	Interstate Highway
TX	I 10	I 10	WALLER	Interstate Highway
TX	I 110	I 110	EL PASO	Interstate Highway
TX	I 14	I 14	BELL	Interstate Highway
TX	I 14	I 14	CORYELL	Interstate Highway
TX	I 20	I 20	CALLAHAN	Interstate Highway
TX	I 20	I 20	CRANE	Interstate Highway
TX	I 20	I 20	DALLAS	Interstate Highway
TX	I 20	I 20	EASTLAND	Interstate Highway
TX	I 20	I 20	ECTOR	Interstate Highway
TX	I 20	I 20	ERATH	Interstate Highway
TX	I 20	I 20	GREGG	Interstate Highway
TX	I 20	I 20	HOWARD	Interstate Highway
TX	I 20	I 20	KAUFMAN	Interstate Highway
TX	I 20	I 20	MARTIN	Interstate Highway
TX	I 20	I 20	MIDLAND	Interstate Highway
TX	I 20	I 20	MITCHELL	Interstate Highway
TX	I 20	I 20	NOLAN	Interstate Highway
TX	I 20	I 20	PALO PINTO	Interstate Highway

TX	I 20	I 20	PARKER	Interstate Highway
TX	I 20	I 20	REEVES	Interstate Highway
TX	I 20	I 20	SMITH	Interstate Highway
TX	I 20	I 20	TARRANT	Interstate Highway
TX	I 20	I 20	TAYLOR	Interstate Highway
TX	I 20	I 20	VAN ZANDT	Interstate Highway
TX	I 20	I 20	WARD	Interstate Highway
TX	I 30	I 30	BOWIE	Interstate Highway
TX	I 30	I 30	DALLAS	Interstate Highway
TX	TOM LANDRY FWY	I 30	DALLAS	Interstate Highway
TX	I 30	I 30	FRANKLIN	Interstate Highway
TX	I 30	I 30	HOPKINS	Interstate Highway
TX	I 30	I 30	HUNT	Interstate Highway
TX	I 30	I 30	MORRIS	Interstate Highway
TX	I 30	I 30	PARKER	Interstate Highway
TX	I 30	I 30	ROCKWALL	Interstate Highway
TX	I 30	I 30	TARRANT	Interstate Highway
TX	TOM LANDRY FWY	I 30	TARRANT	Interstate Highway
TX	I 30	I 30	TITUS	Interstate Highway
TX	I 345	I 345	DALLAS	Other Controlled Access Highway
TX	I 35	I 35	ATASCOSA	Interstate Highway
TX	I 35	I 35	BELL	Interstate Highway
TX	I 35	I 35	BEXAR	Interstate Highway
TX	I 35 LOWER LEVEL	I 35	BEXAR	Interstate Highway
TX	I 35 UPPER LEVEL	I 35	BEXAR	Interstate Highway
TX	I 35	I 35	COMAL	Interstate Highway
TX	I 35	I 35	COOKE	Interstate Highway
TX	I 35	I 35	DENTON	Interstate Highway
TX	I 35	I 35	FALLS	Interstate Highway
TX	I 35	I 35	FRIO	Interstate Highway
TX	I 35	I 35	GUADALUPE	Interstate Highway

TX	I 35	I 35	HAYS	Interstate Highway
TX	I 35	I 35	HILL	Interstate Highway
TX	I 35	I 35	LA SALLE	Interstate Highway
TX	I 35	I 35	MCLENNAN	Interstate Highway
TX	I 35	I 35	MEDINA	Interstate Highway
TX	I 35	I 35	TRAVIS	Interstate Highway
TX	I 35	I 35	WEBB	Interstate Highway
TX	I 35	I 35	WILLIAMSON	Interstate Highway
TX	I 35E	I 35E	DALLAS	Interstate Highway
TX	I 35E	I 35E	DENTON	Interstate Highway
TX	I 35E	I 35E	ELLIS	Interstate Highway
TX	I 35E	I 35E	HILL	Interstate Highway
TX	I 35W	I 35W	DENTON	Interstate Highway
TX	I 35W	I 35W	HILL	Interstate Highway
TX	I 35W	I 35W	JOHNSON	Interstate Highway
TX	I 35W	I 35W	TARRANT	Interstate Highway
TX	I 37	I 37	ATASCOSA	Interstate Highway
TX	I 37	I 37	BEXAR	Interstate Highway
TX	I 37	I 37	LIVE OAK	Interstate Highway
TX	I 37	I 37	NUECES	Interstate Highway
TX	I 37	I 37	SAN PATRICIO	Interstate Highway
TX	I 410	I 410	BEXAR	Interstate Highway
TX	I 45	I 45	DALLAS	Interstate Highway
TX	I 45	I 45	ELLIS	Interstate Highway
TX	I 45	I 45	FREESTONE	Interstate Highway
TX	I 45	I 45	GALVESTON	Interstate Highway
TX	I 45	I 45	HARRIS	Interstate Highway
TX	I 45	I 45	LEON	Interstate Highway
TX	I 45	I 45	MADISON	Interstate Highway
TX	I 45	I 45	MONTGOMERY	Interstate Highway
TX	I 45	I 45	NAVARRO	Interstate Highway

TX	I 45	I 45	WALKER	Interstate Highway
TX	I 610	I 610	HARRIS	Interstate Highway
TX	I 635	I 635	DALLAS	Interstate Highway
TX	I 69	I 69	FORT BEND	Interstate Highway
TX	I 69	I 69	HARRIS	Interstate Highway
TX	I 69	I 69	LIBERTY	Interstate Highway
TX	I 69	I 69	MONTGOMERY	Interstate Highway
TX	I 69	I 69	NUECES	Interstate Highway
TX	I 69E	I 69E	WILLACY	Interstate Highway
TX	I 69W	I 69W	WEBB	Interstate Highway
TX	I 820	I 820	TARRANT	Interstate Highway
TX	AIRPORT FWY	TX 121	TARRANT	Other Controlled Access Highway
TX	TX 121	TX 121	TARRANT	Other Controlled Access Highway
TX	TX 146	TX 146	HARRIS	Other Controlled Access Highway
TX	ARTCRAFT RD	TX 178	EL PASO	Other Controlled Access Highway
TX	AIRPORT FWY	TX 183	DALLAS	Other Controlled Access Highway
TX	TX 183	TX 183	DALLAS	Other Controlled Access Highway
TX	AIRPORT FWY	TX 183	TARRANT	Other Controlled Access Highway
TX	TX 225	TX 225	HARRIS	Other Controlled Access Highway
TX	TX 288	TX 288	HARRIS	Other Controlled Access Highway
TX	GULF ST	TX 380	JEFFERSON	Arterial or Major Collector
TX	US 290	US 290	HARRIS	Other Controlled Access Highway
TX	US 57	US 57	FRIO	Arterial or Major Collector
TX	MAIN ST	US 57	MAVERICK	Arterial or Major Collector
TX	US 57	US 57	MAVERICK	Arterial or Major Collector
TX	US 57	US 57	ZAVALA	Arterial or Major Collector

TX	SAUNDERS ST	US 59	WEBB	Arterial or Major Collector
TX	US 67	US 67	DALLAS	Other Controlled Access Highway
TX	US 75	US 75	COLLIN	Other Controlled Access Highway
TX	US 75	US 75	DALLAS	Other Controlled Access Highway
TX	US 77	US 77	KENEDY	Arterial or Major Collector
TX	US 77	US 77	KLEBERG	Arterial or Major Collector
TX	US 77	US 77	NUECES	Arterial or Major Collector
TX	US 77	US 77	WILLACY	Arterial or Major Collector
TX	US 80	US 80	DALLAS	Other Controlled Access Highway
TX	US 90 ALTERNATE	US 90 A	FORT BEND	Arterial or Major Collector
TX	I 410 FRONTAGE RD		BEXAR	Frontage/Service Road
TX	AIRPORT BLVD		BEXAR	Arterial or Major Collector
TX	DALLAS NORTH TOLLWAY		COLLIN	Other Controlled Access Highway
TX	DALLAS NORTH TOLLWAY		DALLAS	Other Controlled Access Highway
TX	PRESIDENT GEORGE BUSH TPKE		DALLAS	Other Controlled Access Highway
TX	AIRWAY BLVD		EL PASO	Arterial or Major Collector
TX	TROWBRIDGE DR		EL PASO	Arterial or Major Collector
TX	HARDY TOLL RD		HARRIS	Other Controlled Access Highway
TX	JOHN F KENNEDY BLVD		HARRIS	Arterial or Major Collector
TX	EAST BLVD		HARRIS	Arterial or Major Collector
TX	LOCKWOOD DR		HARRIS	Arterial or Major Collector
TX	WILL CLAYTON PKWY		HARRIS	Arterial or Major Collector
UT	I 15	I 15	BEAVER	Interstate Highway
UT	I 15	I 15	BOX ELDER	Interstate Highway
UT	I 15	I 15	DAVIS	Interstate Highway
UT	I 15	I 15	IRON	Interstate Highway
UT	I 15	I 15	JUAB	Interstate Highway

UT	I 15	I 15	MILLARD	Interstate Highway
UT	I 15	I 15	SALT LAKE	Interstate Highway
UT	I 15	I 15	UTAH	Interstate Highway
UT	I 15	I 15	WASHINGTON	Interstate Highway
UT	I 15	I 15	WEBER	Interstate Highway
UT	I 215	I 215	DAVIS	Interstate Highway
UT	I 215	I 215	SALT LAKE	Interstate Highway
UT	I 70	I 70	EMERY	Interstate Highway
UT	I 70	I 70	GRAND	Interstate Highway
UT	I 70	I 70	MILLARD	Interstate Highway
UT	I 70	I 70	SEVIER	Interstate Highway
UT	I 80	I 80	SALT LAKE	Interstate Highway
UT	I 80	I 80	SUMMIT	Interstate Highway
UT	I 80	I 80	TOOELE	Interstate Highway
UT	I 84	I 84	BOX ELDER	Interstate Highway
UT	I 84	I 84	DAVIS	Interstate Highway
UT	I 84	I 84	MORGAN	Interstate Highway
UT	I 84	I 84	SUMMIT	Interstate Highway
UT	I 84	I 84	WEBER	Interstate Highway
UT	SR 36	SR 36	TOOELE	Arterial or Major Collector
UT	E 6200 S		SALT LAKE	Arterial or Major Collector
VA	BELTLINE EXPY	I 195	HENRICO	Interstate Highway
VA	BELTLINE EXPY	I 195	RICHMOND CITY	Interstate Highway
VA	I 264	I 264	CHESAPEAKE	Interstate Highway
VA	I 264	I 264	NORFOLK	Interstate Highway
VA	I 264	I 264	PORTSMOUTH	Interstate Highway
VA	I 264	I 264	VIRGINIA BEACH	Interstate Highway
VA	I 295	I 295	CHESTERFIELD	Interstate Highway
VA	I 295	I 295	HANOVER	Interstate Highway
VA	I 295	I 295	HENRICO	Interstate Highway
VA	I 295	I 295	HOPEWELL	Interstate Highway

VA	I 295	I 295	PRINCE GEORGE	Interstate Highway
VA	I 395	I 395	ALEXANDRIA	Interstate Highway
VA	I 395	I 395	ARLINGTON	Interstate Highway
VA	I 395	I 395	FAIRFAX	Interstate Highway
VA	I 464	I 464	CHESAPEAKE	Interstate Highway
VA	I 464	I 464	NORFOLK	Interstate Highway
VA	I 495	I 495	FAIRFAX	Interstate Highway
VA	I 564	I 564	NORFOLK	Interstate Highway
VA	I 581	I 581	ROANOKE	Interstate Highway
VA	I 581	I 581	ROANOKE CITY	Interstate Highway
VA	I 64	I 64	ALBEMARLE	Interstate Highway
VA	I 64	I 64	ALLEGHANY	Interstate Highway
VA	I 64	I 64	AUGUSTA	Interstate Highway
VA	I 64	I 64	CHESAPEAKE	Interstate Highway
VA	I 64	I 64	COVINGTON	Interstate Highway
VA	I 64	I 64	FLUVANNA	Interstate Highway
VA	I 64	I 64	GOOCHLAND	Interstate Highway
VA	I 64	I 64	HAMPTON	Interstate Highway
VA	I 64	I 64	HENRICO	Interstate Highway
VA	I 64	I 64	JAMES CITY	Interstate Highway
VA	I 64	I 64	LOUISA	Interstate Highway
VA	I 64	I 64	NELSON	Interstate Highway
VA	I 64	I 64	NEW KENT	Interstate Highway
VA	I 64	I 64	NEWPORT NEWS	Interstate Highway
VA	I 64	I 64	NORFOLK	Interstate Highway
VA	I 64	I 64	RICHMOND CITY	Interstate Highway
VA	I 64	I 64	ROCKBRIDGE	Interstate Highway
VA	I 64	I 64	VIRGINIA BEACH	Interstate Highway
VA	I 64	I 64	WAYNESBORO	Interstate Highway
VA	I 64	I 64	YORK	Interstate Highway
VA	I 66	I 66	ARLINGTON	Interstate Highway

VA	I 66	I 66	FAIRFAX	Interstate Highway
VA	I 66	I 66	FAUQUIER	Interstate Highway
VA	I 66	I 66	PRINCE WILLIAM	Interstate Highway
VA	I 66	I 66	WARREN	Interstate Highway
VA	I 664	I 664	CHESAPEAKE	Interstate Highway
VA	I 664	I 664	HAMPTON	Interstate Highway
VA	I 664	I 664	NEWPORT NEWS	Interstate Highway
VA	I 664	I 664	SUFFOLK	Interstate Highway
VA	I 77	I 77	BLAND	Interstate Highway
VA	I 77	I 77	CARROLL	Interstate Highway
VA	I 77	I 77	WYTHE	Interstate Highway
VA	I 81	I 81	AUGUSTA	Interstate Highway
VA	I 81	I 81	BOTETOURT	Interstate Highway
VA	I 81	I 81	FREDERICK	Interstate Highway
VA	I 81	I 81	HARRISONBURG	Interstate Highway
VA	I 81	I 81	MONTGOMERY	Interstate Highway
VA	I 81	I 81	PULASKI	Interstate Highway
VA	I 81	I 81	ROANOKE	Interstate Highway
VA	I 81	I 81	ROCKBRIDGE	Interstate Highway
VA	I 81	I 81	ROCKINGHAM	Interstate Highway
VA	I 81	I 81	SALEM	Interstate Highway
VA	I 81	I 81	SHENANDOAH	Interstate Highway
VA	I 81	I 81	SMYTH	Interstate Highway
VA	I 81	I 81	WARREN	Interstate Highway
VA	I 81	I 81	WYTHE	Interstate Highway
VA	I 85	I 85	BRUNSWICK	Interstate Highway
VA	I 85	I 85	DINWIDDIE	Interstate Highway
VA	I 85	I 85	MECKLENBURG	Interstate Highway
VA	I 85	I 85	PETERSBURG	Interstate Highway
VA	I 95	I 95	ALEXANDRIA	Interstate Highway
VA	I 95	I 95	CAROLINE	Interstate Highway

VA	I 95	I 95	CHESTERFIELD	Interstate Highway
VA	I 95	I 95	COLONIAL HEIGHTS	Interstate Highway
VA	I 95	I 95	EMPORIA	Interstate Highway
VA	I 95	I 95	FAIRFAX	Interstate Highway
VA	I 95	I 95	FREDERICKSBURG	Interstate Highway
VA	I 95	I 95	GREENSVILLE	Interstate Highway
VA	I 95	I 95	HANOVER	Interstate Highway
VA	I 95	I 95	HENRICO	Interstate Highway
VA	I 95	I 95	PETERSBURG	Interstate Highway
VA	I 95	I 95	PRINCE GEORGE	Interstate Highway
VA	I 95	I 95	PRINCE WILLIAM	Interstate Highway
VA	I 95	I 95	RICHMOND CITY	Interstate Highway
VA	I 95	I 95	SPOTSYLVANIA	Interstate Highway
VA	I 95	I 95	STAFFORD	Interstate Highway
VA	I 95	I 95	SUSSEX	Interstate Highway
VA	CLEBURNE BLVD	SR 100	PULASKI	Arterial or Major Collector
VA	LASALLE AVE	SR 167	HAMPTON	Arterial or Major Collector
VA	SR 337	SR 337	NORFOLK	Arterial or Major Collector
VA	SR 42	SR 42	ALLEGHANY	Arterial or Major Collector
VA	US 60	US 60	ALLEGHANY	Arterial or Major Collector
VT	I 89	I 89	ORANGE	Interstate Highway
VT	I 89	I 89	WINDSOR	Interstate Highway
VT	I 91	I 91	CALEDONIA	Interstate Highway
VT	I 91	I 91	ORANGE	Interstate Highway
VT	I 91	I 91	WINDHAM	Interstate Highway
VT	I 91	I 91	WINDSOR	Interstate Highway
WA	I 205	I 205	CLARK	Interstate Highway
WA	I 405	I 405	KING	Interstate Highway
WA	I 405	I 405	SNOHOMISH	Interstate Highway
WA	I 5	I 5	CLARK	Interstate Highway
WA	I 5	I 5	COWLITZ	Interstate Highway

WA	I 5	I 5	KING	Interstate Highway
WA	I 5	I 5	LEWIS	Interstate Highway
WA	I 5	I 5	PIERCE	Interstate Highway
WA	I 5	I 5	SKAGIT	Interstate Highway
WA	I 5	I 5	SNOHOMISH	Interstate Highway
WA	I 5	I 5	THURSTON	Interstate Highway
WA	I 5	I 5	WHATCOM	Interstate Highway
WA	I 705	I 705	PIERCE	Interstate Highway
WA	I 82	I 82	KITTITAS	Interstate Highway
WA	I 82	I 82	YAKIMA	Interstate Highway
WA	I 90	I 90	ADAMS	Interstate Highway
WA	I 90	I 90	GRANT	Interstate Highway
WA	I 90	I 90	KING	Interstate Highway
WA	I 90	I 90	KITTITAS	Interstate Highway
WA	I 90	I 90	LINCOLN	Interstate Highway
WA	I 90	I 90	SPOKANE	Interstate Highway
WA	SR 167	SR 167	KING	Other Controlled Access Highway
WA	SR 18	SR 18	KING	Other Controlled Access Highway
WA	SR 518	SR 518	KING	Other Controlled Access Highway
WA	US 2	US 2	SPOKANE	Other Controlled Access Highway
WA	WA 543	WA 543	WHATCOM	Arterial or Major Collector
WA	W SEATTLE FWY		KING	Other Controlled Access Highway
WA	PACIFIC AVE		SNOHOMISH	Arterial or Major Collector
WI	I 39	I 39	COLUMBIA	Interstate Highway
WI	I 39	I 39	DANE	Interstate Highway
WI	I 39	I 39	MARQUETTE	Interstate Highway
WI	I 39	I 39	ROCK	Interstate Highway
WI	I 41	I 41	DODGE	Interstate Highway

WI	I 41	I 41	FOND DU LAC	Interstate Highway
WI	I 41	I 41	KENOSHA	Interstate Highway
WI	I 41	I 41	MILWAUKEE	Interstate Highway
WI	I 41	I 41	OUTAGAMIE	Interstate Highway
WI	I 41	I 41	RACINE	Interstate Highway
WI	I 41	I 41	WASHINGTON	Interstate Highway
WI	I 41	I 41	WAUKESHA	Interstate Highway
WI	I 41	I 41	WINNEBAGO	Interstate Highway
WI	I 43	I 43	BROWN	Interstate Highway
WI	I 43	I 43	MANITOWOC	Interstate Highway
WI	I 43	I 43	MILWAUKEE	Interstate Highway
WI	I 43	I 43	OZAUKEE	Interstate Highway
WI	I 43	I 43	ROCK	Interstate Highway
WI	I 43	I 43	SHEBOYGAN	Interstate Highway
WI	I 43	I 43	WALWORTH	Interstate Highway
WI	I 43	I 43	WAUKESHA	Interstate Highway
WI	I 535	I 535	DOUGLAS	Interstate Highway
WI	I 794	I 794	MILWAUKEE	Interstate Highway
WI	I 90	I 90	COLUMBIA	Interstate Highway
WI	I 90	I 90	JUNEAU	Interstate Highway
WI	I 90	I 90	MONROE	Interstate Highway
WI	I 90	I 90	SAUK	Interstate Highway
WI	I 94	I 94	DANE	Interstate Highway
WI	I 94	I 94	DUNN	Interstate Highway
WI	I 94	I 94	EAU CLAIRE	Interstate Highway
WI	I 94	I 94	JACKSON	Interstate Highway
WI	I 94	I 94	JEFFERSON	Interstate Highway
WI	I 94	I 94	MILWAUKEE	Interstate Highway
WI	I 94	I 94	MONROE	Interstate Highway
WI	I 94	I 94	ST. CROIX	Interstate Highway
WI	I 94	I 94	TREMPEALEAU	Interstate Highway

WI	I 94	I 94	WAUKESHA	Interstate Highway
WV	I 470	I 470	OHIO	Interstate Highway
WV	I 64	I 64	CABELL	Interstate Highway
WV	I 64	I 64	GREENBRIER	Interstate Highway
WV	I 64	I 64	KANAWHA	Interstate Highway
WV	I 64	I 64	PUTNAM	Interstate Highway
WV	I 64	I 64	RALEIGH	Interstate Highway
WV	I 64	I 64	SUMMERS	Interstate Highway
WV	I 64	I 64	WAYNE	Interstate Highway
WV	I 68	I 68	MONONGALIA	Interstate Highway
WV	I 68	I 68	PRESTON	Interstate Highway
WV	I 70	I 70	OHIO	Interstate Highway
WV	I 77	I 77	FAYETTE	Interstate Highway
WV	I 77	I 77	JACKSON	Interstate Highway
WV	I 77	I 77	KANAWHA	Interstate Highway
WV	I 77	I 77	MERCER	Interstate Highway
WV	I 77	I 77	RALEIGH	Interstate Highway
WV	I 77	I 77	WOOD	Interstate Highway
WV	I 79	I 79	BRAXTON	Interstate Highway
WV	I 79	I 79	CLAY	Interstate Highway
WV	I 79	I 79	GILMER	Interstate Highway
WV	I 79	I 79	HARRISON	Interstate Highway
WV	I 79	I 79	KANAWHA	Interstate Highway
WV	I 79	I 79	LEWIS	Interstate Highway
WV	I 79	I 79	MARION	Interstate Highway
WV	I 79	I 79	MONONGALIA	Interstate Highway
WV	I 79	I 79	ROANE	Interstate Highway
WV	I 81	I 81	BERKELEY	Interstate Highway
WV	MIDLAND TRL	US 60	CABELL	Arterial or Major Collector
WY	I 25	I 25	LARAMIE	Interstate Highway
WY	I 80	I 80	ALBANY	Interstate Highway

WY	I 80	I 80	CARBON	Interstate Highway
WY	I 80	I 80	LARAMIE	Interstate Highway
WY	I 80	I 80	SWEETWATER	Interstate Highway
WY	I 80	I 80	UINTA	Interstate Highway

Appendix G: List of Zero-Emission Freight Corridors in Phase 4

State	Road Name	Route Sign	County Name	Description
AK	GLENN HWY	I A1	ANCHORAGE	Interstate Highway
AK	E 6TH AVE	I A1	ANCHORAGE	Arterial or Major Collector
AK	E 5TH AVE	I A1	ANCHORAGE	Arterial or Major Collector
AK	GLENN HWY	I A1	MATANUSKA-SUSITNA	Interstate Highway
AK	ALASKA HWY	I A1	SOUTHEAST FAIRBANKS	Non-Freeway Interstate (Alaska)
AK	TOK CUT-OFF HWY	I A1	SOUTHEAST FAIRBANKS	Non-Freeway Interstate (Alaska)
AK	GLENN HWY	I A1	VALDEZ-CORDOVA	Non-Freeway Interstate (Alaska)
AK	RICHARDSON HWY	I A1	VALDEZ-CORDOVA	Non-Freeway Interstate (Alaska)
AK	TOK CUT-OFF HWY	I A1	VALDEZ-CORDOVA	Non-Freeway Interstate (Alaska)
AK	RICHARDSON HWY	I A2	FAIRBANKS NORTH STAR	Non-Freeway Interstate (Alaska)
AK	RICHARDSON HWY	I A2	SOUTHEAST FAIRBANKS	Non-Freeway Interstate (Alaska)
AK	ALASKA HWY	I A2	SOUTHEAST FAIRBANKS	Non-Freeway Interstate (Alaska)
AK	SEWARD HWY	I A3	ANCHORAGE	Non-Freeway Interstate (Alaska)
AK	STERLING HWY	I A3	KENAI PENINSULA	Non-Freeway Interstate (Alaska)
AK	SEWARD HWY	I A3	KENAI PENINSULA	Non-Freeway Interstate (Alaska)
AK	GEORGE PARKS HWY	I A4	DENALI	Non-Freeway Interstate (Alaska)
AK	GEORGE PARKS HWY	I A4	FAIRBANKS NORTH STAR	Non-Freeway Interstate (Alaska)
AK	PARKS HWY	I A4	FAIRBANKS NORTH STAR	Interstate Highway
AK	PARKS HWY	I A4	MATANUSKA-SUSITNA	Interstate Highway

AK	GEORGE PARKS HWY	I A4	MATANUSKA-SUSITNA	Non-Freeway Interstate (Alaska)
AK	GEORGE PARKS HWY	I A4	YUKON-KOYUKUK	Non-Freeway Interstate (Alaska)
AL	I 10	I 10	BALDWIN	Interstate Highway
AL	I 10	I 10	MOBILE	Interstate Highway
AL	I 165	I 165	MOBILE	Interstate Highway
AL	I 20	I 20	CALHOUN	Interstate Highway
AL	I 20	I 20	CLEBURNE	Interstate Highway
AL	I 20	I 20	GREENE	Interstate Highway
AL	I 20	I 20	JEFFERSON	Interstate Highway
AL	I 20	I 20	ST. CLAIR	Interstate Highway
AL	I 20	I 20	SUMTER	Interstate Highway
AL	I 20	I 20	TALLADEGA	Interstate Highway
AL	I 20	I 20	TUSCALOOSA	Interstate Highway
AL	I 22	I 22	JEFFERSON	Interstate Highway
AL	I 22	I 22	MARION	Interstate Highway
AL	I 22	I 22	WALKER	Interstate Highway
AL	I 359	I 359	TUSCALOOSA	Interstate Highway
AL	I 459	I 459	JEFFERSON	Interstate Highway
AL	I 565	I 565	LIMESTONE	Interstate Highway
AL	I 565	I 565	MADISON	Interstate Highway
AL	I 59	I 59	DEKALB	Interstate Highway
AL	I 59	I 59	ETOWAH	Interstate Highway
AL	I 59	I 59	JEFFERSON	Interstate Highway
AL	I 59	I 59	ST. CLAIR	Interstate Highway
AL	I 65	I 65	AUTAUGA	Interstate Highway
AL	I 65	I 65	BALDWIN	Interstate Highway
AL	I 65	I 65	BLOUNT	Interstate Highway
AL	I 65	I 65	BUTLER	Interstate Highway
AL	I 65	I 65	CHILTON	Interstate Highway
AL	I 65	I 65	CONECUH	Interstate Highway

AL	I 65	I 65	CULLMAN	Interstate Highway
AL	I 65	I 65	ELMORE	Interstate Highway
AL	I 65	I 65	ESCAMBIA	Interstate Highway
AL	I 65	I 65	JEFFERSON	Interstate Highway
AL	I 65	I 65	LIMESTONE	Interstate Highway
AL	I 65	I 65	LOWNDES	Interstate Highway
AL	I 65	I 65	MOBILE	Interstate Highway
AL	I 65	I 65	MONTGOMERY	Interstate Highway
AL	I 65	I 65	MORGAN	Interstate Highway
AL	I 65	I 65	SHELBY	Interstate Highway
AL	I 759	I 759	ETOWAH	Interstate Highway
AL	I 85	I 85	CHAMBERS	Interstate Highway
AL	I 85	I 85	LEE	Interstate Highway
AL	I 85	I 85	MACON	Interstate Highway
AL	I 85	I 85	MONTGOMERY	Interstate Highway
AL	ANDREW JACKSON WY	US 72	MADISON	Arterial or Major Collector
AL	CRESTWOOD BLVD	US 78	JEFFERSON	Arterial or Major Collector
AR	I 30	I 30	CLARK	Interstate Highway
AR	I 30	I 30	HEMPSTEAD	Interstate Highway
AR	I 30	I 30	HOT SPRING	Interstate Highway
AR	I 30	I 30	MILLER	Interstate Highway
AR	I 30	I 30	NEVADA	Interstate Highway
AR	I 30	I 30	PULASKI	Interstate Highway
AR	I 30	I 30	SALINE	Interstate Highway
AR	I 40	I 40	CONWAY	Interstate Highway
AR	I 40	I 40	CRAWFORD	Interstate Highway
AR	I 40	I 40	CRITTENDEN	Interstate Highway
AR	I 40	I 40	FAULKNER	Interstate Highway
AR	I 40	I 40	FRANKLIN	Interstate Highway
AR	I 40	I 40	JOHNSON	Interstate Highway
AR	I 40	I 40	LONOKE	Interstate Highway

AR	I 40	I 40	MONROE	Interstate Highway
AR	I 40	I 40	POPE	Interstate Highway
AR	I 40	I 40	PRAIRIE	Interstate Highway
AR	I 40	I 40	PULASKI	Interstate Highway
AR	I 40	I 40	ST. FRANCIS	Interstate Highway
AR	I 430	I 430	PULASKI	Interstate Highway
AR	I 440	I 440	PULASKI	Interstate Highway
AR	I 49	I 49	BENTON	Interstate Highway
AR	I 49	I 49	CRAWFORD	Interstate Highway
AR	I 49	I 49	MILLER	Interstate Highway
AR	I 49	I 49	WASHINGTON	Interstate Highway
AR	I 530	I 530	GRANT	Interstate Highway
AR	I 530	I 530	JEFFERSON	Interstate Highway
AR	I 530	I 530	PULASKI	Interstate Highway
AR	I 530	I 530	SALINE	Interstate Highway
AR	I 540	I 540	CRAWFORD	Interstate Highway
AR	I 540	I 540	SEBASTIAN	Interstate Highway
AR	I 55	I 55	CRITTENDEN	Interstate Highway
AR	I 55	I 55	MISSISSIPPI	Interstate Highway
AR	I 555	I 555	CRAIGHEAD	Interstate Highway
AR	I 555	I 555	CRITTENDEN	Interstate Highway
AR	I 555	I 555	POINSETT	Interstate Highway
AR	I 630	I 630	PULASKI	Interstate Highway
AZ	I 10	I 10	COCHISE	Interstate Highway
AZ	I 10	I 10	LA PAZ	Interstate Highway
AZ	I 10	I 10	MARICOPA	Interstate Highway
AZ	I 10	I 10	PIMA	Interstate Highway
AZ	I 10	I 10	PINAL	Interstate Highway
AZ	I 15	I 15	MOHAVE	Interstate Highway
AZ	I 17	I 17	COCONINO	Interstate Highway
AZ	I 17	I 17	MARICOPA	Interstate Highway

AZ	I 17	I 17	YAVAPAI	Interstate Highway
AZ	I 19	I 19	PIMA	Interstate Highway
AZ	I 19	I 19	SANTA CRUZ	Interstate Highway
AZ	I 40	I 40	APACHE	Interstate Highway
AZ	I 40	I 40	COCONINO	Interstate Highway
AZ	I 40	I 40	MOHAVE	Interstate Highway
AZ	I 40	I 40	NAVAJO	Interstate Highway
AZ	I 40	I 40	YAVAPAI	Interstate Highway
AZ	I 40 BUSINESS	I 40 B	MOHAVE	Arterial or Major Collector
AZ	I 8	I 8	MARICOPA	Interstate Highway
AZ	I 8	I 8	PINAL	Interstate Highway
AZ	I 8	I 8	YUMA	Interstate Highway
AZ	LOOP 101	SR 101	MARICOPA	Other Controlled Access Highway
AZ	LOOP 202	SR 202	MARICOPA	Other Controlled Access Highway
AZ	SR 51	SR 51	MARICOPA	Other Controlled Access Highway
AZ	US 60	US 60	MARICOPA	Other Controlled Access Highway
AZ	US 93	US 93	MOHAVE	Arterial or Major Collector
CA	SANTA MONICA FWY	I 10	LOS ANGELES	Interstate Highway
CA	I 10	I 10	LOS ANGELES	Interstate Highway
CA	I 10	I 10	RIVERSIDE	Interstate Highway
CA	I 10	I 10	SAN BERNARDINO	Interstate Highway
CA	I 105	I 105	LOS ANGELES	Interstate Highway
CA	HARBOR FREEWAY	I 110	LOS ANGELES	Interstate Highway
CA	I 15	I 15	RIVERSIDE	Interstate Highway
CA	I 15	I 15	SAN BERNARDINO	Interstate Highway
CA	I 15	I 15	SAN DIEGO	Interstate Highway
CA	I 205	I 205	ALAMEDA	Interstate Highway
CA	I 205	I 205	SAN JOAQUIN	Interstate Highway
CA	I 210	I 210	LOS ANGELES	Interstate Highway

CA	I 215	I 215	RIVERSIDE	Interstate Highway
CA	I 215	I 215	SAN BERNARDINO	Interstate Highway
CA	I 238	I 238	ALAMEDA	Interstate Highway
CA	I 280	I 280	SAN FRANCISCO	Interstate Highway
CA	I 280	I 280	SAN MATEO	Interstate Highway
CA	I 280	I 280	SANTA CLARA	Interstate Highway
CA	I 380	I 380	SAN MATEO	Interstate Highway
CA	I 40	I 40	SAN BERNARDINO	Interstate Highway
CA	SAN DIEGO FWY	I 405	LOS ANGELES	Interstate Highway
CA	SAN DIEGO FWY	I 405	ORANGE	Interstate Highway
CA	I 5	I 5	COLUSA	Interstate Highway
CA	I 5	I 5	FRESNO	Interstate Highway
CA	I 5	I 5	GLENN	Interstate Highway
CA	I 5	I 5	KERN	Interstate Highway
CA	I 5	I 5	KINGS	Interstate Highway
CA	I 5	I 5	LOS ANGELES	Interstate Highway
CA	I 5	I 5	MERCED	Interstate Highway
CA	SAN DIEGO FWY	I 5	ORANGE	Interstate Highway
CA	I 5	I 5	ORANGE	Interstate Highway
CA	I 5	I 5	SACRAMENTO	Interstate Highway
CA	SAN DIEGO FWY	I 5	SAN DIEGO	Interstate Highway
CA	I 5 LOCAL BYPASS LANES	I 5	SAN DIEGO	Interstate Highway
CA	I 5	I 5	SAN DIEGO	Interstate Highway
CA	I 5	I 5	SAN JOAQUIN	Interstate Highway
CA	I 5	I 5	SHASTA	Interstate Highway
CA	I 5	I 5	SISKIYOU	Interstate Highway
CA	I 5	I 5	STANISLAUS	Interstate Highway
CA	I 5	I 5	TEHAMA	Interstate Highway
CA	I 5	I 5	YOLO	Interstate Highway
CA	I 505	I 505	SOLANO	Interstate Highway
CA	I 505	I 505	YOLO	Interstate Highway

CA	I 580	I 580	ALAMEDA	Interstate Highway
CA	I 580	I 580	CONTRA COSTA	Interstate Highway
CA	I 580	I 580	MARIN	Interstate Highway
CA	I 580	I 580	SAN JOAQUIN	Interstate Highway
CA	I 605	I 605	LOS ANGELES	Interstate Highway
CA	I 605	I 605	ORANGE	Interstate Highway
CA	I 680	I 680	ALAMEDA	Interstate Highway
CA	I 680	I 680	CONTRA COSTA	Interstate Highway
CA	I 680	I 680	SANTA CLARA	Interstate Highway
CA	I 680	I 680	SOLANO	Interstate Highway
CA	I 710	I 710	LOS ANGELES	Interstate Highway
CA	I 780	I 780	SOLANO	Interstate Highway
CA	I 8	I 8	IMPERIAL	Interstate Highway
CA	I 8	I 8	SAN DIEGO	Interstate Highway
CA	I 80	I 80	ALAMEDA	Interstate Highway
CA	I 80	I 80	CONTRA COSTA	Interstate Highway
CA	I 80	I 80	NAPA	Interstate Highway
CA	I 80	I 80	NEVADA	Interstate Highway
CA	I 80	I 80	PLACER	Interstate Highway
CA	I 80	I 80	SACRAMENTO	Interstate Highway
CA	I 80	I 80	SAN FRANCISCO	Interstate Highway
CA	I 80	I 80	SIERRA	Interstate Highway
CA	I 80	I 80	SOLANO	Interstate Highway
CA	I 80	I 80	YOLO	Interstate Highway
CA	I 805	I 805	SAN DIEGO	Interstate Highway
CA	I 5 LOCAL BYPASS LANES	I 805	SAN DIEGO	Interstate Highway
CA	I 880	I 880	ALAMEDA	Interstate Highway
CA	I 880	I 880	SANTA CLARA	Interstate Highway
CA	I 980	I 980	ALAMEDA	Interstate Highway
CA	SR 120	SR 120	SAN JOAQUIN	Other Controlled Access Highway

CA	SR 134	SR 134	LOS ANGELES	Other Controlled Access Highway
CA	SR 14	SR 14	LOS ANGELES	Other Controlled Access Highway
CA	SR 170	SR 170	LOS ANGELES	Other Controlled Access Highway
CA	SR 198	SR 198	FRESNO	Arterial or Major Collector
CA	SR 22	SR 22	ORANGE	Other Controlled Access Highway
CA	SR 23	SR 23	VENTURA	Other Controlled Access Highway
CA	SR 4	SR 4	SAN JOAQUIN	Other Controlled Access Highway
CA	SR 47	SR 47	LOS ANGELES	Other Controlled Access Highway
CA	COSTA MESA FWY	SR 55	ORANGE	Other Controlled Access Highway
CA	SR 57	SR 57	LOS ANGELES	Other Controlled Access Highway
CA	SR 57	SR 57	ORANGE	Other Controlled Access Highway
CA	SR 58	SR 58	KERN	Other Controlled Access Highway
CA	SR 58	SR 58	SAN BERNARDINO	Other Controlled Access Highway
CA	POMONA FWY	SR 60	LOS ANGELES	Other Controlled Access Highway
CA	SR 60	SR 60	LOS ANGELES	Other Controlled Access Highway
CA	SR 60	SR 60	RIVERSIDE	Other Controlled Access Highway
CA	POMONA FWY	SR 60	RIVERSIDE	Other Controlled Access Highway
CA	POMONA FWY	SR 60	SAN BERNARDINO	Other Controlled Access Highway
CA	SR 71	SR 71	LOS ANGELES	Other Controlled Access Highway
CA	LONG BEACH FWY	SR 710	LOS ANGELES	Other Controlled Access Highway

CA	SR 91	SR 91	LOS ANGELES	Other Controlled Access Highway
CA	SR 91	SR 91	ORANGE	Other Controlled Access Highway
CA	SR 91	SR 91	RIVERSIDE	Other Controlled Access Highway
CA	SR 99	SR 99	FRESNO	Other Controlled Access Highway
CA	SR 99	SR 99	KERN	Other Controlled Access Highway
CA	SR 99	SR 99	MADERA	Other Controlled Access Highway
CA	SR 99	SR 99	MERCED	Other Controlled Access Highway
CA	SR 99	SR 99	SACRAMENTO	Other Controlled Access Highway
CA	SR 99	SR 99	SAN JOAQUIN	Other Controlled Access Highway
CA	SR 99	SR 99	STANISLAUS	Other Controlled Access Highway
CA	SR 99	SR 99	TULARE	Other Controlled Access Highway
CA	US 101	US 101	LOS ANGELES	Other Controlled Access Highway
CA	US 101	US 101	SAN FRANCISCO	Other Controlled Access Highway
CA	US 101	US 101	SAN MATEO	Other Controlled Access Highway
CA	US 101	US 101	SANTA CLARA	Other Controlled Access Highway
CA	US 101	US 101	VENTURA	Other Controlled Access Highway
CA	US 50	US 50	SACRAMENTO	Other Controlled Access Highway
CA	US 50	US 50	YOLO	Other Controlled Access Highway
CA	I 580 TRUCK LANE		ALAMEDA	Express Lane (Truck Only)
CA	I 5 - TRUCK ROUTE S		LOS ANGELES	Express Lane (Truck Route)
CA	I 5 - TRUCK ROUTE N		LOS ANGELES	Express Lane (Truck Route)

CA	I 215 / SR 60 TRUCK LANE		RIVERSIDE	Express Lane (Truck Route)
CA	OLD BAKERSFIELD HWY		SAN BERNARDINO	Arterial or Major Collector
CA	POMERADO RD		SAN DIEGO	Arterial or Major Collector
CA	LAUREL ST		SAN DIEGO	Arterial or Major Collector
CA	GRAPE ST		SAN DIEGO	Arterial or Major Collector
CA	HAWTHORNE ST		SAN DIEGO	Arterial or Major Collector
CA	CESAR CHAVEZ ST		SAN FRANCISCO	Arterial or Major Collector
CA	ROTH RD		SAN JOAQUIN	Arterial or Major Collector
CA	LAS POSAS RD		VENTURA	Arterial or Major Collector
CO	I 225	I 225	ADAMS	Interstate Highway
CO	I 225	I 225	ARAPAHOE	Interstate Highway
CO	I 225	I 225	DENVER	Interstate Highway
CO	I 25	I 25	ADAMS	Interstate Highway
CO	I 25	I 25	ARAPAHOE	Interstate Highway
CO	I 25	I 25	BROOMFIELD	Interstate Highway
CO	I 25	I 25	DENVER	Interstate Highway
CO	I 25	I 25	DOUGLAS	Interstate Highway
CO	I 25	I 25	EL PASO	Interstate Highway
CO	I 25	I 25	HUERFANO	Interstate Highway
CO	I 25	I 25	LARIMER	Interstate Highway
CO	I 25	I 25	LAS ANIMAS	Interstate Highway
CO	I 25	I 25	PUEBLO	Interstate Highway
CO	I 25	I 25	WELD	Interstate Highway
CO	I 270	I 270	ADAMS	Interstate Highway
CO	I 270	I 270	DENVER	Interstate Highway
CO	I 70	I 70	ADAMS	Interstate Highway
CO	I 70	I 70	ARAPAHOE	Interstate Highway
CO	I 70	I 70	CLEAR CREEK	Interstate Highway
CO	I 70	I 70	DENVER	Interstate Highway
CO	I 70	I 70	EAGLE	Interstate Highway
CO	I 70	I 70	ELBERT	Interstate Highway

CO	I 70	I 70	GARFIELD	Interstate Highway
CO	I 70	I 70	JEFFERSON	Interstate Highway
CO	I 70	I 70	KIT CARSON	Interstate Highway
CO	I 70	I 70	LINCOLN	Interstate Highway
CO	I 70	I 70	MESA	Interstate Highway
CO	I 70	I 70	SUMMIT	Interstate Highway
CO	I 76	I 76	ADAMS	Interstate Highway
CO	I 76	I 76	DENVER	Interstate Highway
CO	I 76	I 76	JEFFERSON	Interstate Highway
CO	I 76	I 76	LOGAN	Interstate Highway
CO	I 76	I 76	MORGAN	Interstate Highway
CO	I 76	I 76	SEDGWICK	Interstate Highway
CO	I 76	I 76	WASHINGTON	Interstate Highway
CO	I 76	I 76	WELD	Interstate Highway
CO	E 470	SR 470	ADAMS	Other Controlled Access Highway
CO	E 470	SR 470	DENVER	Other Controlled Access Highway
CO	US 24	US 24	LINCOLN	Arterial or Major Collector
CO	BRIGHTON RD		ADAMS	Arterial or Major Collector
CO	PENA BLVD		DENVER	Other Controlled Access Highway
CT	CT 32	CT 32	NEW LONDON	Arterial or Major Collector
CT	I 291	I 291	HARTFORD	Interstate Highway
CT	I 384	I 384	HARTFORD	Interstate Highway
CT	I 384	I 384	TOLLAND	Interstate Highway
CT	I 395	I 395	NEW LONDON	Interstate Highway
CT	I 395	I 395	WINDHAM	Interstate Highway
CT	I 684	I 684	FAIRFIELD	Interstate Highway
CT	I 691	I 691	HARTFORD	Interstate Highway
CT	I 691	I 691	NEW HAVEN	Interstate Highway
CT	I 84	I 84	FAIRFIELD	Interstate Highway
CT	I 84	I 84	HARTFORD	Interstate Highway

CT	I 84	I 84	NEW HAVEN	Interstate Highway
CT	I 84	I 84	TOLLAND	Interstate Highway
CT	I 84	I 84	WINDHAM	Interstate Highway
CT	I 90	I 90	TOLLAND	Interstate Highway
CT	I 91	I 91	HARTFORD	Interstate Highway
CT	I 91	I 91	MIDDLESEX	Interstate Highway
CT	I 91	I 91	NEW HAVEN	Interstate Highway
CT	I 95	I 95	FAIRFIELD	Interstate Highway
CT	I 95	I 95	MIDDLESEX	Interstate Highway
CT	I 95	I 95	NEW HAVEN	Interstate Highway
CT	I 95	I 95	NEW LONDON	Interstate Highway
CT	SR 159	SR 159	HARTFORD	Arterial or Major Collector
DC	I 295	I 295	DISTRICT OF COLUMBIA	Interstate Highway
DC	I 395	I 395	DISTRICT OF COLUMBIA	Interstate Highway
DC	I 66	I 66	DISTRICT OF COLUMBIA	Interstate Highway
DC	I 695	I 695	DISTRICT OF COLUMBIA	Interstate Highway
DE	I 295	I 295	NEW CASTLE	Interstate Highway
DE	I 495	I 495	NEW CASTLE	Interstate Highway
DE	I 95	I 95	NEW CASTLE	Interstate Highway
FL	I 10	I 10	BAKER	Interstate Highway
FL	I 10	I 10	COLUMBIA	Interstate Highway
FL	I 10	I 10	DUVAL	Interstate Highway
FL	I 10	I 10	ESCAMBIA	Interstate Highway
FL	I 10	I 10	GADSDEN	Interstate Highway
FL	I 10	I 10	HOLMES	Interstate Highway
FL	I 10	I 10	JACKSON	Interstate Highway
FL	I 10	I 10	JEFFERSON	Interstate Highway
FL	I 10	I 10	LEON	Interstate Highway
FL	I 10	I 10	MADISON	Interstate Highway

FL	I 10	I 10	NASSAU	Interstate Highway
FL	I 10	I 10	OKALOOSA	Interstate Highway
FL	I 10	I 10	SANTA ROSA	Interstate Highway
FL	I 10	I 10	SUWANNEE	Interstate Highway
FL	I 10	I 10	WALTON	Interstate Highway
FL	I 10	I 10	WASHINGTON	Interstate Highway
FL	I 110	I 110	ESCAMBIA	Interstate Highway
FL	I 175	I 175	PINELLAS	Interstate Highway
FL	I 195	I 195	MIAMI-DADE	Interstate Highway
FL	I 275	I 275	HILLSBOROUGH	Interstate Highway
FL	I 275	I 275	MANATEE	Interstate Highway
FL	I 275	I 275	PASCO	Interstate Highway
FL	I 275	I 275	PINELLAS	Interstate Highway
FL	I 295	I 295	DUVAL	Interstate Highway
FL	I 375	I 375	PINELLAS	Interstate Highway
FL	DOLPHIN EXPY	I 395	MIAMI-DADE	Interstate Highway
FL	I 4	I 4	HILLSBOROUGH	Interstate Highway
FL	I 4	I 4	ORANGE	Interstate Highway
FL	I 4	I 4	OSCEOLA	Interstate Highway
FL	I 4	I 4	POLK	Interstate Highway
FL	I 4	I 4	SEMINOLE	Interstate Highway
FL	I 4	I 4	VOLUSIA	Interstate Highway
FL	I 595	I 595	BROWARD	Interstate Highway
FL	I 75	I 75	ALACHUA	Interstate Highway
FL	I 75	I 75	BROWARD	Interstate Highway
FL	I 75	I 75	CHARLOTTE	Interstate Highway
FL	I 75	I 75	COLLIER	Interstate Highway
FL	I 75	I 75	COLUMBIA	Interstate Highway
FL	I 75	I 75	DESOTO	Interstate Highway
FL	I 75	I 75	HAMILTON	Interstate Highway
FL	I 75	I 75	HERNANDO	Interstate Highway

FL	I 75	I 75	HILLSBOROUGH	Interstate Highway
FL	I 75	I 75	LEE	Interstate Highway
FL	I 75	I 75	MANATEE	Interstate Highway
FL	I 75	I 75	MARION	Interstate Highway
FL	I 75	I 75	MIAMI-DADE	Interstate Highway
FL	I 75	I 75	PASCO	Interstate Highway
FL	I 75	I 75	SARASOTA	Interstate Highway
FL	I 75	I 75	SUMTER	Interstate Highway
FL	I 75	I 75	SUWANNEE	Interstate Highway
FL	I 95	I 95	BREVARD	Interstate Highway
FL	I 95	I 95	BROWARD	Interstate Highway
FL	I 95	I 95	DUVAL	Interstate Highway
FL	I 95	I 95	FLAGLER	Interstate Highway
FL	I 95	I 95	INDIAN RIVER	Interstate Highway
FL	I 95	I 95	MARTIN	Interstate Highway
FL	I 95	I 95	MIAMI-DADE	Interstate Highway
FL	I 95	I 95	NASSAU	Interstate Highway
FL	I 95	I 95	PALM BEACH	Interstate Highway
FL	I 95	I 95	ST. JOHNS	Interstate Highway
FL	I 95	I 95	ST. LUCIE	Interstate Highway
FL	I 95	I 95	VOLUSIA	Interstate Highway
FL	NE 1ST AVE		MIAMI-DADE	Arterial or Major Collector
FL	NE 2ND AVE		MIAMI-DADE	Arterial or Major Collector
FL	NW 3RD AVE		MIAMI-DADE	Arterial or Major Collector
GA	I 16	I 16	BIBB	Interstate Highway
GA	I 16	I 16	BLECKLEY	Interstate Highway
GA	I 16	I 16	BRYAN	Interstate Highway
GA	I 16	I 16	BULLOCH	Interstate Highway
GA	I 16	I 16	CANDLER	Interstate Highway
GA	I 16	I 16	CHATHAM	Interstate Highway
GA	I 16	I 16	EFFINGHAM	Interstate Highway

GA	I 16	I 16	EMANUEL	Interstate Highway
GA	I 16	I 16	LAURENS	Interstate Highway
GA	I 16	I 16	TREUTLEN	Interstate Highway
GA	I 16	I 16	TWIGGS	Interstate Highway
GA	I 185	I 185	HARRIS	Interstate Highway
GA	I 185	I 185	MUSCOGEE	Interstate Highway
GA	I 185	I 185	TROUP	Interstate Highway
GA	I 20	I 20	CARROLL	Interstate Highway
GA	I 20	I 20	COBB	Interstate Highway
GA	I 20	I 20	COLUMBIA	Interstate Highway
GA	I 20	I 20	DEKALB	Interstate Highway
GA	I 20	I 20	DOUGLAS	Interstate Highway
GA	I 20	I 20	FULTON	Interstate Highway
GA	I 20	I 20	GREENE	Interstate Highway
GA	I 20	I 20	HARALSON	Interstate Highway
GA	I 20	I 20	MCDUFFIE	Interstate Highway
GA	I 20	I 20	MORGAN	Interstate Highway
GA	I 20	I 20	NEWTON	Interstate Highway
GA	I 20	I 20	RICHMOND	Interstate Highway
GA	I 20	I 20	ROCKDALE	Interstate Highway
GA	I 20	I 20	TALIAFERRO	Interstate Highway
GA	I 20	I 20	WALTON	Interstate Highway
GA	I 20	I 20	WARREN	Interstate Highway
GA	I 24	I 24	DADE	Interstate Highway
GA	I 285	I 285	CLAYTON	Interstate Highway
GA	I 285	I 285	COBB	Interstate Highway
GA	I 285	I 285	DEKALB	Interstate Highway
GA	I 285	I 285	FULTON	Interstate Highway
GA	I 475	I 475	BIBB	Interstate Highway
GA	I 475	I 475	MONROE	Interstate Highway
GA	I 516	I 516	CHATHAM	Interstate Highway

GA	I 520	I 520	RICHMOND	Interstate Highway
GA	I 575	I 575	CHEROKEE	Interstate Highway
GA	I 575	I 575	COBB	Interstate Highway
GA	I 575	I 575	PICKENS	Interstate Highway
GA	I 59	I 59	DADE	Interstate Highway
GA	I 675	I 675	CLAYTON	Interstate Highway
GA	I 675	I 675	DEKALB	Interstate Highway
GA	I 675	I 675	HENRY	Interstate Highway
GA	I 75	I 75	BARTOW	Interstate Highway
GA	I 75	I 75	BIBB	Interstate Highway
GA	I 75	I 75	BUTTS	Interstate Highway
GA	I 75	I 75	CATOOSA	Interstate Highway
GA	I 75	I 75	CHEROKEE	Interstate Highway
GA	I 75	I 75	CLAYTON	Interstate Highway
GA	I 75	I 75	COBB	Interstate Highway
GA	I 75	I 75	COOK	Interstate Highway
GA	I 75	I 75	CRAWFORD	Interstate Highway
GA	I 75	I 75	CRISP	Interstate Highway
GA	I 75	I 75	DOOLY	Interstate Highway
GA	I 75	I 75	FULTON	Interstate Highway
GA	I 75	I 75	GORDON	Interstate Highway
GA	I 75	I 75	HENRY	Interstate Highway
GA	I 75	I 75	HOUSTON	Interstate Highway
GA	I 75	I 75	LAMAR	Interstate Highway
GA	I 75	I 75	LOWNDES	Interstate Highway
GA	I 75	I 75	MONROE	Interstate Highway
GA	I 75	I 75	PEACH	Interstate Highway
GA	I 75	I 75	SPALDING	Interstate Highway
GA	I 75	I 75	TIFT	Interstate Highway
GA	I 75	I 75	TURNER	Interstate Highway
GA	I 75	I 75	WHITFIELD	Interstate Highway

GA	I 85	I 85	BANKS	Interstate Highway
GA	I 85	I 85	BARROW	Interstate Highway
GA	I 85	I 85	CLAYTON	Interstate Highway
GA	I 85	I 85	COWETA	Interstate Highway
GA	I 85	I 85	DEKALB	Interstate Highway
GA	I 85	I 85	FRANKLIN	Interstate Highway
GA	I 85	I 85	FULTON	Interstate Highway
GA	I 85	I 85	GWINNETT	Interstate Highway
GA	I 85	I 85	HARRIS	Interstate Highway
GA	I 85	I 85	HART	Interstate Highway
GA	I 85	I 85	JACKSON	Interstate Highway
GA	I 85	I 85	MERIWETHER	Interstate Highway
GA	I 85	I 85	TROUP	Interstate Highway
GA	I 95	I 95	BRYAN	Interstate Highway
GA	I 95	I 95	CAMDEN	Interstate Highway
GA	I 95	I 95	CHATHAM	Interstate Highway
GA	I 95	I 95	EFFINGHAM	Interstate Highway
GA	I 95	I 95	GLYNN	Interstate Highway
GA	I 95	I 95	LIBERTY	Interstate Highway
GA	I 95	I 95	MCINTOSH	Interstate Highway
GA	I 985	I 985	GWINNETT	Interstate Highway
GA	I 985	I 985	HALL	Interstate Highway
GA	SR 16	SR 16	BUTTS	Arterial or Major Collector
GA	US 82	US 82	TIFT	Arterial or Major Collector
HI	I H1	I H1	HONOLULU	Interstate Highway
HI	QUEEN LILIUOKALANI FWY	I H1	HONOLULU	Interstate Highway
HI	I H2	I H2	HONOLULU	Interstate Highway
HI	I H201	I H201	HONOLULU	Interstate Highway
HI	I H3	I H3	HONOLULU	Interstate Highway
HI	ATKINSON DR		HONOLULU	Arterial or Major Collector
HI	AHUA ST		HONOLULU	Arterial or Major Collector

IA	I 129	I 129	WOODBURY	Interstate Highway
IA	I 235	I 235	POLK	Interstate Highway
IA	I 280	I 280	SCOTT	Interstate Highway
IA	I 29	I 29	FREMONT	Interstate Highway
IA	I 29	I 29	HARRISON	Interstate Highway
IA	I 29	I 29	MILLS	Interstate Highway
IA	I 29	I 29	MONONA	Interstate Highway
IA	I 29	I 29	POTTAWATTAMIE	Interstate Highway
IA	I 29	I 29	WOODBURY	Interstate Highway
IA	I 35	I 35	CERRO GORDO	Interstate Highway
IA	I 35	I 35	CLARKE	Interstate Highway
IA	I 35	I 35	DECATUR	Interstate Highway
IA	I 35	I 35	FRANKLIN	Interstate Highway
IA	I 35	I 35	HAMILTON	Interstate Highway
IA	I 35	I 35	POLK	Interstate Highway
IA	I 35	I 35	STORY	Interstate Highway
IA	I 35	I 35	WARREN	Interstate Highway
IA	I 35	I 35	WORTH	Interstate Highway
IA	I 35	I 35	WRIGHT	Interstate Highway
IA	I 380	I 380	BENTON	Interstate Highway
IA	I 380	I 380	BLACK HAWK	Interstate Highway
IA	I 380	I 380	BUCHANAN	Interstate Highway
IA	I 380	I 380	JOHNSON	Interstate Highway
IA	I 380	I 380	LINN	Interstate Highway
IA	I 480	I 480	POTTAWATTAMIE	Interstate Highway
IA	I 680	I 680	POTTAWATTAMIE	Interstate Highway
IA	I 74	I 74	SCOTT	Interstate Highway
IA	I 80	I 80	ADAIR	Interstate Highway
IA	I 80	I 80	CASS	Interstate Highway
IA	I 80	I 80	CEDAR	Interstate Highway
IA	I 80	I 80	DALLAS	Interstate Highway

IA	I 80	I 80	IOWA	Interstate Highway
IA	I 80	I 80	JASPER	Interstate Highway
IA	I 80	I 80	JOHNSON	Interstate Highway
IA	I 80	I 80	MADISON	Interstate Highway
IA	I 80	I 80	POLK	Interstate Highway
IA	I 80	I 80	POTTAWATTAMIE	Interstate Highway
IA	I 80	I 80	POWESHIEK	Interstate Highway
IA	I 80	I 80	SCOTT	Interstate Highway
IA	E SAN MARNAN DR		BLACK HAWK	Arterial or Major Collector
IA	TEXAS ST		BLACK HAWK	Arterial or Major Collector
ID	I 15	I 15	BANNOCK	Interstate Highway
ID	I 15	I 15	BINGHAM	Interstate Highway
ID	I 15	I 15	BONNEVILLE	Interstate Highway
ID	I 15	I 15	CLARK	Interstate Highway
ID	I 15	I 15	JEFFERSON	Interstate Highway
ID	I 15	I 15	ONEIDA	Interstate Highway
ID	I 184	I 184	ADA	Interstate Highway
ID	I 84	I 84	ADA	Interstate Highway
ID	I 84	I 84	CANYON	Interstate Highway
ID	I 84	I 84	CASSIA	Interstate Highway
ID	I 84	I 84	ELMORE	Interstate Highway
ID	I 84	I 84	GOODING	Interstate Highway
ID	I 84	I 84	JEROME	Interstate Highway
ID	I 84	I 84	MINIDOKA	Interstate Highway
ID	I 84	I 84	ONEIDA	Interstate Highway
ID	I 84	I 84	PAYETTE	Interstate Highway
ID	I 86	I 86	BANNOCK	Interstate Highway
ID	I 86	I 86	CASSIA	Interstate Highway
ID	I 86	I 86	POWER	Interstate Highway
ID	I 90	I 90	KOOTENAI	Interstate Highway
ID	I 90	I 90	SHOSHONE	Interstate Highway

IL	I 155	I 155	LOGAN	Interstate Highway
IL	I 155	I 155	TAZEWELL	Interstate Highway
IL	I 172	I 172	ADAMS	Interstate Highway
IL	I 172	I 172	PIKE	Interstate Highway
IL	I 180	I 180	BUREAU	Interstate Highway
IL	I 180	I 180	PUTNAM	Interstate Highway
IL	KENNEDY EXPY	I 190	COOK	Interstate Highway
IL	I 24	I 24	JOHNSON	Interstate Highway
IL	I 24	I 24	MASSAC	Interstate Highway
IL	I 24	I 24	WILLIAMSON	Interstate Highway
IL	I 255	I 255	MADISON	Interstate Highway
IL	I 255	I 255	MONROE	Interstate Highway
IL	I 255	I 255	ST. CLAIR	Interstate Highway
IL	I 270	I 270	MADISON	Interstate Highway
IL	I 280	I 280	ROCK ISLAND	Interstate Highway
IL	I 290	I 290	COOK	Interstate Highway
IL	I 290	I 290	DUPAGE	Interstate Highway
IL	I 294	I 294	COOK	Interstate Highway
IL	I 294	I 294	DUPAGE	Interstate Highway
IL	I 294	I 294	LAKE	Interstate Highway
IL	I 355	I 355	COOK	Interstate Highway
IL	I 355	I 355	DUPAGE	Interstate Highway
IL	I 355	I 355	WILL	Interstate Highway
IL	I 39	I 39	LASALLE	Interstate Highway
IL	I 39	I 39	LEE	Interstate Highway
IL	I 39	I 39	MARSHALL	Interstate Highway
IL	I 39	I 39	MCLEAN	Interstate Highway
IL	I 39	I 39	OGLE	Interstate Highway
IL	I 39	I 39	WINNEBAGO	Interstate Highway
IL	I 39	I 39	WOODFORD	Interstate Highway
IL	I 474	I 474	PEORIA	Interstate Highway

IL	I 474	I 474	TAZEWELL	Interstate Highway
IL	I 55	I 55	COOK	Interstate Highway
IL	I 55	I 55	DUPAGE	Interstate Highway
IL	I 55	I 55	GRUNDY	Interstate Highway
IL	I 55	I 55	LIVINGSTON	Interstate Highway
IL	I 55	I 55	LOGAN	Interstate Highway
IL	I 55	I 55	MACOUPIN	Interstate Highway
IL	I 55	I 55	MADISON	Interstate Highway
IL	I 55	I 55	MCLEAN	Interstate Highway
IL	I 55	I 55	MONTGOMERY	Interstate Highway
IL	I 55	I 55	SANGAMON	Interstate Highway
IL	I 55	I 55	ST. CLAIR	Interstate Highway
IL	I 55	I 55	WILL	Interstate Highway
IL	I 57	I 57	ALEXANDER	Interstate Highway
IL	I 57	I 57	CHAMPAIGN	Interstate Highway
IL	I 57	I 57	CLAY	Interstate Highway
IL	I 57	I 57	COLES	Interstate Highway
IL	I 57	I 57	COOK	Interstate Highway
IL	I 57	I 57	CUMBERLAND	Interstate Highway
IL	I 57	I 57	DOUGLAS	Interstate Highway
IL	I 57	I 57	EFFINGHAM	Interstate Highway
IL	I 57	I 57	FAYETTE	Interstate Highway
IL	I 57	I 57	FORD	Interstate Highway
IL	I 57	I 57	FRANKLIN	Interstate Highway
IL	I 57	I 57	IROQUOIS	Interstate Highway
IL	I 57	I 57	JEFFERSON	Interstate Highway
IL	I 57	I 57	JOHNSON	Interstate Highway
IL	I 57	I 57	KANKAKEE	Interstate Highway
IL	I 57	I 57	MARION	Interstate Highway
IL	I 57	I 57	PULASKI	Interstate Highway
IL	I 57	I 57	UNION	Interstate Highway

IL	I 57	I 57	WILL	Interstate Highway
IL	I 57	I 57	WILLIAMSON	Interstate Highway
IL	I 64	I 64	CLINTON	Interstate Highway
IL	I 64	I 64	JEFFERSON	Interstate Highway
IL	I 64	I 64	ST. CLAIR	Interstate Highway
IL	I 64	I 64	WASHINGTON	Interstate Highway
IL	I 64	I 64	WAYNE	Interstate Highway
IL	I 64	I 64	WHITE	Interstate Highway
IL	I 70	I 70	BOND	Interstate Highway
IL	I 70	I 70	CLARK	Interstate Highway
IL	I 70	I 70	CUMBERLAND	Interstate Highway
IL	I 70	I 70	EFFINGHAM	Interstate Highway
IL	I 70	I 70	FAYETTE	Interstate Highway
IL	I 70	I 70	MADISON	Interstate Highway
IL	I 70	I 70	ST. CLAIR	Interstate Highway
IL	I 72	I 72	CHAMPAIGN	Interstate Highway
IL	I 72	I 72	MACON	Interstate Highway
IL	I 72	I 72	MORGAN	Interstate Highway
IL	I 72	I 72	PIATT	Interstate Highway
IL	I 72	I 72	PIKE	Interstate Highway
IL	I 72	I 72	SANGAMON	Interstate Highway
IL	I 72	I 72	SCOTT	Interstate Highway
IL	I 74	I 74	CHAMPAIGN	Interstate Highway
IL	I 74	I 74	DEWITT	Interstate Highway
IL	I 74	I 74	HENRY	Interstate Highway
IL	I 74	I 74	KNOX	Interstate Highway
IL	I 74	I 74	MCLEAN	Interstate Highway
IL	I 74	I 74	PEORIA	Interstate Highway
IL	I 74	I 74	PIATT	Interstate Highway
IL	I 74	I 74	ROCK ISLAND	Interstate Highway
IL	I 74	I 74	TAZEWELL	Interstate Highway

IL	I 74	I 74	VERMILION	Interstate Highway
IL	I 74	I 74	WOODFORD	Interstate Highway
IL	I 80	I 80	BUREAU	Interstate Highway
IL	I 80	I 80	COOK	Interstate Highway
IL	I 80	I 80	GRUNDY	Interstate Highway
IL	I 80	I 80	HENRY	Interstate Highway
IL	I 80	I 80	LASALLE	Interstate Highway
IL	I 80	I 80	ROCK ISLAND	Interstate Highway
IL	I 80	I 80	WILL	Interstate Highway
IL	I 88	I 88	COOK	Interstate Highway
IL	I 88	I 88	DEKALB	Interstate Highway
IL	I 88	I 88	DUPAGE	Interstate Highway
IL	I 88	I 88	KANE	Interstate Highway
IL	I 88	I 88	LEE	Interstate Highway
IL	I 88	I 88	OGLE	Interstate Highway
IL	I 88	I 88	ROCK ISLAND	Interstate Highway
IL	I 88	I 88	WHITESIDE	Interstate Highway
IL	I 90	I 90	BOONE	Interstate Highway
IL	I 90	I 90	COOK	Interstate Highway
IL	KENNEDY EXPY	I 90	COOK	Interstate Highway
IL	I 90	I 90	KANE	Interstate Highway
IL	I 90	I 90	MCHENRY	Interstate Highway
IL	I 90	I 90	WINNEBAGO	Interstate Highway
IL	KENNEDY EXPY	I 94	COOK	Interstate Highway
IL	I 94	I 94	COOK	Interstate Highway
IL	I 94	I 94	LAKE	Interstate Highway
IN	I 265	I 265	CLARK	Interstate Highway
IN	I 265	I 265	FLOYD	Interstate Highway
IN	I 275	I 275	DEARBORN	Interstate Highway
IN	I 465	I 465	BOONE	Interstate Highway
IN	I 465	I 465	HAMILTON	Interstate Highway

IN	I 465	I 465	MARION	Interstate Highway
IN	I 469	I 469	ALLEN	Interstate Highway
IN	I 64	I 64	CRAWFORD	Interstate Highway
IN	I 64	I 64	DUBOIS	Interstate Highway
IN	I 64	I 64	FLOYD	Interstate Highway
IN	I 64	I 64	GIBSON	Interstate Highway
IN	I 64	I 64	HARRISON	Interstate Highway
IN	I 64	I 64	PERRY	Interstate Highway
IN	I 64	I 64	POSEY	Interstate Highway
IN	I 64	I 64	SPENCER	Interstate Highway
IN	I 64	I 64	VANDERBURGH	Interstate Highway
IN	I 64	I 64	WARRICK	Interstate Highway
IN	I 65	I 65	BARTHOLOMEW	Interstate Highway
IN	I 65	I 65	BOONE	Interstate Highway
IN	I 65	I 65	CLARK	Interstate Highway
IN	I 65	I 65	CLINTON	Interstate Highway
IN	I 65	I 65	HENDRICKS	Interstate Highway
IN	I 65	I 65	JACKSON	Interstate Highway
IN	I 65	I 65	JASPER	Interstate Highway
IN	I 65	I 65	JOHNSON	Interstate Highway
IN	I 65	I 65	LAKE	Interstate Highway
IN	I 65	I 65	MARION	Interstate Highway
IN	I 65	I 65	NEWTON	Interstate Highway
IN	I 65	I 65	SCOTT	Interstate Highway
IN	I 65	I 65	SHELBY	Interstate Highway
IN	I 65	I 65	TIPPECANOE	Interstate Highway
IN	I 65	I 65	WHITE	Interstate Highway
IN	I 69	I 69	ALLEN	Interstate Highway
IN	I 69	I 69	DAVIESS	Interstate Highway
IN	I 69	I 69	DEKALB	Interstate Highway
IN	I 69	I 69	DELAWARE	Interstate Highway

IN	I 69	I 69	GIBSON	Interstate Highway
IN	I 69	I 69	GRANT	Interstate Highway
IN	I 69	I 69	GREENE	Interstate Highway
IN	I 69	I 69	HAMILTON	Interstate Highway
IN	I 69	I 69	HUNTINGTON	Interstate Highway
IN	I 69	I 69	MADISON	Interstate Highway
IN	I 69	I 69	MARION	Interstate Highway
IN	I 69	I 69	MONROE	Interstate Highway
IN	I 69	I 69	PIKE	Interstate Highway
IN	I 69	I 69	STEUBEN	Interstate Highway
IN	I 69	I 69	VANDERBURGH	Interstate Highway
IN	I 69	I 69	WARRICK	Interstate Highway
IN	I 69	I 69	WELLS	Interstate Highway
IN	I 70	I 70	CLAY	Interstate Highway
IN	I 70	I 70	HANCOCK	Interstate Highway
IN	I 70	I 70	HENDRICKS	Interstate Highway
IN	I 70	I 70	HENRY	Interstate Highway
IN	I 70	I 70	MARION	Interstate Highway
IN	I 70	I 70	MORGAN	Interstate Highway
IN	I 70	I 70	PUTNAM	Interstate Highway
IN	I 70	I 70	VIGO	Interstate Highway
IN	I 70	I 70	WAYNE	Interstate Highway
IN	I 74	I 74	BOONE	Interstate Highway
IN	I 74	I 74	DEARBORN	Interstate Highway
IN	I 74	I 74	DECATUR	Interstate Highway
IN	I 74	I 74	FOUNTAIN	Interstate Highway
IN	I 74	I 74	FRANKLIN	Interstate Highway
IN	I 74	I 74	HENDRICKS	Interstate Highway
IN	I 74	I 74	MARION	Interstate Highway
IN	I 74	I 74	MONTGOMERY	Interstate Highway
IN	I 74	I 74	RIPLEY	Interstate Highway

IN	I 74	I 74	RUSH	Interstate Highway
IN	I 74	I 74	SHELBY	Interstate Highway
IN	I 74	I 74	VERMILLION	Interstate Highway
IN	I 80	I 80	ELKHART	Interstate Highway
IN	I 80	I 80	LAGRANGE	Interstate Highway
IN	I 80	I 80	LAKE	Interstate Highway
IN	I 80	I 80	LAPORTE	Interstate Highway
IN	I 80	I 80	PORTER	Interstate Highway
IN	I 80	I 80	ST. JOSEPH	Interstate Highway
IN	I 80	I 80	STEUBEN	Interstate Highway
IN	I 865	I 865	BOONE	Interstate Highway
IN	I 90	I 90	LAKE	Interstate Highway
IN	I 94	I 94	LAKE	Interstate Highway
IN	I 94	I 94	LAPORTE	Interstate Highway
IN	I 94	I 94	PORTER	Interstate Highway
IN	BINFORD BLVD		MARION	Interstate Highway
KS	I 135	I 135	HARVEY	Interstate Highway
KS	I 135	I 135	MCPHERSON	Interstate Highway
KS	I 135	I 135	SALINE	Interstate Highway
KS	I 135	I 135	SEDGWICK	Interstate Highway
KS	I 235	I 235	SEDGWICK	Interstate Highway
KS	I 335	I 335	LYON	Interstate Highway
KS	I 335	I 335	OSAGE	Interstate Highway
KS	I 335	I 335	SHAWNEE	Interstate Highway
KS	I 335	I 335	WABAUNSEE	Interstate Highway
KS	I 35	I 35	BUTLER	Interstate Highway
KS	I 35	I 35	CHASE	Interstate Highway
KS	I 35	I 35	COFFEY	Interstate Highway
KS	I 35	I 35	FRANKLIN	Interstate Highway
KS	I 35	I 35	JOHNSON	Interstate Highway
KS	I 35	I 35	LYON	Interstate Highway

KS	I 35	I 35	MIAMI	Interstate Highway
KS	I 35	I 35	OSAGE	Interstate Highway
KS	I 35	I 35	SEDGWICK	Interstate Highway
KS	I 35	I 35	SUMNER	Interstate Highway
KS	I 35	I 35	WYANDOTTE	Interstate Highway
KS	I 435	I 435	JOHNSON	Interstate Highway
KS	I 435	I 435	WYANDOTTE	Interstate Highway
KS	I 470	I 470	SHAWNEE	Interstate Highway
KS	I 635	I 635	JOHNSON	Interstate Highway
KS	I 635	I 635	WYANDOTTE	Interstate Highway
KS	I 670	I 670	WYANDOTTE	Interstate Highway
KS	I 70	I 70	DICKINSON	Interstate Highway
KS	I 70	I 70	DOUGLAS	Interstate Highway
KS	I 70	I 70	ELLIS	Interstate Highway
KS	I 70	I 70	ELLSWORTH	Interstate Highway
KS	I 70	I 70	GEARY	Interstate Highway
KS	I 70	I 70	GOVE	Interstate Highway
KS	I 70	I 70	LEAVENWORTH	Interstate Highway
KS	I 70	I 70	LINCOLN	Interstate Highway
KS	I 70	I 70	LOGAN	Interstate Highway
KS	I 70	I 70	RILEY	Interstate Highway
KS	I 70	I 70	RUSSELL	Interstate Highway
KS	I 70	I 70	SALINE	Interstate Highway
KS	I 70	I 70	SHAWNEE	Interstate Highway
KS	I 70	I 70	SHERMAN	Interstate Highway
KS	I 70	I 70	THOMAS	Interstate Highway
KS	I 70	I 70	TREGO	Interstate Highway
KS	I 70	I 70	WABAUNSEE	Interstate Highway
KS	I 70	I 70	WYANDOTTE	Interstate Highway
KS	SR 254	SR 254	SEDGWICK	Other Controlled Access Highway

KS	SR 5	SR 5	WYANDOTTE	Other Controlled Access Highway
KS	OLD TRAIL RD		HARVEY	Arterial or Major Collector
KS	N 3RD ST		WYANDOTTE	Arterial or Major Collector
KY	I 165	I 165	BUTLER	Interstate Highway
KY	I 165	I 165	DAVIESS	Interstate Highway
KY	I 165	I 165	OHIO	Interstate Highway
KY	I 165	I 165	WARREN	Interstate Highway
KY	I 169	I 169	CHRISTIAN	Interstate Highway
KY	I 169	I 169	HOPKINS	Interstate Highway
KY	I 24	I 24	CALDWELL	Interstate Highway
KY	I 24	I 24	CHRISTIAN	Interstate Highway
KY	I 24	I 24	LIVINGSTON	Interstate Highway
KY	I 24	I 24	LYON	Interstate Highway
KY	I 24	I 24	MARSHALL	Interstate Highway
KY	I 24	I 24	MCCRACKEN	Interstate Highway
KY	I 24	I 24	TRIGG	Interstate Highway
KY	I 264	I 264	JEFFERSON	Interstate Highway
KY	I 265	I 265	JEFFERSON	Interstate Highway
KY	I 275	I 275	BOONE	Interstate Highway
KY	I 275	I 275	CAMPBELL	Interstate Highway
KY	I 275	I 275	KENTON	Interstate Highway
KY	I 471	I 471	CAMPBELL	Interstate Highway
KY	I 64	I 64	BATH	Interstate Highway
KY	I 64	I 64	BOYD	Interstate Highway
KY	I 64	I 64	CARTER	Interstate Highway
KY	I 64	I 64	CLARK	Interstate Highway
KY	I 64	I 64	FAYETTE	Interstate Highway
KY	I 64	I 64	FRANKLIN	Interstate Highway
KY	I 64	I 64	JEFFERSON	Interstate Highway
KY	I 64	I 64	MONTGOMERY	Interstate Highway
KY	I 64	I 64	ROWAN	Interstate Highway

KY	I 64	I 64	SCOTT	Interstate Highway
KY	I 64	I 64	SHELBY	Interstate Highway
KY	I 64	I 64	WOODFORD	Interstate Highway
KY	I 65	I 65	BARREN	Interstate Highway
KY	I 65	I 65	BULLITT	Interstate Highway
KY	I 65	I 65	EDMONSON	Interstate Highway
KY	I 65	I 65	HARDIN	Interstate Highway
KY	I 65	I 65	HART	Interstate Highway
KY	I 65	I 65	JEFFERSON	Interstate Highway
KY	I 65	I 65	LARUE	Interstate Highway
KY	I 65	I 65	SIMPSON	Interstate Highway
KY	I 65	I 65	WARREN	Interstate Highway
KY	I 69	I 69	CALDWELL	Interstate Highway
KY	PURCHASE PKWY	I 69	FULTON	Interstate Highway
KY	JULIAN M CARROLL PURCHASE PKWY	I 69	GRAVES	Interstate Highway
KY	PURCHASE PKWY	I 69	GRAVES	Interstate Highway
KY	PENNYRILE PKWY	I 69	HENDERSON	Other Controlled Access Highway
KY	PURCHASE PKWY	I 69	HICKMAN	Interstate Highway
KY	PENNYRILE PKWY	I 69	HOPKINS	Interstate Highway
KY	I 69	I 69	HOPKINS	Interstate Highway
KY	I 69 NB	I 69	LYON	Interstate Highway
KY	I 69	I 69	LYON	Interstate Highway
KY	JULIAN M CARROLL PURCHASE PKWY	I 69	MARSHALL	Other Controlled Access Highway
KY	PENNYRILE PKWY	I 69	WEBSTER	Interstate Highway
KY	I 71	I 71	BOONE	Interstate Highway
KY	I 71	I 71	CARROLL	Interstate Highway
KY	I 71	I 71	GALLATIN	Interstate Highway
KY	I 71	I 71	HENRY	Interstate Highway
KY	I 71	I 71	JEFFERSON	Interstate Highway
KY	I 71	I 71	OLDHAM	Interstate Highway

KY	I 71	I 71	TRIMBLE	Interstate Highway
KY	I 75	I 75	BOONE	Interstate Highway
KY	I 75	I 75	FAYETTE	Interstate Highway
KY	I 75	I 75	GRANT	Interstate Highway
KY	I 75	I 75	KENTON	Interstate Highway
KY	I 75	I 75	LAUREL	Interstate Highway
KY	I 75	I 75	MADISON	Interstate Highway
KY	I 75	I 75	ROCKCASTLE	Interstate Highway
KY	I 75	I 75	SCOTT	Interstate Highway
KY	I 75	I 75	WHITLEY	Interstate Highway
KY	SR 53	SR 53	OLDHAM	Arterial or Major Collector
LA	I 10	I 10	ACADIA	Interstate Highway
LA	I 10	I 10	ASCENSION	Interstate Highway
LA	I 10	I 10	CALCASIEU	Interstate Highway
LA	I 10	I 10	EAST BATON ROUGE	Interstate Highway
LA	I 10	I 10	IBERVILLE	Interstate Highway
LA	I 10	I 10	JEFFERSON	Interstate Highway
LA	I 10	I 10	JEFFERSON DAVIS	Interstate Highway
LA	I 10	I 10	LAFAYETTE	Interstate Highway
LA	I 10	I 10	ORLEANS	Interstate Highway
LA	I 10	I 10	ST. CHARLES	Interstate Highway
LA	I 10	I 10	ST. JAMES	Interstate Highway
LA	I 10	I 10	ST. JOHN THE BAPTIST	Interstate Highway
LA	I 10	I 10	ST. MARTIN	Interstate Highway
LA	I 10	I 10	ST. TAMMANY	Interstate Highway
LA	I 10	I 10	WEST BATON ROUGE	Interstate Highway
LA	I 110	I 110	EAST BATON ROUGE	Interstate Highway
LA	I 12	I 12	EAST BATON ROUGE	Interstate Highway
LA	I 12	I 12	LIVINGSTON	Interstate Highway
LA	I 12	I 12	ST. TAMMANY	Interstate Highway
LA	I 12	I 12	TANGIPAHOA	Interstate Highway

LA	I 20	I 20	BIENVILLE	Interstate Highway
LA	I 20	I 20	BOSSIER	Interstate Highway
LA	I 20	I 20	CADDO	Interstate Highway
LA	I 20	I 20	LINCOLN	Interstate Highway
LA	I 20	I 20	MADISON	Interstate Highway
LA	I 20	I 20	OUACHITA	Interstate Highway
LA	I 20	I 20	RICHLAND	Interstate Highway
LA	I 20	I 20	WEBSTER	Interstate Highway
LA	I 210	I 210	CALCASIEU	Interstate Highway
LA	I 220	I 220	BOSSIER	Interstate Highway
LA	I 220	I 220	CADDO	Interstate Highway
LA	I 310	I 310	ST. CHARLES	Interstate Highway
LA	I 49	I 49	AVOYELLES	Interstate Highway
LA	I 49	I 49	CADDO	Interstate Highway
LA	I 49	I 49	DESOTO	Interstate Highway
LA	I 49	I 49	EVANGELINE	Interstate Highway
LA	I 49	I 49	LAFAYETTE	Interstate Highway
LA	I 49	I 49	NATCHITOCHES	Interstate Highway
LA	I 49	I 49	RAPIDES	Interstate Highway
LA	I 49	I 49	ST. LANDRY	Interstate Highway
LA	I 510	I 510	ORLEANS	Interstate Highway
LA	I 55	I 55	ORLEANS	Interstate Highway
LA	I 55	I 55	ST. JOHN THE BAPTIST	Interstate Highway
LA	I 55	I 55	ST. TAMMANY	Interstate Highway
LA	I 55	I 55	TANGIPAHOA	Interstate Highway
LA	I 59	I 59	ST. TAMMANY	Interstate Highway
LA	I 610	I 610	ORLEANS	Interstate Highway
LA	SR 21	SR 21	ST. TAMMANY	Arterial or Major Collector
LA	US 190 B	US 190 B	ST. TAMMANY	Arterial or Major Collector
LA	E BOSTON	US 190 B	ST. TAMMANY	Arterial or Major Collector
LA	US 80	US 80	CADDO	Arterial or Major Collector

LA	US 90 BUSINESS	US 90 B	JEFFERSON	Other Controlled Access Highway
LA	US 90 BUSINESS	US 90 B	ORLEANS	Other Controlled Access Highway
LA	PONCHARTRAIN EXPY	US 90 B	ORLEANS	Other Controlled Access Highway
LA	S FIREHOUSE RD		JEFFERSON	Local Road
LA	SERVICE RD		JEFFERSON	Local Road
LA	AIRLINE DR		JEFFERSON	Local Road
LA	AVONDALE GARDEN RD		JEFFERSON	Arterial or Major Collector
LA	N CAUSEWAY BLVD		JEFFERSON	Arterial or Major Collector
LA	ELYSIAN FIELDS RD		ORLEANS	Arterial or Major Collector
LA	RAMP		ORLEANS	Arterial or Major Collector
LA	TCHOUPITOULAS ST		ORLEANS	Arterial or Major Collector
MA	I 190	I 190	WORCESTER	Interstate Highway
MA	I 195	I 195	BRISTOL	Interstate Highway
MA	I 195	I 195	PLYMOUTH	Interstate Highway
MA	I 290	I 290	MIDDLESEX	Interstate Highway
MA	I 290	I 290	WORCESTER	Interstate Highway
MA	I 291	I 291	HAMPDEN	Interstate Highway
MA	I 295	I 295	BRISTOL	Interstate Highway
MA	I 391	I 391	HAMPDEN	Interstate Highway
MA	I 395	I 395	WORCESTER	Interstate Highway
MA	I 495	I 495	BRISTOL	Interstate Highway
MA	I 495	I 495	ESSEX	Interstate Highway
MA	I 495	I 495	MIDDLESEX	Interstate Highway
MA	I 495	I 495	NORFOLK	Interstate Highway
MA	I 495	I 495	PLYMOUTH	Interstate Highway
MA	I 495	I 495	WORCESTER	Interstate Highway
MA	I 84	I 84	WORCESTER	Interstate Highway
MA	MASSACHUSETTS TPKE	I 90	BERKSHIRE	Interstate Highway
MA	MASSACHUSETTS TPKE	I 90	HAMPDEN	Interstate Highway
MA	MASSACHUSETTS TPKE	I 90	MIDDLESEX	Interstate Highway

MA	MASSACHUSETTS TPKE	I 90	SUFFOLK	Interstate Highway
MA	MASSACHUSETTS TPKE	I 90	WORCESTER	Interstate Highway
MA	I 91	I 91	FRANKLIN	Interstate Highway
MA	I 91	I 91	HAMPDEN	Interstate Highway
MA	I 91	I 91	HAMPSHIRE	Interstate Highway
MA	I 93	I 93	ESSEX	Interstate Highway
MA	I 93	I 93	MIDDLESEX	Interstate Highway
MA	I 93	I 93	NORFOLK	Interstate Highway
MA	I 93	I 93	SUFFOLK	Interstate Highway
MA	I 93 N	I 93 N	MIDDLESEX	Interstate Highway
MA	I 93 N	I 93 N	SUFFOLK	Interstate Highway
MA	I 95	I 95	BRISTOL	Interstate Highway
MA	I 95	I 95	ESSEX	Interstate Highway
MA	I 95	I 95	MIDDLESEX	Interstate Highway
MA	I 95	I 95	NORFOLK	Interstate Highway
MA	MA 146	MA 146	WORCESTER	Other Controlled Access Highway
MA	MA 1A	MA 1A	SUFFOLK	Other Controlled Access Highway
MA	MA 2	MA 2	MIDDLESEX	Other Controlled Access Highway
MA	MA 2	MA 2	WORCESTER	Other Controlled Access Highway
MA	HARBORSIDE DR		SUFFOLK	Arterial or Major Collector
MD	I 195	I 195	ANNE ARUNDEL	Interstate Highway
MD	I 195	I 195	BALTIMORE	Interstate Highway
MD	I 270	I 270	FREDERICK	Interstate Highway
MD	I 270	I 270	MONTGOMERY	Interstate Highway
MD	I 270 - EXPRESS LANES	I 270	MONTGOMERY	Interstate Highway
MD	I 270 S	I 270 S	MONTGOMERY	Interstate Highway
MD	I 295	I 295	PRINCE GEORGE'S	Interstate Highway
MD	I 370	I 370	MONTGOMERY	Interstate Highway
MD	I 395	I 395	BALTIMORE CITY	Interstate Highway

MD	I 495	I 495	MONTGOMERY	Interstate Highway
MD	I 495	I 495	PRINCE GEORGE'S	Interstate Highway
MD	I 68	I 68	ALLEGANY	Interstate Highway
MD	I 68	I 68	GARRETT	Interstate Highway
MD	I 68	I 68	WASHINGTON	Interstate Highway
MD	I 695	I 695	ANNE ARUNDEL	Interstate Highway
MD	I 695	I 695	BALTIMORE	Interstate Highway
MD	I 70	I 70	BALTIMORE	Interstate Highway
MD	I 70	I 70	BALTIMORE CITY	Interstate Highway
MD	I 70	I 70	CARROLL	Interstate Highway
MD	I 70	I 70	FREDERICK	Interstate Highway
MD	I 70	I 70	HOWARD	Interstate Highway
MD	I 70	I 70	WASHINGTON	Interstate Highway
MD	I 795	I 795	BALTIMORE	Interstate Highway
MD	I 81	I 81	WASHINGTON	Interstate Highway
MD	I 83	I 83	BALTIMORE	Interstate Highway
MD	JONES FALLS EXPY	I 83	BALTIMORE	Interstate Highway
MD	I 83	I 83	BALTIMORE CITY	Interstate Highway
MD	I 895	I 895	ANNE ARUNDEL	Interstate Highway
MD	I 895	I 895	BALTIMORE	Interstate Highway
MD	I 895	I 895	BALTIMORE CITY	Interstate Highway
MD	I 895	I 895	HOWARD	Interstate Highway
MD	I 95	I 95	BALTIMORE	Interstate Highway
MD	I 95	I 95	BALTIMORE CITY	Interstate Highway
MD	I 95	I 95	CECIL	Interstate Highway
MD	I 95	I 95	HARFORD	Interstate Highway
MD	I 95	I 95	HOWARD	Interstate Highway
MD	I 95	I 95	PRINCE GEORGE'S	Interstate Highway
MD	I 97	I 97	ANNE ARUNDEL	Interstate Highway
MD	MD 100	MD 100	ANNE ARUNDEL	Other Controlled Access Highway

MD	MD 100	MD 100	HOWARD	Other Controlled Access Highway
MD	WATERLOO RD	MD 175	HOWARD	Arterial or Major Collector
MD	BALTIMORE-WASHINGTON PKWY	MD 295	ANNE ARUNDEL	Other Controlled Access Highway
MD	MD 995A	MD 995A	ANNE ARUNDEL	Arterial or Major Collector
MD	US 50	US 50	ANNE ARUNDEL	Other Controlled Access Highway
MD	US 50	US 50	PRINCE GEORGE'S	Interstate Highway
MD	US 50	US 50	QUEEN ANNE'S	Other Controlled Access Highway
MD	AVIATION BLVD		ANNE ARUNDEL	Arterial or Major Collector
MD	HANOVER ST		BALTIMORE CITY	Arterial or Major Collector
MD	I 270 - LOCAL LANES		MONTGOMERY	Interstate Highway
ME	I 195	I 195	YORK	Interstate Highway
ME	I 295	I 295	CUMBERLAND	Interstate Highway
ME	I 295	I 295	KENNEBEC	Interstate Highway
ME	I 295	I 295	SAGADAHOC	Interstate Highway
ME	I 395	I 395	PENOBSCOT	Interstate Highway
ME	I 95	I 95	ANDROSCOGGIN	Interstate Highway
ME	I 95	I 95	AROOSTOOK	Interstate Highway
ME	I 95	I 95	CUMBERLAND	Interstate Highway
ME	I 95	I 95	KENNEBEC	Interstate Highway
ME	I 95	I 95	PENOBSCOT	Interstate Highway
ME	I 95	I 95	SOMERSET	Interstate Highway
ME	I 95	I 95	WALDO	Interstate Highway
ME	I 95	I 95	YORK	Interstate Highway
ME	VETERANS MEMORIAL BRG		CUMBERLAND	Arterial or Major Collector
ME	MAINE MALL RD		CUMBERLAND	Arterial or Major Collector
ME	MAINE TURNPIKE APPROACH RD		CUMBERLAND	Other Controlled Access Highway
MI	I 194	I 194	CALHOUN	Interstate Highway
MI	I 196	I 196	ALLEGAN	Interstate Highway

MI	I 196	I 196	BERRIEN	Interstate Highway
MI	I 196	I 196	KENT	Interstate Highway
MI	I 196	I 196	OTTAWA	Interstate Highway
MI	I 196	I 196	VAN BUREN	Interstate Highway
MI	I 275	I 275	MONROE	Interstate Highway
MI	I 275	I 275	WAYNE	Interstate Highway
MI	I 375	I 375	WAYNE	Interstate Highway
MI	I 475	I 475	GENESEE	Interstate Highway
MI	I 496	I 496	EATON	Interstate Highway
MI	I 496	I 496	INGHAM	Interstate Highway
MI	I 675	I 675	SAGINAW	Interstate Highway
MI	I 69	I 69	BRANCH	Interstate Highway
MI	I 69	I 69	CALHOUN	Interstate Highway
MI	I 69	I 69	CLINTON	Interstate Highway
MI	I 69	I 69	EATON	Interstate Highway
MI	I 69	I 69	GENESEE	Interstate Highway
MI	I 69	I 69	LAPEER	Interstate Highway
MI	I 69	I 69	SHIAWASSEE	Interstate Highway
MI	I 69	I 69	ST. CLAIR	Interstate Highway
MI	I 696	I 696	MACOMB	Interstate Highway
MI	I 696	I 696	OAKLAND	Interstate Highway
MI	I 75	I 75	ARENAC	Interstate Highway
MI	I 75	I 75	BAY	Interstate Highway
MI	I 75	I 75	CHEBOYGAN	Interstate Highway
MI	I 75	I 75	CHIPPEWA	Interstate Highway
MI	I 75	I 75	CRAWFORD	Interstate Highway
MI	I 75	I 75	EMMET	Interstate Highway
MI	I 75	I 75	GENESEE	Interstate Highway
MI	I 75	I 75	MACKINAC	Interstate Highway
MI	I 75	I 75	MONROE	Interstate Highway
MI	I 75	I 75	OAKLAND	Interstate Highway

MI	I 75	I 75	OGEMAW	Interstate Highway
MI	I 75	I 75	OTSEGO	Interstate Highway
MI	I 75	I 75	ROSCOMMON	Interstate Highway
MI	I 75	I 75	SAGINAW	Interstate Highway
MI	I 75	I 75	WAYNE	Interstate Highway
MI	I 94	I 94	BERRIEN	Interstate Highway
MI	I 94	I 94	CALHOUN	Interstate Highway
MI	I 94	I 94	JACKSON	Interstate Highway
MI	I 94	I 94	KALAMAZOO	Interstate Highway
MI	I 94	I 94	MACOMB	Interstate Highway
MI	I 94	I 94	ST. CLAIR	Interstate Highway
MI	I 94	I 94	VAN BUREN	Interstate Highway
MI	I 94	I 94	WASHTENAW	Interstate Highway
MI	I 94	I 94	WAYNE	Interstate Highway
MI	I 96	I 96	CLINTON	Interstate Highway
MI	I 96	I 96	EATON	Interstate Highway
MI	I 96	I 96	INGHAM	Interstate Highway
MI	I 96	I 96	IONIA	Interstate Highway
MI	I 96	I 96	KENT	Interstate Highway
MI	I 96	I 96	LIVINGSTON	Interstate Highway
MI	I 96	I 96	MUSKEGON	Interstate Highway
MI	I 96	I 96	OAKLAND	Interstate Highway
MI	I 96	I 96	OTTAWA	Interstate Highway
MI	I 96	I 96	WAYNE	Interstate Highway
MI	I 296	US 131	KENT	Interstate Highway
MN	I 35	I 35	ANOKA	Interstate Highway
MN	I 35	I 35	CARLTON	Interstate Highway
MN	I 35	I 35	CHISAGO	Interstate Highway
MN	I 35	I 35	DAKOTA	Interstate Highway
MN	I 35	I 35	FREEBORN	Interstate Highway
MN	I 35	I 35	PINE	Interstate Highway

MN	I 35	I 35	RICE	Interstate Highway
MN	I 35	I 35	SCOTT	Interstate Highway
MN	I 35	I 35	ST. LOUIS	Interstate Highway
MN	I 35	I 35	STEELE	Interstate Highway
MN	I 35	I 35	WASHINGTON	Interstate Highway
MN	I 35E	I 35E	ANOKA	Interstate Highway
MN	I 35E	I 35E	DAKOTA	Interstate Highway
MN	I 35E	I 35E	RAMSEY	Interstate Highway
MN	I 35W	I 35W	ANOKA	Interstate Highway
MN	I 35W	I 35W	DAKOTA	Interstate Highway
MN	I 35W	I 35W	HENNEPIN	Interstate Highway
MN	I 35W	I 35W	RAMSEY	Interstate Highway
MN	I 394	I 394	HENNEPIN	Interstate Highway
MN	I 494	I 494	DAKOTA	Interstate Highway
MN	I 494	I 494	HENNEPIN	Interstate Highway
MN	I 494 NB	I 494	HENNEPIN	Interstate Highway
MN	I 494	I 494	RAMSEY	Interstate Highway
MN	I 494	I 494	WASHINGTON	Interstate Highway
MN	I 535	I 535	ST. LOUIS	Interstate Highway
MN	I 694	I 694	ANOKA	Interstate Highway
MN	I 694	I 694	HENNEPIN	Interstate Highway
MN	I 694	I 694	RAMSEY	Interstate Highway
MN	I 694	I 694	WASHINGTON	Interstate Highway
MN	I 90	I 90	FARIBAULT	Interstate Highway
MN	I 90	I 90	FREEBORN	Interstate Highway
MN	I 90	I 90	JACKSON	Interstate Highway
MN	I 90	I 90	MARTIN	Interstate Highway
MN	I 90	I 90	MOWER	Interstate Highway
MN	I 90	I 90	NOBLES	Interstate Highway
MN	I 90	I 90	OLMSTED	Interstate Highway
MN	I 90	I 90	ROCK	Interstate Highway

MN	I 90	I 90	WINONA	Interstate Highway
MN	I 94	I 94	CLAY	Interstate Highway
MN	I 94	I 94	DOUGLAS	Interstate Highway
MN	I 94	I 94	GRANT	Interstate Highway
MN	I 94	I 94	HENNEPIN	Interstate Highway
MN	I 94	I 94	OTTER TAIL	Interstate Highway
MN	I 94	I 94	RAMSEY	Interstate Highway
MN	I 94	I 94	STEARNS	Interstate Highway
MN	I 94	I 94	TODD	Interstate Highway
MN	I 94	I 94	WASHINGTON	Interstate Highway
MN	I 94	I 94	WILKIN	Interstate Highway
MN	I 94	I 94	WRIGHT	Interstate Highway
MO	I 155	I 155	PEMISCOT	Interstate Highway
MO	I 170	I 170	ST. LOUIS	Interstate Highway
MO	I 229	I 229	ANDREW	Interstate Highway
MO	I 229	I 229	BUCHANAN	Interstate Highway
MO	I 255	I 255	ST. LOUIS	Interstate Highway
MO	I 270	I 270	ST. LOUIS	Interstate Highway
MO	I 270	I 270	ST. LOUIS CITY	Interstate Highway
MO	I 29	I 29	ANDREW	Interstate Highway
MO	I 29	I 29	ATCHISON	Interstate Highway
MO	I 29	I 29	BUCHANAN	Interstate Highway
MO	I 29	I 29	CLAY	Interstate Highway
MO	I 29	I 29	HOLT	Interstate Highway
MO	I 29	I 29	JACKSON	Interstate Highway
MO	I 29	I 29	PLATTE	Interstate Highway
MO	I 35	I 35	CALDWELL	Interstate Highway
MO	I 35	I 35	CLAY	Interstate Highway
MO	I 35	I 35	CLINTON	Interstate Highway
MO	I 35	I 35	DAVIESS	Interstate Highway
MO	I 35	I 35	DEKALB	Interstate Highway

MO	I 35	I 35	HARRISON	Interstate Highway
MO	I 35	I 35	JACKSON	Interstate Highway
MO	I 435	I 435	CLAY	Interstate Highway
MO	I 435	I 435	JACKSON	Interstate Highway
MO	I 435	I 435	PLATTE	Interstate Highway
MO	I 44	I 44	CRAWFORD	Interstate Highway
MO	I 44	I 44	FRANKLIN	Interstate Highway
MO	I 44	I 44	GREENE	Interstate Highway
MO	I 44	I 44	JASPER	Interstate Highway
MO	I 44	I 44	LACLEDE	Interstate Highway
MO	I 44	I 44	LAWRENCE	Interstate Highway
MO	I 44	I 44	NEWTON	Interstate Highway
MO	I 44	I 44	PHELPS	Interstate Highway
MO	I 44	I 44	PULASKI	Interstate Highway
MO	I 44	I 44	ST. LOUIS	Interstate Highway
MO	I 44	I 44	ST. LOUIS CITY	Interstate Highway
MO	I 44	I 44	WEBSTER	Interstate Highway
MO	I 470	I 470	JACKSON	Interstate Highway
MO	I 49	I 49	BARTON	Interstate Highway
MO	I 49	I 49	BATES	Interstate Highway
MO	I 49	I 49	CASS	Interstate Highway
MO	I 49	I 49	JACKSON	Interstate Highway
MO	I 49	I 49	JASPER	Interstate Highway
MO	I 49	I 49	MCDONALD	Interstate Highway
MO	I 49	I 49	NEWTON	Interstate Highway
MO	I 49	I 49	VERNON	Interstate Highway
MO	I 55	I 55	CAPE GIRARDEAU	Interstate Highway
MO	I 55	I 55	JEFFERSON	Interstate Highway
MO	I 55	I 55	NEW MADRID	Interstate Highway
MO	I 55	I 55	PEMISCOT	Interstate Highway
MO	I 55	I 55	PERRY	Interstate Highway

MO	I 55	I 55	SCOTT	Interstate Highway
MO	I 55	I 55	ST. LOUIS	Interstate Highway
MO	I 55	I 55	ST. LOUIS CITY	Interstate Highway
MO	I 64	I 55	ST. LOUIS CITY	Interstate Highway
MO	I 55	I 55	STE. GENEVIEVE	Interstate Highway
MO	I 57	I 57	MISSISSIPPI	Interstate Highway
MO	I 57	I 57	SCOTT	Interstate Highway
MO	I 635	I 635	PLATTE	Interstate Highway
MO	I 64	I 64	ST. CHARLES	Interstate Highway
MO	I 64	I 64	ST. LOUIS	Interstate Highway
MO	I 64	I 64	ST. LOUIS CITY	Interstate Highway
MO	I 670	I 670	JACKSON	Interstate Highway
MO	I 70	I 70	BOONE	Interstate Highway
MO	I 70	I 70	CALLAWAY	Interstate Highway
MO	I 70	I 70	COOPER	Interstate Highway
MO	I 70	I 70	JACKSON	Interstate Highway
MO	I 70	I 70	LAFAYETTE	Interstate Highway
MO	I 70	I 70	MONTGOMERY	Interstate Highway
MO	I 70	I 70	SALINE	Interstate Highway
MO	I 70	I 70	ST. CHARLES	Interstate Highway
MO	I 70	I 70	ST. LOUIS	Interstate Highway
MO	I 70	I 70	ST. LOUIS CITY	Interstate Highway
MO	I 70	I 70	WARREN	Interstate Highway
MO	I 72	I 72	MARION	Interstate Highway
MO	US 71	US 71	JACKSON	Other Controlled Access Highway
MO	JAMES RD		MARION	Arterial or Major Collector
MS	I 10	I 10	HANCOCK	Interstate Highway
MS	I 10	I 10	HARRISON	Interstate Highway
MS	I 10	I 10	JACKSON	Interstate Highway
MS	I 110	I 110	HARRISON	Interstate Highway
MS	I 20	I 20	HINDS	Interstate Highway

MS	I 20	I 20	LAUDERDALE	Interstate Highway
MS	I 20	I 20	NEWTON	Interstate Highway
MS	I 20	I 20	RANKIN	Interstate Highway
MS	I 20	I 20	SCOTT	Interstate Highway
MS	I 20	I 20	WARREN	Interstate Highway
MS	I 22	I 22	BENTON	Interstate Highway
MS	I 22	I 22	ITAWAMBA	Interstate Highway
MS	I 22	I 22	LEE	Interstate Highway
MS	I 22	I 22	MARSHALL	Interstate Highway
MS	I 22	I 22	PONTOTOC	Interstate Highway
MS	I 22	I 22	UNION	Interstate Highway
MS	I 220	I 220	HINDS	Interstate Highway
MS	I 220	I 220	MADISON	Interstate Highway
MS	I 269	I 269	DESOTO	Interstate Highway
MS	I 269	I 269	MARSHALL	Interstate Highway
MS	I 55	I 55	CARROLL	Interstate Highway
MS	I 55	I 55	COPIAH	Interstate Highway
MS	I 55	I 55	DESOTO	Interstate Highway
MS	I 55	I 55	GRENADA	Interstate Highway
MS	I 55	I 55	HINDS	Interstate Highway
MS	I 55	I 55	HOLMES	Interstate Highway
MS	I 55	I 55	LINCOLN	Interstate Highway
MS	I 55	I 55	MADISON	Interstate Highway
MS	I 55	I 55	MONTGOMERY	Interstate Highway
MS	I 55	I 55	PANOLA	Interstate Highway
MS	I 55	I 55	PIKE	Interstate Highway
MS	I 55	I 55	RANKIN	Interstate Highway
MS	I 55	I 55	TATE	Interstate Highway
MS	I 55	I 55	YALOBUSHA	Interstate Highway
MS	I 55	I 55	YAZOO	Interstate Highway
MS	I 59	I 59	CLARKE	Interstate Highway

MS	I 59	I 59	FORREST	Interstate Highway
MS	I 59	I 59	JASPER	Interstate Highway
MS	I 59	I 59	JONES	Interstate Highway
MS	I 59	I 59	LAMAR	Interstate Highway
MS	I 59	I 59	LAUDERDALE	Interstate Highway
MS	I 59	I 59	PEARL RIVER	Interstate Highway
MS	I 65	I 65	HINDS	Interstate Highway
MS	I 65	I 65	SCOTT	Interstate Highway
MS	I 69	I 69	DESOTO	Interstate Highway
MS	CANAL RD		HARRISON	Arterial or Major Collector
MS	FORTIFICATION ST		HINDS	Arterial or Major Collector
MT	I 115	I 115	SILVER BOW	Interstate Highway
MT	I 15	I 15	BEAVERHEAD	Interstate Highway
MT	I 15	I 15	CASCADE	Interstate Highway
MT	I 15	I 15	JEFFERSON	Interstate Highway
MT	I 15	I 15	LEWIS AND CLARK	Interstate Highway
MT	I 15	I 15	MADISON	Interstate Highway
MT	I 15	I 15	PONDERA	Interstate Highway
MT	I 15	I 15	SILVER BOW	Interstate Highway
MT	I 15	I 15	TETON	Interstate Highway
MT	I 15	I 15	TOOLE	Interstate Highway
MT	I 315	I 315	CASCADE	Interstate Highway
MT	I 90	I 90	BIG HORN	Interstate Highway
MT	I 90	I 90	BROADWATER	Interstate Highway
MT	I 90	I 90	DEER LODGE	Interstate Highway
MT	I 90	I 90	GALLATIN	Interstate Highway
MT	I 90	I 90	GRANITE	Interstate Highway
MT	I 90	I 90	JEFFERSON	Interstate Highway
MT	I 90	I 90	MINERAL	Interstate Highway
MT	I 90	I 90	MISSOULA	Interstate Highway
MT	I 90	I 90	PARK	Interstate Highway

MT	I 90	I 90	POWELL	Interstate Highway
MT	I 90	I 90	SILVER BOW	Interstate Highway
MT	I 90	I 90	STILLWATER	Interstate Highway
MT	I 90	I 90	SWEET GRASS	Interstate Highway
MT	I 90	I 90	YELLOWSTONE	Interstate Highway
MT	I 94	I 94	CUSTER	Interstate Highway
MT	I 94	I 94	DAWSON	Interstate Highway
MT	I 94	I 94	PRAIRIE	Interstate Highway
MT	I 94	I 94	ROSEBUD	Interstate Highway
MT	I 94	I 94	TREASURE	Interstate Highway
MT	I 94	I 94	WIBAUX	Interstate Highway
MT	I 94	I 94	YELLOWSTONE	Interstate Highway
NC	JOHN JAY BURNEY JR FWY	I 140	BRUNSWICK	Interstate Highway
NC	JOHN JAY BURNEY JR FWY	I 140	NEW HANOVER	Interstate Highway
NC	I 240	I 240	BUNCOMBE	Interstate Highway
NC	I 26	I 26	BUNCOMBE	Interstate Highway
NC	I 26	I 26	HENDERSON	Interstate Highway
NC	I 26	I 26	MADISON	Interstate Highway
NC	I 26	I 26	POLK	Interstate Highway
NC	I 277	I 277	MECKLENBURG	Interstate Highway
NC	I 285	I 285	FORSYTH	Interstate Highway
NC	I 295	I 295	CUMBERLAND	Interstate Highway
NC	I 40	I 40	ALAMANCE	Interstate Highway
NC	I 40	I 40	BUNCOMBE	Interstate Highway
NC	I 40	I 40	BURKE	Interstate Highway
NC	I 40	I 40	CATAWBA	Interstate Highway
NC	I 40	I 40	DAVIE	Interstate Highway
NC	I 40	I 40	DUPLIN	Interstate Highway
NC	I 40	I 40	DURHAM	Interstate Highway
NC	I 40	I 40	FORSYTH	Interstate Highway
NC	I 40	I 40	GUILFORD	Interstate Highway

NC	I 40	I 40	HAYWOOD	Interstate Highway
NC	I 40	I 40	IREDELL	Interstate Highway
NC	I 40	I 40	JOHNSTON	Interstate Highway
NC	I 40	I 40	MCDOWELL	Interstate Highway
NC	I 40	I 40	NEW HANOVER	Interstate Highway
NC	I 40	I 40	ORANGE	Interstate Highway
NC	I 40	I 40	PENDER	Interstate Highway
NC	I 40	I 40	SAMPSON	Interstate Highway
NC	I 40	I 40	WAKE	Interstate Highway
NC	I 40 BUSINESS	I 40 B	FORSYTH	Other Controlled Access Highway
NC	I 440	I 440	WAKE	Interstate Highway
NC	CHARLOTTE BELTWAY	I 485	MECKLENBURG	Interstate Highway
NC	I 540	I 540	DURHAM	Interstate Highway
NC	I 540	I 540	WAKE	Interstate Highway
NC	I 73	I 73	GUILFORD	Interstate Highway
NC	I 73	I 73	MONTGOMERY	Interstate Highway
NC	I 73	I 73	RANDOLPH	Interstate Highway
NC	I 73	I 73	RICHMOND	Interstate Highway
NC	I 73	I 73	ROCKINGHAM	Interstate Highway
NC	I 74	I 74	FORSYTH	Interstate Highway
NC	I 74	I 74	GUILFORD	Interstate Highway
NC	I 74	I 74	RANDOLPH	Interstate Highway
NC	I 74	I 74	ROBESON	Interstate Highway
NC	I 74	I 74	SURRY	Interstate Highway
NC	I 77	I 77	IREDELL	Interstate Highway
NC	I 77	I 77	MECKLENBURG	Interstate Highway
NC	I 77	I 77	SURRY	Interstate Highway
NC	I 77	I 77	YADKIN	Interstate Highway
NC	I 785	I 785	GUILFORD	Interstate Highway
NC	I 795	I 795	WAYNE	Interstate Highway
NC	I 795	I 795	WILSON	Interstate Highway

NC	I 840	I 840	GUILFORD	Interstate Highway
NC	I 85	I 85	CABARRUS	Interstate Highway
NC	I 85	I 85	CLEVELAND	Interstate Highway
NC	I 85	I 85	DAVIDSON	Interstate Highway
NC	I 85	I 85	DURHAM	Interstate Highway
NC	I 85	I 85	GASTON	Interstate Highway
NC	I 85	I 85	GRANVILLE	Interstate Highway
NC	I 85	I 85	GUILFORD	Interstate Highway
NC	I 85	I 85	MECKLENBURG	Interstate Highway
NC	I 85	I 85	ORANGE	Interstate Highway
NC	I 85	I 85	RANDOLPH	Interstate Highway
NC	I 85	I 85	ROWAN	Interstate Highway
NC	I 85	I 85	VANCE	Interstate Highway
NC	I 85	I 85	WARREN	Interstate Highway
NC	I 87	I 87	WAKE	Interstate Highway
NC	I 95	I 95	CUMBERLAND	Interstate Highway
NC	I 95	I 95	HALIFAX	Interstate Highway
NC	I 95	I 95	HARNETT	Interstate Highway
NC	I 95	I 95	JOHNSTON	Interstate Highway
NC	I 95	I 95	NASH	Interstate Highway
NC	I 95	I 95	NORTHAMPTON	Interstate Highway
NC	I 95	I 95	ROBESON	Interstate Highway
NC	I 95	I 95	WILSON	Interstate Highway
NC	WEST MARKET ST	NC 1008	GUILFORD	Arterial or Major Collector
NC	GALLIMORE DAIRY RD	NC 1556	GUILFORD	Arterial or Major Collector
NC	BRAGG BLVD	NC 24	CUMBERLAND	Arterial or Major Collector
NC	NC 24	NC 24	CUMBERLAND	Other Controlled Access Highway
NC	NC 68	NC 68	GUILFORD	Arterial or Major Collector
NC	BRAGG BLVD	SR 24	CUMBERLAND	Arterial or Major Collector
NC	US 1	US 1	WAKE	Other Controlled Access Highway

NC	US 17	US 17	BRUNSWICK	Arterial or Major Collector
NC	US 17	US 17	NEW HANOVER	Interstate Highway
NC	US 19	US 19	BUNCOMBE	Other Controlled Access Highway
NC	FREEMAN MILL RD	US 220	GUILFORD	Other Controlled Access Highway
NC	US 220	US 220	GUILFORD	Other Controlled Access Highway
NC	US 29	US 29	GUILFORD	Other Controlled Access Highway
NC	O HENRY BLVD	US 29	GUILFORD	Other Controlled Access Highway
NC	MLK JR DR	US 311	FORSYTH	Arterial or Major Collector
NC	US 421	US 421	NEW HANOVER	Arterial or Major Collector
NC	CAROLINA BEACH RD	US 421	NEW HANOVER	Arterial or Major Collector
NC	US 52	US 52	FORSYTH	Other Controlled Access Highway
NC	US 70	US 70	JOHNSTON	Arterial or Major Collector
NC	US 70 BYPASS	US 70 P	JOHNSTON	Arterial or Major Collector
NC	INDEPENDENCE BLVD	US 74	MECKLENBURG	Arterial or Major Collector
NC	US 74	US 74	ROBESON	Interstate Highway
NC	US 74 ALTERNATE	US 74 A	BUNCOMBE	Arterial or Major Collector
NC	US 76	US 76	BRUNSWICK	Other Controlled Access Highway
NC	US 76	US 76	NEW HANOVER	Other Controlled Access Highway
NC	RANDOLPH ST		CUMBERLAND	Arterial or Major Collector
NC	N BREVARD ST		MECKLENBURG	Arterial or Major Collector
NC	FRONT ST		NEW HANOVER	Arterial or Major Collector
ND	I 194	I 194	MORTON	Interstate Highway
ND	I 29	I 29	CASS	Interstate Highway
ND	I 29	I 29	GRAND FORKS	Interstate Highway
ND	I 29	I 29	PEMBINA	Interstate Highway
ND	I 29	I 29	RICHLAND	Interstate Highway
ND	I 29	I 29	TRAILL	Interstate Highway

ND	I 29	I 29	WALSH	Interstate Highway
ND	I 94	I 94	BARNES	Interstate Highway
ND	I 94	I 94	BILLINGS	Interstate Highway
ND	I 94	I 94	BURLEIGH	Interstate Highway
ND	I 94	I 94	CASS	Interstate Highway
ND	I 94	I 94	GOLDEN VALLEY	Interstate Highway
ND	I 94	I 94	KIDDER	Interstate Highway
ND	I 94	I 94	MORTON	Interstate Highway
ND	I 94	I 94	STARK	Interstate Highway
ND	I 94	I 94	STUTSMAN	Interstate Highway
ND	US 2	US 2	GRAND FORKS	Arterial or Major Collector
NE	I 129	I 129	DAKOTA	Interstate Highway
NE	I 180	I 180	LANCASTER	Interstate Highway
NE	I 480	I 480	DOUGLAS	Interstate Highway
NE	I 680	I 680	DOUGLAS	Interstate Highway
NE	I 76	I 76	DEUEL	Interstate Highway
NE	I 80	I 80	BUFFALO	Interstate Highway
NE	I 80	I 80	CASS	Interstate Highway
NE	I 80	I 80	CHEYENNE	Interstate Highway
NE	I 80	I 80	DAWSON	Interstate Highway
NE	I 80	I 80	DEUEL	Interstate Highway
NE	I 80	I 80	DOUGLAS	Interstate Highway
NE	I 80	I 80	HALL	Interstate Highway
NE	I 80	I 80	HAMILTON	Interstate Highway
NE	I 80	I 80	KEITH	Interstate Highway
NE	I 80	I 80	KIMBALL	Interstate Highway
NE	I 80	I 80	LANCASTER	Interstate Highway
NE	I 80	I 80	LINCOLN	Interstate Highway
NE	I 80	I 80	SARPY	Interstate Highway
NE	I 80	I 80	SEWARD	Interstate Highway
NE	I 80	I 80	YORK	Interstate Highway

NH	I 293	I 293	HILLSBOROUGH	Interstate Highway
NH	F E EVERETT TPKE	I 293	HILLSBOROUGH	Interstate Highway
NH	F E EVERETT TPKE	I 293	MERRIMACK	Interstate Highway
NH	I 393	I 393	MERRIMACK	Interstate Highway
NH	I 89	I 89	GRAFTON	Interstate Highway
NH	I 89	I 89	MERRIMACK	Interstate Highway
NH	I 89	I 89	SULLIVAN	Interstate Highway
NH	I 93	I 93	BELKNAP	Interstate Highway
NH	I 93	I 93	GRAFTON	Interstate Highway
NH	I 93	I 93	HILLSBOROUGH	Interstate Highway
NH	F E EVERETT TPKE	I 93	MERRIMACK	Interstate Highway
NH	I 93	I 93	MERRIMACK	Interstate Highway
NH	I 93	I 93	ROCKINGHAM	Interstate Highway
NH	BLUE STAR TPKE	I 95	ROCKINGHAM	Interstate Highway
NJ	I 195	I 195	MERCER	Interstate Highway
NJ	I 195	I 195	MONMOUTH	Interstate Highway
NJ	I 195	I 195	OCEAN	Interstate Highway
NJ	I 278	I 278	UNION	Interstate Highway
NJ	I 280	I 280	ESSEX	Interstate Highway
NJ	I 280	I 280	HUDSON	Interstate Highway
NJ	I 280	I 280	MORRIS	Interstate Highway
NJ	I 287	I 287	BERGEN	Interstate Highway
NJ	I 287	I 287	MIDDLESEX	Interstate Highway
NJ	I 287	I 287	MORRIS	Interstate Highway
NJ	I 287	I 287	PASSAIC	Interstate Highway
NJ	I 287	I 287	SOMERSET	Interstate Highway
NJ	I 295	I 295	BURLINGTON	Interstate Highway
NJ	I 295	I 295	CAMDEN	Interstate Highway
NJ	I 295	I 295	GLOUCESTER	Interstate Highway
NJ	I 295	I 295	MERCER	Interstate Highway
NJ	I 295	I 295	SALEM	Interstate Highway

NJ	I 676	I 676	CAMDEN	Interstate Highway
NJ	I 676 - BEN FRANKLIN BRG TOLL PLAZA	I 676	CAMDEN	Interstate Highway
NJ	NORTH-SOUTH FWY	I 76	CAMDEN	Interstate Highway
NJ	I 76	I 76	CAMDEN	Interstate Highway
NJ	I 78	I 78	ESSEX	Interstate Highway
NJ	NEWARK BAY BRIDGE	I 78	ESSEX	Interstate Highway
NJ	I 78 - NEWARK EB TOLL PLAZA	I 78	ESSEX	Interstate Highway
NJ	NEWARK BAY BRIDGE	I 78	HUDSON	Interstate Highway
NJ	I 78	I 78	HUDSON	Interstate Highway
NJ	HOLLAND TUNNEL	I 78	HUDSON	Interstate Highway
NJ	I 78	I 78	HUNTERDON	Interstate Highway
NJ	I 78	I 78	SOMERSET	Interstate Highway
NJ	I 78	I 78	UNION	Interstate Highway
NJ	I 78	I 78	WARREN	Interstate Highway
NJ	I 80	I 80	BERGEN	Interstate Highway
NJ	I 80	I 80	ESSEX	Interstate Highway
NJ	I 80	I 80	MORRIS	Interstate Highway
NJ	I 80 - LOCAL LANES	I 80	MORRIS	Interstate Highway
NJ	I 80 - EXPRESS LANES	I 80	MORRIS	Interstate Highway
NJ	I 80	I 80	PASSAIC	Interstate Highway
NJ	I 80	I 80	SUSSEX	Interstate Highway
NJ	I 80	I 80	WARREN	Interstate Highway
NJ	I 95 EXT - LOCAL LANES	I 95	BERGEN	Interstate Highway
NJ	NEW JERSEY TPKE - EASTERN SPUR	I 95	BERGEN	Interstate Highway
NJ	I 95 NB APPROACH to I 80	I 95	BERGEN	Interstate Highway
NJ	NEW JERSEY TPKE - WESTERN SPUR	I 95	BERGEN	Interstate Highway
NJ	NEW JERSEY TPKE - I 95 EXT	I 95	BERGEN	Interstate Highway
NJ	I 95 EXT - EXPRESS LANES	I 95	BERGEN	Interstate Highway
NJ	GEORGE WASHINGTON BRG - LOWER DECK APPROACH	I 95	BERGEN	Interstate Highway
NJ	GEORGE WASHINGTON BRG - LOWER DECK	I 95	BERGEN	Interstate Highway

NJ	GEORGE WASHINGTON BRG - UPPER DECK	I 95	BERGEN	Interstate Highway
NJ	GEORGE WASHINGTON BRG - UPPER DECK APPROACH	I 95	BERGEN	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	BURLINGTON	Interstate Highway
NJ	I 95	I 95	BURLINGTON	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	ESSEX	Interstate Highway
NJ	NEW JERSEY TPKE - EASTERN SPUR	I 95	ESSEX	Interstate Highway
NJ	NEW JERSEY TPKE - WESTERN SPUR	I 95	ESSEX	Interstate Highway
NJ	NEW JERSEY TPKE - EASTERN SPUR	I 95	HUDSON	Interstate Highway
NJ	NEW JERSEY TPKE - WESTERN SPUR	I 95	HUDSON	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	MERCER	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	MIDDLESEX	Interstate Highway
NJ	NEW JERSEY TPKE	I 95	UNION	Interstate Highway
NJ	NJ 29	NJ 29	MERCER	Other Controlled Access Highway
NJ	US 1 - LOCAL LANES	US 1	ESSEX	Other Controlled Access Highway
NJ	US 1	US 1	MERCER	Other Controlled Access Highway
NJ	I 76 CONNECTOR		CAMDEN	Other Controlled Access Highway
NM	I 10	I 10	DOÃ‘A ANA	Interstate Highway
NM	I 10	I 10	GRANT	Interstate Highway
NM	I 10	I 10	HIDALGO	Interstate Highway
NM	I 10	I 10	LUNA	Interstate Highway
NM	I 25	I 25	BERNALILLO	Interstate Highway
NM	I 25	I 25	COLFAX	Interstate Highway
NM	I 25	I 25	DOÃ‘A ANA	Interstate Highway
NM	I 25	I 25	MORA	Interstate Highway
NM	I 25	I 25	SAN MIGUEL	Interstate Highway
NM	I 25	I 25	SANDOVAL	Interstate Highway
NM	I 25	I 25	SANTA FE	Interstate Highway
NM	I 25	I 25	SIERRA	Interstate Highway

NM	I 25	I 25	SOCORRO	Interstate Highway
NM	I 25	I 25	VALENCIA	Interstate Highway
NM	I 40	I 40	BERNALILLO	Interstate Highway
NM	I 40	I 40	CIBOLA	Interstate Highway
NM	I 40	I 40	GUADALUPE	Interstate Highway
NM	I 40	I 40	MCKINLEY	Interstate Highway
NM	I 40	I 40	QUAY	Interstate Highway
NM	I 40	I 40	SANTA FE	Interstate Highway
NM	I 40	I 40	TORRANCE	Interstate Highway
NM	SUNPORT BLVD		BERNALILLO	Arterial or Major Collector
NV	I 11	I 11	CLARK	Interstate Highway
NV	I 15	I 15	CLARK	Interstate Highway
NV	I 215	I 215	CLARK	Interstate Highway
NV	I 515	I 515	CLARK	Interstate Highway
NV	I 580	I 580	CARSON CITY	Interstate Highway
NV	I 580	I 580	WASHOE	Interstate Highway
NV	I 80	I 80	CHURCHILL	Interstate Highway
NV	I 80	I 80	ELKO	Interstate Highway
NV	I 80	I 80	EUREKA	Interstate Highway
NV	I 80	I 80	HUMBOLDT	Interstate Highway
NV	I 80	I 80	LANDER	Interstate Highway
NV	I 80	I 80	LYON	Interstate Highway
NV	I 80	I 80	PERSHING	Interstate Highway
NV	I 80	I 80	STOREY	Interstate Highway
NV	I 80	I 80	WASHOE	Interstate Highway
NV	US 93	US 93	CLARK	Interstate Highway
NV	US 95	US 95	CLARK	Other Controlled Access Highway
NY	NIAGARA THWY	I 190	ERIE	Interstate Highway
NY	NIAGARA EXPY	I 190	NIAGARA	Interstate Highway
NY	I 278	I 278	BRONX	Interstate Highway
NY	RFK TRIBOROUGH BRG	I 278	BRONX	Interstate Highway

NY	GOWANUS EXPY	I 278	KINGS	Interstate Highway
NY	BROOKLYN-QUEENS EXPY	I 278	KINGS	Interstate Highway
NY	VERRAZANO-NARROWS BRG - UPPER DECK APPROACH LANE	I 278	KINGS	Interstate Highway
NY	VERRAZANO-NARROWS BRG - UPPER DECK	I 278	KINGS	Interstate Highway
NY	RFK TRIBOROUGH BRG	I 278	NEW YORK	Interstate Highway
NY	RFK TRIBOROUGH BRG	I 278	QUEENS	Interstate Highway
NY	BROOKLYN-QUEENS EXPY	I 278	QUEENS	Interstate Highway
NY	GRAND CENTRAL PKWY	I 278	QUEENS	Interstate Highway
NY	I 278	I 278	RICHMOND	Interstate Highway
NY	VERRAZANO-NARROWS BRG - UPPER DECK APPROACH LANE	I 278	RICHMOND	Interstate Highway
NY	VERRAZANO-NARROWS BRG - LOWER DECK APPROACH LANE	I 278	RICHMOND	Interstate Highway
NY	VERRAZANO-NARROWS BRG - UPPER DECK	I 278	RICHMOND	Interstate Highway
NY	I 287	I 287	ROCKLAND	Interstate Highway
NY	CROSS-WESTCHESTER EXPY	I 287	WESTCHESTER	Interstate Highway
NY	I 290	I 290	ERIE	Interstate Highway
NY	CLEARVIEW EXPY	I 295	BRONX	Interstate Highway
NY	THROGS NECK BRG	I 295	BRONX	Interstate Highway
NY	CLEARVIEW EXPY	I 295	QUEENS	Interstate Highway
NY	THROGS NECK BRG	I 295	QUEENS	Interstate Highway
NY	GENESEE EXPY	I 390	LIVINGSTON	Interstate Highway
NY	GENESEE EXPY	I 390	MONROE	Interstate Highway
NY	ROCHESTER OUTER LP	I 390	MONROE	Interstate Highway
NY	GENESEE EXPY	I 390	STEUBEN	Interstate Highway
NY	BROOKLYN-BATTERY TUNNEL	I 478	KINGS	Interstate Highway
NY	BROOKLYN-BATTERY TUNNEL	I 478	NEW YORK	Interstate Highway
NY	I 481	I 481	ONONDAGA	Interstate Highway
NY	I 490	I 490	GENESEE	Interstate Highway
NY	I 490	I 490	MONROE	Interstate Highway

NY	I 490	I 490	ONTARIO	Interstate Highway
NY	LONG ISLAND EXPY	I 495	NASSAU	Interstate Highway
NY	QUEENS-MIDTOWN TUNNEL	I 495	NEW YORK	Interstate Highway
NY	HORACE HARDING EXPY	I 495	QUEENS	Interstate Highway
NY	QUEENS-MIDTOWN EXPY	I 495	QUEENS	Interstate Highway
NY	QUEENS-MIDTOWN TUNNEL	I 495	QUEENS	Interstate Highway
NY	LONG ISLAND EXPY	I 495	SUFFOLK	Interstate Highway
NY	I 590	I 590	MONROE	Interstate Highway
NY	BRONX-WHITESTONE BRG	I 678	BRONX	Interstate Highway
NY	I 678	I 678	BRONX	Interstate Highway
NY	I 678	I 678	QUEENS	Interstate Highway
NY	BRONX-WHITESTONE BRG	I 678	QUEENS	Interstate Highway
NY	I 684	I 684	PUTNAM	Interstate Highway
NY	I 684	I 684	WESTCHESTER	Interstate Highway
NY	I 690	I 690	ONONDAGA	Interstate Highway
NY	THROGS NECK EXPY	I 695	BRONX	Interstate Highway
NY	HOLLAND TUNNEL	I 78	NEW YORK	Interstate Highway
NY	I 781	I 781	JEFFERSON	Interstate Highway
NY	I 787	I 787	ALBANY	Interstate Highway
NY	I 787	I 787	RENSSELAER	Other Controlled Access Highway
NY	I 790	I 790	ONEIDA	Interstate Highway
NY	I 81	I 81	BROOME	Interstate Highway
NY	I 81	I 81	CORTLAND	Interstate Highway
NY	I 81	I 81	JEFFERSON	Interstate Highway
NY	I 81	I 81	ONONDAGA	Interstate Highway
NY	I 81	I 81	OSWEGO	Interstate Highway
NY	I 84	I 84	DUTCHESS	Interstate Highway
NY	I 84	I 84	ORANGE	Interstate Highway
NY	I 84	I 84	PUTNAM	Interstate Highway
NY	SOUTHERN TIER EXPY	I 86	ALLEGANY	Interstate Highway
NY	QUICKWAY	I 86	BROOME	Interstate Highway

NY	SOUTHERN TIER EXPY	I 86	CATTARAUGUS	Interstate Highway
NY	SOUTHERN TIER EXPY	I 86	CHAUTAUQUA	Interstate Highway
NY	SOUTHERN TIER EXPY	I 86	CHEMUNG	Other Controlled Access Highway
NY	SOUTHERN TIER EXPY	I 86	STEUBEN	Interstate Highway
NY	SOUTHERN TIER EXPY	I 86	TIOGA	Other Controlled Access Highway
NY	NEW YORK STATE THWY	I 87	ALBANY	Interstate Highway
NY	ADIRONDACK NORTHWAY	I 87	ALBANY	Interstate Highway
NY	I 87/I 90	I 87	ALBANY	Interstate Highway
NY	I 87	I 87	ALBANY	Interstate Highway
NY	I 87	I 87	BRONX	Interstate Highway
NY	MAJOR DEEGAN EXPY	I 87	BRONX	Interstate Highway
NY	ADIRONDACK NORTHWAY	I 87	CLINTON	Interstate Highway
NY	ADIRONDACK NORTHWAY	I 87	ESSEX	Interstate Highway
NY	NEW YORK STATE THWY	I 87	GREENE	Interstate Highway
NY	NEW YORK STATE THWY	I 87	ORANGE	Interstate Highway
NY	NEW YORK STATE THWY	I 87	ROCKLAND	Interstate Highway
NY	TAPPAN ZEE BRG	I 87	ROCKLAND	Interstate Highway
NY	ADIRONDACK NORTHWAY	I 87	SARATOGA	Interstate Highway
NY	NEW YORK STATE THWY	I 87	ULSTER	Interstate Highway
NY	ADIRONDACK NORTHWAY	I 87	WARREN	Interstate Highway
NY	NEW YORK STATE THWY	I 87	WESTCHESTER	Interstate Highway
NY	TAPPAN ZEE BRG	I 87	WESTCHESTER	Interstate Highway
NY	I 88	I 88	BROOME	Interstate Highway
NY	I 88	I 88	CHENANGO	Interstate Highway
NY	I 88	I 88	DELAWARE	Interstate Highway
NY	I 88	I 88	OTSEGO	Interstate Highway
NY	I 88	I 88	SCHENECTADY	Interstate Highway
NY	I 88	I 88	SCHOHARIE	Interstate Highway
NY	I 890	I 890	ALBANY	Interstate Highway
NY	I 890	I 890	SCHENECTADY	Interstate Highway

NY	NEW YORK STATE THWY	I 90	ALBANY	Interstate Highway
NY	I 90	I 90	ALBANY	Interstate Highway
NY	NEW YORK STATE THWY	I 90	CAYUGA	Interstate Highway
NY	NEW YORK STATE THWY	I 90	CHAUTAUQUA	Interstate Highway
NY	BERKSHIRE CONNECTOR	I 90	COLUMBIA	Interstate Highway
NY	NEW YORK STATE THWY	I 90	ERIE	Interstate Highway
NY	NEW YORK STATE THWY	I 90	GENESEE	Interstate Highway
NY	NEW YORK STATE THWY	I 90	HERKIMER	Interstate Highway
NY	NEW YORK STATE THWY	I 90	MADISON	Interstate Highway
NY	NEW YORK STATE THWY	I 90	MONROE	Interstate Highway
NY	NEW YORK STATE THWY	I 90	MONTGOMERY	Interstate Highway
NY	NEW YORK STATE THWY	I 90	ONEIDA	Interstate Highway
NY	NEW YORK STATE THWY	I 90	ONONDAGA	Interstate Highway
NY	NEW YORK STATE THWY	I 90	ONTARIO	Interstate Highway
NY	I 90	I 90	RENSSELAER	Interstate Highway
NY	BERKSHIRE CONNECTOR	I 90	RENSSELAER	Interstate Highway
NY	NEW YORK STATE THWY	I 90	SCHENECTADY	Interstate Highway
NY	NEW YORK STATE THWY	I 90	SENECA	Interstate Highway
NY	NEW ENGLAND THWY	I 95	BRONX	Interstate Highway
NY	BRUCKNER EXPY	I 95	BRONX	Interstate Highway
NY	CROSS BRONX EXPY	I 95	BRONX	Interstate Highway
NY	ALEXANDER HAMILTON BRG	I 95	BRONX	Interstate Highway
NY	ALEXANDER HAMILTON BRG	I 95	NEW YORK	Interstate Highway
NY	I 95	I 95	NEW YORK	Interstate Highway
NY	GEORGE WASHINGTON BRIDGE - LOWER	I 95	NEW YORK	Interstate Highway
NY	GEORGE WASHINGTON BRIDGE - UPPER	I 95	NEW YORK	Interstate Highway
NY	NEW ENGLAND THWY	I 95	WESTCHESTER	Interstate Highway
NY	I 99	I 99	STEUBEN	Interstate Highway
NY	I 990	I 990	ERIE	Interstate Highway
NY	W VESTAL PKWY	NY 434	TIOGA	Arterial or Major Collector

NY	SHERIDAN EXPY	NY 895	BRONX	Other Controlled Access Highway
NY	SR 434	SR 434	TIOGA	Arterial or Major Collector
NY	EAST AVE	SR 96	MONROE	Arterial or Major Collector
NY	BRUCKNER EXPY		BRONX	Arterial or Major Collector
NY	I 81/I 86 ACCESS RD		BROOME	Arterial or Major Collector
NY	SHERIDAN DR		ERIE	Arterial or Major Collector
NY	IRAQI FREEDOM DR		JEFFERSON	Facility Access/Circulator Road
NY	39TH ST		KINGS	Arterial or Major Collector
OH	I 270	I 270	FRANKLIN	Interstate Highway
OH	I 271	I 271	CUYAHOGA	Interstate Highway
OH	I 271 - LOCAL LANES	I 271	CUYAHOGA	Interstate Highway
OH	I 271 - LOCAL LANES	I 271	LAKE	Interstate Highway
OH	I 271	I 271	MEDINA	Interstate Highway
OH	I 271	I 271	SUMMIT	Interstate Highway
OH	I 275	I 275	CLERMONT	Interstate Highway
OH	I 275	I 275	HAMILTON	Interstate Highway
OH	I 277	I 277	SUMMIT	Interstate Highway
OH	I 280	I 280	LUCAS	Interstate Highway
OH	I 280	I 280	WOOD	Interstate Highway
OH	I 470	I 470	BELMONT	Interstate Highway
OH	I 471	I 471	HAMILTON	Interstate Highway
OH	I 475	I 475	LUCAS	Interstate Highway
OH	I 475	I 475	WOOD	Interstate Highway
OH	I 480	I 480	CUYAHOGA	Interstate Highway
OH	I 480	I 480	LORAIN	Interstate Highway
OH	I 480	I 480	PORTAGE	Interstate Highway
OH	I 480	I 480	SUMMIT	Interstate Highway
OH	I 480N	I 480N	CUYAHOGA	Interstate Highway
OH	I 490	I 490	CUYAHOGA	Interstate Highway
OH	I 670	I 670	FRANKLIN	Interstate Highway

OH	I 675	I 675	CLARK	Interstate Highway
OH	I 675	I 675	GREENE	Interstate Highway
OH	I 675	I 675	MONTGOMERY	Interstate Highway
OH	I 680	I 680	MAHONING	Interstate Highway
OH	I 70	I 70	BELMONT	Interstate Highway
OH	I 70	I 70	CLARK	Interstate Highway
OH	I 70	I 70	FAIRFIELD	Interstate Highway
OH	I 70	I 70	FRANKLIN	Interstate Highway
OH	I 70	I 70	GUERNSEY	Interstate Highway
OH	I 70	I 70	LICKING	Interstate Highway
OH	I 70	I 70	MADISON	Interstate Highway
OH	I 70	I 70	MONTGOMERY	Interstate Highway
OH	I 70	I 70	MUSKINGUM	Interstate Highway
OH	I 70	I 70	PREBLE	Interstate Highway
OH	I 71	I 71	ASHLAND	Interstate Highway
OH	I 71	I 71	CLINTON	Interstate Highway
OH	I 71	I 71	CUYAHOGA	Interstate Highway
OH	I 71	I 71	DELAWARE	Interstate Highway
OH	I 71	I 71	FAYETTE	Interstate Highway
OH	I 71	I 71	FRANKLIN	Interstate Highway
OH	I 71	I 71	GREENE	Interstate Highway
OH	I 71	I 71	HAMILTON	Interstate Highway
OH	I 71	I 71	MADISON	Interstate Highway
OH	I 71	I 71	MEDINA	Interstate Highway
OH	I 71	I 71	MORROW	Interstate Highway
OH	I 71	I 71	PICKAWAY	Interstate Highway
OH	I 71	I 71	RICHLAND	Interstate Highway
OH	I 71	I 71	WARREN	Interstate Highway
OH	I 71	I 71	WAYNE	Interstate Highway
OH	I 74	I 74	HAMILTON	Interstate Highway
OH	I 75	I 75	ALLEN	Interstate Highway

OH	I 75	I 75	AUGLAIZE	Interstate Highway
OH	I 75	I 75	BUTLER	Interstate Highway
OH	I 75	I 75	HAMILTON	Interstate Highway
OH	I 75	I 75	HANCOCK	Interstate Highway
OH	I 75	I 75	LUCAS	Interstate Highway
OH	I 75	I 75	MIAMI	Interstate Highway
OH	I 75	I 75	MONTGOMERY	Interstate Highway
OH	I 75	I 75	SHELBY	Interstate Highway
OH	I 75	I 75	WARREN	Interstate Highway
OH	I 75	I 75	WOOD	Interstate Highway
OH	I 76	I 76	MAHONING	Interstate Highway
OH	I 76	I 76	MEDINA	Interstate Highway
OH	I 76	I 76	PORTAGE	Interstate Highway
OH	I 76	I 76	SUMMIT	Interstate Highway
OH	I 77	I 77	CUYAHOGA	Interstate Highway
OH	I 77	I 77	GUERNSEY	Interstate Highway
OH	I 77	I 77	NOBLE	Interstate Highway
OH	I 77	I 77	STARK	Interstate Highway
OH	I 77	I 77	SUMMIT	Interstate Highway
OH	I 77	I 77	TUSCARAWAS	Interstate Highway
OH	I 77	I 77	WASHINGTON	Interstate Highway
OH	I 80	I 80	CUYAHOGA	Interstate Highway
OH	I 80	I 80	ERIE	Interstate Highway
OH	I 80	I 80	FULTON	Interstate Highway
OH	I 80	I 80	LORAIN	Interstate Highway
OH	I 80	I 80	LUCAS	Interstate Highway
OH	I 80	I 80	MAHONING	Interstate Highway
OH	I 80	I 80	OTTAWA	Interstate Highway
OH	I 80	I 80	PORTAGE	Interstate Highway
OH	I 80	I 80	SANDUSKY	Interstate Highway
OH	I 80	I 80	SUMMIT	Interstate Highway

OH	I 80	I 80	TRUMBULL	Interstate Highway
OH	I 80	I 80	WILLIAMS	Interstate Highway
OH	I 80	I 80	WOOD	Interstate Highway
OH	I 90	I 90	ASHTABULA	Interstate Highway
OH	I 90	I 90	CUYAHOGA	Interstate Highway
OH	I 90	I 90	LAKE	Interstate Highway
OH	I 90	I 90	LORAIN	Interstate Highway
OH	ORANGE AVE	US 422	CUYAHOGA	Arterial or Major Collector
OH	W 3RD ST		CUYAHOGA	Arterial or Major Collector
OK	I 235	I 235	OKLAHOMA	Interstate Highway
OK	I 240	I 240	OKLAHOMA	Interstate Highway
OK	I 244	I 244	TULSA	Interstate Highway
OK	I 35	I 35	CARTER	Interstate Highway
OK	I 35	I 35	CLEVELAND	Interstate Highway
OK	I 35	I 35	GARVIN	Interstate Highway
OK	I 35	I 35	KAY	Interstate Highway
OK	I 35	I 35	LOGAN	Interstate Highway
OK	I 35	I 35	LOVE	Interstate Highway
OK	I 35	I 35	MCCLAIN	Interstate Highway
OK	I 35	I 35	MURRAY	Interstate Highway
OK	I 35	I 35	NOBLE	Interstate Highway
OK	I 35	I 35	OKLAHOMA	Interstate Highway
OK	I 35	I 35	PAYNE	Interstate Highway
OK	I 40	I 40	BECKHAM	Interstate Highway
OK	I 40	I 40	CADDO	Interstate Highway
OK	I 40	I 40	CANADIAN	Interstate Highway
OK	I 40	I 40	CUSTER	Interstate Highway
OK	I 40	I 40	MCINTOSH	Interstate Highway
OK	I 40	I 40	MUSKOGEE	Interstate Highway
OK	I 40	I 40	OKFUSKEE	Interstate Highway
OK	I 40	I 40	OKLAHOMA	Interstate Highway

OK	I 40	I 40	OKMULGEE	Interstate Highway
OK	I 40	I 40	POTTAWATOMIE	Interstate Highway
OK	I 40	I 40	SEMINOLE	Interstate Highway
OK	I 40	I 40	SEQUOYAH	Interstate Highway
OK	I 40	I 40	WASHITA	Interstate Highway
OK	I 44	I 44	CADDO	Interstate Highway
OK	I 44	I 44	CLEVELAND	Interstate Highway
OK	I 44	I 44	COMANCHE	Interstate Highway
OK	I 44	I 44	COTTON	Interstate Highway
OK	I 44	I 44	CRAIG	Interstate Highway
OK	I 44	I 44	CREEK	Interstate Highway
OK	I 44	I 44	GRADY	Interstate Highway
OK	I 44	I 44	LINCOLN	Interstate Highway
OK	I 44	I 44	MAYES	Interstate Highway
OK	I 44	I 44	MCCLAIN	Interstate Highway
OK	I 44	I 44	OKLAHOMA	Interstate Highway
OK	I 44	I 44	OTTAWA	Interstate Highway
OK	I 44	I 44	ROGERS	Interstate Highway
OK	I 44	I 44	TULSA	Interstate Highway
OK	I 44	I 44	WAGONER	Interstate Highway
OK	I 444	I 444	TULSA	Interstate Highway
OK	SR 266	SR 266	ROGERS	Arterial or Major Collector
OK	CREEK TPKE	SR 364	CREEK	Other Controlled Access Highway
OK	CREEK TPKE	SR 364	TULSA	Other Controlled Access Highway
OK	CREEK TPKE	SR 364	WAGONER	Other Controlled Access Highway
OK	US 412	US 412	ROGERS	Arterial or Major Collector
OK	US 75 A	US 75 A	CREEK	Arterial or Major Collector
OK	N 4150 RD		ROGERS	Local Road
OR	I 105	I 105	LANE	Interstate Highway
OR	I 205	I 205	CLACKAMAS	Interstate Highway

OR	I 205	I 205	MULTNOMAH	Interstate Highway
OR	I 205	I 205	WASHINGTON	Interstate Highway
OR	I 405	I 405	MULTNOMAH	Interstate Highway
OR	I 5	I 5	CLACKAMAS	Interstate Highway
OR	I 5	I 5	DOUGLAS	Interstate Highway
OR	I 5	I 5	JACKSON	Interstate Highway
OR	I 5	I 5	JOSEPHINE	Interstate Highway
OR	I 5	I 5	LANE	Interstate Highway
OR	I 5	I 5	LINN	Interstate Highway
OR	I 5	I 5	MARION	Interstate Highway
OR	I 5	I 5	MULTNOMAH	Interstate Highway
OR	I 5	I 5	WASHINGTON	Interstate Highway
OR	I 82	I 82	UMATILLA	Interstate Highway
OR	I 84	I 84	BAKER	Interstate Highway
OR	I 84	I 84	GILLIAM	Interstate Highway
OR	I 84	I 84	HOOD RIVER	Interstate Highway
OR	I 84	I 84	MALHEUR	Interstate Highway
OR	I 84	I 84	MORROW	Interstate Highway
OR	I 84	I 84	MULTNOMAH	Interstate Highway
OR	I 84	I 84	SHERMAN	Interstate Highway
OR	I 84	I 84	UMATILLA	Interstate Highway
OR	I 84	I 84	UNION	Interstate Highway
OR	I 84	I 84	WASCO	Interstate Highway
OR	US 30	US 30	MULTNOMAH	Other Controlled Access Highway
OR	BELMONT ST		MULTNOMAH	Arterial or Major Collector
PA	I 176	I 176	BERKS	Interstate Highway
PA	I 180	I 180	LYCOMING	Interstate Highway
PA	I 180	I 180	NORTHUMBERLAND	Interstate Highway
PA	I 276	I 276	BUCKS	Interstate Highway
PA	I 276	I 276	MONTGOMERY	Interstate Highway
PA	I 279	I 279	ALLEGHENY	Interstate Highway

PA	I 283	I 283	DAUPHIN	Interstate Highway
PA	I 376	I 376	ALLEGHENY	Interstate Highway
PA	I 376	I 376	BEAVER	Interstate Highway
PA	I 376	I 376	LAWRENCE	Interstate Highway
PA	I 376	I 376	MERCER	Interstate Highway
PA	I 380	I 380	LACKAWANNA	Interstate Highway
PA	I 380	I 380	MONROE	Interstate Highway
PA	I 380	I 380	WAYNE	Interstate Highway
PA	I 476	I 476	BUCKS	Interstate Highway
PA	I 476	I 476	CARBON	Interstate Highway
PA	I 476	I 476	DELAWARE	Interstate Highway
PA	I 476	I 476	LACKAWANNA	Interstate Highway
PA	I 476	I 476	LEHIGH	Interstate Highway
PA	I 476	I 476	LUZERNE	Interstate Highway
PA	I 476	I 476	MONTGOMERY	Interstate Highway
PA	I 579	I 579	ALLEGHENY	Interstate Highway
PA	I 676	I 676	PHILADELPHIA	Interstate Highway
PA	I 70	I 70	BEDFORD	Interstate Highway
PA	I 70	I 70	FULTON	Interstate Highway
PA	I 70	I 70	WASHINGTON	Interstate Highway
PA	I 70	I 70	WESTMORELAND	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	ALLEGHENY	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	BEAVER	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	BEDFORD	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	BERKS	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	BUTLER	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	CHESTER	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	CUMBERLAND	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	DAUPHIN	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	FRANKLIN	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	FULTON	Interstate Highway

PA	PENNSYLVANIA TPKE	I 76	HUNTINGDON	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	LANCASTER	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	LAWRENCE	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	LEBANON	Interstate Highway
PA	SCHUYKILL EXPY	I 76	MONTGOMERY	Interstate Highway
PA	SCHUYKILL EXPY	I 76	PHILADELPHIA	Interstate Highway
PA	WALT WHITMAN BRG	I 76	PHILADELPHIA	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	SOMERSET	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	WESTMORELAND	Interstate Highway
PA	PENNSYLVANIA TPKE	I 76	YORK	Interstate Highway
PA	I 78	I 78	BERKS	Interstate Highway
PA	I 78	I 78	LEBANON	Interstate Highway
PA	I 78	I 78	LEHIGH	Interstate Highway
PA	I 78	I 78	NORTHAMPTON	Interstate Highway
PA	I 79	I 79	ALLEGHENY	Interstate Highway
PA	I 79	I 79	BUTLER	Interstate Highway
PA	I 79	I 79	CRAWFORD	Interstate Highway
PA	I 79	I 79	ERIE	Interstate Highway
PA	I 79	I 79	GREENE	Interstate Highway
PA	I 79	I 79	LAWRENCE	Interstate Highway
PA	I 79	I 79	MERCER	Interstate Highway
PA	I 79	I 79	WASHINGTON	Interstate Highway
PA	I 80	I 80	BUTLER	Interstate Highway
PA	I 80	I 80	CARBON	Interstate Highway
PA	I 80	I 80	CENTRE	Interstate Highway
PA	I 80	I 80	CLARION	Interstate Highway
PA	I 80	I 80	CLEARFIELD	Interstate Highway
PA	I 80	I 80	CLINTON	Interstate Highway
PA	I 80	I 80	COLUMBIA	Interstate Highway
PA	I 80	I 80	JEFFERSON	Interstate Highway
PA	I 80	I 80	LUZERNE	Interstate Highway

PA	I 80	I 80	MERCER	Interstate Highway
PA	I 80	I 80	MONROE	Interstate Highway
PA	I 80	I 80	MONTOUR	Interstate Highway
PA	I 80	I 80	NORTHUMBERLAND	Interstate Highway
PA	I 80	I 80	UNION	Interstate Highway
PA	I 80	I 80	VENANGO	Interstate Highway
PA	I 81	I 81	CUMBERLAND	Interstate Highway
PA	I 81	I 81	DAUPHIN	Interstate Highway
PA	I 81	I 81	FRANKLIN	Interstate Highway
PA	I 81	I 81	LACKAWANNA	Interstate Highway
PA	I 81	I 81	LEBANON	Interstate Highway
PA	I 81	I 81	LUZERNE	Interstate Highway
PA	I 81	I 81	SCHUYLKILL	Interstate Highway
PA	I 81	I 81	SUSQUEHANNA	Interstate Highway
PA	I 83	I 83	CUMBERLAND	Interstate Highway
PA	I 83	I 83	DAUPHIN	Interstate Highway
PA	I 83	I 83	YORK	Interstate Highway
PA	I 84	I 84	LACKAWANNA	Interstate Highway
PA	I 84	I 84	PIKE	Interstate Highway
PA	I 84	I 84	WAYNE	Interstate Highway
PA	I 86	I 86	ERIE	Interstate Highway
PA	I 90	I 90	ERIE	Interstate Highway
PA	I 95	I 95	BUCKS	Interstate Highway
PA	I 95	I 95	DELAWARE	Interstate Highway
PA	I 95	I 95	PHILADELPHIA	Interstate Highway
PA	I 99	I 99	BEDFORD	Interstate Highway
PA	I 99	I 99	BLAIR	Interstate Highway
PA	I 99	I 99	CENTRE	Interstate Highway
PA	PA 423	PA 423	MONROE	Arterial or Major Collector
PA	CLAIRTON BLVD	PA 51	ALLEGHENY	Arterial or Major Collector
PA	MARKET ST	SR 114	CUMBERLAND	Arterial or Major Collector

PA	US 1	US 1	BUCKS	Other Controlled Access Highway
PA	US 15	US 15	LYCOMING	Arterial or Major Collector
PA	US 22	US 22	DAUPHIN	Other Controlled Access Highway
PA	US 30	US 30	LANCASTER	Other Controlled Access Highway
PA	US 30	US 30	YORK	Other Controlled Access Highway
PA	US 322	US 322	DAUPHIN	Other Controlled Access Highway
PA	US 422 BYPASS	US 422 P	BERKS	Other Controlled Access Highway
PA	MONROEVILLE RD		ALLEGHENY	Arterial or Major Collector
PA	BATH ST		PHILADELPHIA	Arterial or Major Collector
PA	VARE ST		PHILADELPHIA	Frontage/Service Road
PA	I 95 NB COLLECTOR/DISTRIBUTOR LANE		PHILADELPHIA	Collector/Distributor Lane
RI	I 195	I 195	PROVIDENCE	Interstate Highway
RI	I 295	I 295	KENT	Interstate Highway
RI	I 295	I 295	PROVIDENCE	Interstate Highway
RI	I 95	I 95	KENT	Interstate Highway
RI	I 95	I 95	PROVIDENCE	Interstate Highway
RI	I 95	I 95	WASHINGTON	Interstate Highway
RI	RI 4	RI 4	KENT	Other Controlled Access Highway
RI	RI 403	RI 403	WASHINGTON	Other Controlled Access Highway
RI	TF GREEN AIRPORT CONNECTOR RD		KENT	Facility Access/Circulator Road
SC	I 126	I 126	RICHLAND	Interstate Highway
SC	SOUTHERN CONNECTOR	I 185	GREENVILLE	Interstate Highway
SC	I 185	I 185	GREENVILLE	Interstate Highway
SC	I 20	I 20	AIKEN	Interstate Highway
SC	I 20	I 20	DARLINGTON	Interstate Highway
SC	I 20	I 20	FLORENCE	Interstate Highway

SC	I 20	I 20	KERSHAW	Interstate Highway
SC	I 20	I 20	LEE	Interstate Highway
SC	I 20	I 20	LEXINGTON	Interstate Highway
SC	I 20	I 20	RICHLAND	Interstate Highway
SC	I 26	I 26	BERKELEY	Interstate Highway
SC	I 26	I 26	CALHOUN	Interstate Highway
SC	I 26	I 26	CHARLESTON	Interstate Highway
SC	I 26	I 26	DORCHESTER	Interstate Highway
SC	I 26	I 26	LAURENS	Interstate Highway
SC	I 26	I 26	LEXINGTON	Interstate Highway
SC	I 26	I 26	NEWBERRY	Interstate Highway
SC	I 26	I 26	ORANGEBURG	Interstate Highway
SC	I 26	I 26	RICHLAND	Interstate Highway
SC	I 26	I 26	SPARTANBURG	Interstate Highway
SC	I 385	I 385	GREENVILLE	Interstate Highway
SC	I 385	I 385	LAURENS	Interstate Highway
SC	I 520	I 520	AIKEN	Interstate Highway
SC	I 526	I 526	BERKELEY	Interstate Highway
SC	I 526	I 526	CHARLESTON	Interstate Highway
SC	I 585	I 585	SPARTANBURG	Interstate Highway
SC	I 77	I 77	CHESTER	Interstate Highway
SC	I 77	I 77	FAIRFIELD	Interstate Highway
SC	I 77	I 77	LEXINGTON	Interstate Highway
SC	I 77	I 77	RICHLAND	Interstate Highway
SC	I 77	I 77	YORK	Interstate Highway
SC	I 85	I 85	ANDERSON	Interstate Highway
SC	I 85	I 85	CHEROKEE	Interstate Highway
SC	I 85	I 85	GREENVILLE	Interstate Highway
SC	I 85	I 85	OCONEE	Interstate Highway
SC	I 85	I 85	SPARTANBURG	Interstate Highway
SC	I 95	I 95	CLARENDON	Interstate Highway

SC	I 95	I 95	COLLETON	Interstate Highway
SC	I 95	I 95	DARLINGTON	Interstate Highway
SC	I 95	I 95	DILLON	Interstate Highway
SC	I 95	I 95	DORCHESTER	Interstate Highway
SC	I 95	I 95	FLORENCE	Interstate Highway
SC	I 95	I 95	HAMPTON	Interstate Highway
SC	I 95	I 95	JASPER	Interstate Highway
SC	I 95	I 95	MARLBORO	Interstate Highway
SC	I 95	I 95	ORANGEBURG	Interstate Highway
SC	I 95	I 95	SUMTER	Interstate Highway
SC	SR 327	SR 327	FLORENCE	Arterial or Major Collector
SD	I 190	I 190	PENNINGTON	Interstate Highway
SD	I 229	I 229	LINCOLN	Interstate Highway
SD	I 229	I 229	MINNEHAHA	Interstate Highway
SD	I 29	I 29	BROOKINGS	Interstate Highway
SD	I 29	I 29	CODINGTON	Interstate Highway
SD	I 29	I 29	DEUEL	Interstate Highway
SD	I 29	I 29	GRANT	Interstate Highway
SD	I 29	I 29	HAMLIN	Interstate Highway
SD	I 29	I 29	LINCOLN	Interstate Highway
SD	I 29	I 29	MINNEHAHA	Interstate Highway
SD	I 29	I 29	MOODY	Interstate Highway
SD	I 29	I 29	ROBERTS	Interstate Highway
SD	I 29	I 29	UNION	Interstate Highway
SD	I 90	I 90	AURORA	Interstate Highway
SD	I 90	I 90	BRULE	Interstate Highway
SD	I 90	I 90	DAVISON	Interstate Highway
SD	I 90	I 90	HANSON	Interstate Highway
SD	I 90	I 90	JACKSON	Interstate Highway
SD	I 90	I 90	JONES	Interstate Highway
SD	I 90	I 90	LAWRENCE	Interstate Highway

SD	I 90	I 90	LYMAN	Interstate Highway
SD	I 90	I 90	MCCOOK	Interstate Highway
SD	I 90	I 90	MEADE	Interstate Highway
SD	I 90	I 90	MINNEHAHA	Interstate Highway
SD	I 90	I 90	PENNINGTON	Interstate Highway
TN	PELLISSIPPI PKWY	I 140	BLOUNT	Interstate Highway
TN	PELLISSIPPI PKWY	I 140	KNOX	Interstate Highway
TN	I 155	I 155	DYER	Interstate Highway
TN	I 24	I 24	BEDFORD	Interstate Highway
TN	I 24	I 24	CHEATHAM	Interstate Highway
TN	I 24	I 24	COFFEE	Interstate Highway
TN	I 24	I 24	DAVIDSON	Interstate Highway
TN	I 24	I 24	GRUNDY	Interstate Highway
TN	I 24	I 24	HAMILTON	Interstate Highway
TN	I 24	I 24	MARION	Interstate Highway
TN	I 24	I 24	MONTGOMERY	Interstate Highway
TN	I 24	I 24	ROBERTSON	Interstate Highway
TN	I 24	I 24	RUTHERFORD	Interstate Highway
TN	I 240	I 240	SHELBY	Interstate Highway
TN	I 26	I 26	CARTER	Interstate Highway
TN	I 26	I 26	SULLIVAN	Interstate Highway
TN	I 26	I 26	UNICOI	Interstate Highway
TN	I 26	I 26	WASHINGTON	Interstate Highway
TN	I 269	I 269	FAYETTE	Interstate Highway
TN	I 269	I 269	SHELBY	Interstate Highway
TN	I 275	I 275	KNOX	Interstate Highway
TN	I 40	I 40	BENTON	Interstate Highway
TN	I 40	I 40	CARROLL	Interstate Highway
TN	I 40	I 40	CHEATHAM	Interstate Highway
TN	I 40	I 40	COCKE	Interstate Highway
TN	I 40	I 40	CUMBERLAND	Interstate Highway

TN	I 40	I 40	DAVIDSON	Interstate Highway
TN	I 40	I 40	DECATUR	Interstate Highway
TN	I 40	I 40	DICKSON	Interstate Highway
TN	I 40	I 40	FAYETTE	Interstate Highway
TN	I 40	I 40	HAYWOOD	Interstate Highway
TN	I 40	I 40	HENDERSON	Interstate Highway
TN	I 40	I 40	HICKMAN	Interstate Highway
TN	I 40	I 40	HUMPHREYS	Interstate Highway
TN	I 40	I 40	JEFFERSON	Interstate Highway
TN	I 40	I 40	KNOX	Interstate Highway
TN	I 40	I 40	LOUDON	Interstate Highway
TN	I 40	I 40	MADISON	Interstate Highway
TN	I 40	I 40	PUTNAM	Interstate Highway
TN	I 40	I 40	ROANE	Interstate Highway
TN	I 40	I 40	SEVIER	Interstate Highway
TN	I 40	I 40	SHELBY	Interstate Highway
TN	I 40	I 40	SMITH	Interstate Highway
TN	I 40	I 40	WILLIAMSON	Interstate Highway
TN	I 40	I 40	WILSON	Interstate Highway
TN	I 440	I 440	DAVIDSON	Interstate Highway
TN	I 55	I 55	SHELBY	Interstate Highway
TN	I 640	I 640	KNOX	Interstate Highway
TN	I 65	I 65	DAVIDSON	Interstate Highway
TN	I 65	I 65	GILES	Interstate Highway
TN	I 65	I 65	MARSHALL	Interstate Highway
TN	I 65	I 65	MAURY	Interstate Highway
TN	I 65	I 65	ROBERTSON	Interstate Highway
TN	I 65	I 65	SUMNER	Interstate Highway
TN	I 65	I 65	WILLIAMSON	Interstate Highway
TN	I 75	I 75	ANDERSON	Interstate Highway
TN	I 75	I 75	BRADLEY	Interstate Highway

TN	I 75	I 75	CAMPBELL	Interstate Highway
TN	I 75	I 75	HAMILTON	Interstate Highway
TN	I 75	I 75	KNOX	Interstate Highway
TN	I 75	I 75	LOUDON	Interstate Highway
TN	I 75	I 75	MCMINN	Interstate Highway
TN	I 75	I 75	MONROE	Interstate Highway
TN	I 81	I 81	GREENE	Interstate Highway
TN	I 81	I 81	HAMBLEN	Interstate Highway
TN	I 81	I 81	JEFFERSON	Interstate Highway
TN	I 81	I 81	SULLIVAN	Interstate Highway
TN	I 81	I 81	WASHINGTON	Interstate Highway
TN	I 840	I 840	DICKSON	Interstate Highway
TN	I 840	I 840	HICKMAN	Interstate Highway
TN	I 840	I 840	RUTHERFORD	Interstate Highway
TN	I 840	I 840	WILLIAMSON	Interstate Highway
TN	I 840	I 840	WILSON	Interstate Highway
TX	C1314	C1314	MONTGOMERY	Arterial or Major Collector
TX	E CARLOS TRUAN BLVD	CR 425	KLEBERG	Arterial or Major Collector
TX	I 10	I 10	AUSTIN	Interstate Highway
TX	I 10	I 10	BEXAR	Interstate Highway
TX	I 10	I 10	CALDWELL	Interstate Highway
TX	I 10	I 10	CHAMBERS	Interstate Highway
TX	I 10	I 10	COLORADO	Interstate Highway
TX	I 10	I 10	CROCKETT	Interstate Highway
TX	I 10	I 10	CULBERSON	Interstate Highway
TX	I 10	I 10	EL PASO	Interstate Highway
TX	I 10	I 10	FAYETTE	Interstate Highway
TX	I 10	I 10	FORT BEND	Interstate Highway
TX	I 10	I 10	GILLESPIE	Interstate Highway
TX	I 10	I 10	GONZALES	Interstate Highway
TX	I 10	I 10	GUADALUPE	Interstate Highway

TX	I 10	I 10	HARRIS	Interstate Highway
TX	I 10	I 10	HUDSPETH	Interstate Highway
TX	I 10	I 10	JEFF DAVIS	Interstate Highway
TX	I 10	I 10	JEFFERSON	Interstate Highway
TX	I 10	I 10	KENDALL	Interstate Highway
TX	I 10	I 10	KERR	Interstate Highway
TX	I 10	I 10	KIMBLE	Interstate Highway
TX	I 10	I 10	ORANGE	Interstate Highway
TX	I 10	I 10	PECOS	Interstate Highway
TX	I 10	I 10	REEVES	Interstate Highway
TX	I 10	I 10	SUTTON	Interstate Highway
TX	I 10	I 10	WALLER	Interstate Highway
TX	I 110	I 110	EL PASO	Interstate Highway
TX	I 14	I 14	BELL	Interstate Highway
TX	I 14	I 14	CORYELL	Interstate Highway
TX	I 169	I 169	CAMERON	Interstate Highway
TX	I 2	I 2	CAMERON	Interstate Highway
TX	I 2	I 2	HIDALGO	Interstate Highway
TX	I 20	I 20	CALLAHAN	Interstate Highway
TX	I 20	I 20	CRANE	Interstate Highway
TX	I 20	I 20	DALLAS	Interstate Highway
TX	I 20	I 20	EASTLAND	Interstate Highway
TX	I 20	I 20	ECTOR	Interstate Highway
TX	I 20	I 20	ERATH	Interstate Highway
TX	I 20	I 20	GREGG	Interstate Highway
TX	I 20	I 20	HARRISON	Interstate Highway
TX	I 20	I 20	HOWARD	Interstate Highway
TX	I 20	I 20	KAUFMAN	Interstate Highway
TX	I 20	I 20	MARTIN	Interstate Highway
TX	I 20	I 20	MIDLAND	Interstate Highway
TX	I 20	I 20	MITCHELL	Interstate Highway

TX	I 20	I 20	NOLAN	Interstate Highway
TX	I 20	I 20	PALO PINTO	Interstate Highway
TX	I 20	I 20	PARKER	Interstate Highway
TX	I 20	I 20	REEVES	Interstate Highway
TX	I 20	I 20	SMITH	Interstate Highway
TX	I 20	I 20	TARRANT	Interstate Highway
TX	I 20	I 20	TAYLOR	Interstate Highway
TX	I 20	I 20	VAN ZANDT	Interstate Highway
TX	I 20	I 20	WARD	Interstate Highway
TX	I 27	I 27	HALE	Interstate Highway
TX	I 27	I 27	LUBBOCK	Interstate Highway
TX	I 27	I 27	POTTER	Interstate Highway
TX	I 27	I 27	RANDALL	Interstate Highway
TX	I 27	I 27	SWISHER	Interstate Highway
TX	I 30	I 30	BOWIE	Interstate Highway
TX	I 30	I 30	DALLAS	Interstate Highway
TX	TOM LANDRY FWY	I 30	DALLAS	Interstate Highway
TX	I 30	I 30	FRANKLIN	Interstate Highway
TX	I 30	I 30	HOPKINS	Interstate Highway
TX	I 30	I 30	HUNT	Interstate Highway
TX	I 30	I 30	MORRIS	Interstate Highway
TX	I 30	I 30	PARKER	Interstate Highway
TX	I 30	I 30	ROCKWALL	Interstate Highway
TX	I 30	I 30	TARRANT	Interstate Highway
TX	TOM LANDRY FWY	I 30	TARRANT	Interstate Highway
TX	I 30	I 30	TITUS	Interstate Highway
TX	I 345	I 345	DALLAS	Other Controlled Access Highway
TX	I 35	I 35	ATASCOSA	Interstate Highway
TX	I 35	I 35	BELL	Interstate Highway
TX	I 35	I 35	BEXAR	Interstate Highway
TX	I 35 LOWER LEVEL	I 35	BEXAR	Interstate Highway

TX	I 35 UPPER LEVEL	I 35	BEXAR	Interstate Highway
TX	I 35	I 35	COMAL	Interstate Highway
TX	I 35	I 35	COOKE	Interstate Highway
TX	I 35	I 35	DENTON	Interstate Highway
TX	I 35	I 35	FALLS	Interstate Highway
TX	I 35	I 35	FRIO	Interstate Highway
TX	I 35	I 35	GUADALUPE	Interstate Highway
TX	I 35	I 35	HAYS	Interstate Highway
TX	I 35	I 35	HILL	Interstate Highway
TX	I 35	I 35	LA SALLE	Interstate Highway
TX	I 35	I 35	MCLENNAN	Interstate Highway
TX	I 35	I 35	MEDINA	Interstate Highway
TX	I 35	I 35	TRAVIS	Interstate Highway
TX	I 35	I 35	WEBB	Interstate Highway
TX	I 35	I 35	WILLIAMSON	Interstate Highway
TX	I 35E	I 35E	DALLAS	Interstate Highway
TX	I 35E	I 35E	DENTON	Interstate Highway
TX	I 35E	I 35E	ELLIS	Interstate Highway
TX	I 35E	I 35E	HILL	Interstate Highway
TX	I 35W	I 35W	DENTON	Interstate Highway
TX	I 35W	I 35W	HILL	Interstate Highway
TX	I 35W	I 35W	JOHNSON	Interstate Highway
TX	I 35W	I 35W	TARRANT	Interstate Highway
TX	I 37	I 37	ATASCOSA	Interstate Highway
TX	I 37	I 37	BEXAR	Interstate Highway
TX	I 37	I 37	LIVE OAK	Interstate Highway
TX	I 37	I 37	NUECES	Interstate Highway
TX	I 37	I 37	SAN PATRICIO	Interstate Highway
TX	I 40	I 40	CARSON	Interstate Highway
TX	I 40	I 40	DEAF SMITH	Interstate Highway
TX	I 40	I 40	DONLEY	Interstate Highway

TX	I 40	I 40	GRAY	Interstate Highway
TX	I 40	I 40	OLDHAM	Interstate Highway
TX	I 40	I 40	POTTER	Interstate Highway
TX	I 40	I 40	WHEELER	Interstate Highway
TX	I 410	I 410	BEXAR	Interstate Highway
TX	I 44	I 44	WICHITA	Interstate Highway
TX	I 45	I 45	DALLAS	Interstate Highway
TX	I 45	I 45	ELLIS	Interstate Highway
TX	I 45	I 45	FREESTONE	Interstate Highway
TX	I 45	I 45	GALVESTON	Interstate Highway
TX	I 45	I 45	HARRIS	Interstate Highway
TX	I 45	I 45	LEON	Interstate Highway
TX	I 45	I 45	MADISON	Interstate Highway
TX	I 45	I 45	MONTGOMERY	Interstate Highway
TX	I 45	I 45	NAVARRO	Interstate Highway
TX	I 45	I 45	WALKER	Interstate Highway
TX	I 610	I 610	HARRIS	Interstate Highway
TX	I 635	I 635	DALLAS	Interstate Highway
TX	I 69	I 69	FORT BEND	Interstate Highway
TX	I 69	I 69	HARRIS	Interstate Highway
TX	I 69	I 69	LIBERTY	Interstate Highway
TX	I 69	I 69	MONTGOMERY	Interstate Highway
TX	I 69	I 69	NUECES	Interstate Highway
TX	I 69C	I 69C	HIDALGO	Interstate Highway
TX	I 69E	I 69E	CAMERON	Interstate Highway
TX	I 69E	I 69E	WILLACY	Interstate Highway
TX	I 69W	I 69W	WEBB	Interstate Highway
TX	I 820	I 820	TARRANT	Interstate Highway
TX	SR 48	SR 48	CAMERON	Arterial or Major Collector
TX	AIRPORT FWY	TX 121	TARRANT	Other Controlled Access Highway

TX	TX 121	TX 121	TARRANT	Other Controlled Access Highway
TX	TX 146	TX 146	HARRIS	Other Controlled Access Highway
TX	ARTCRAFT RD	TX 178	EL PASO	Other Controlled Access Highway
TX	AIRPORT FWY	TX 183	DALLAS	Other Controlled Access Highway
TX	TX 183	TX 183	DALLAS	Other Controlled Access Highway
TX	AIRPORT FWY	TX 183	TARRANT	Other Controlled Access Highway
TX	TX 225	TX 225	HARRIS	Other Controlled Access Highway
TX	TX 288	TX 288	HARRIS	Other Controlled Access Highway
TX	GULF ST	TX 380	JEFFERSON	Arterial or Major Collector
TX	INTERNATIONAL BLVD	TX 4	CAMERON	Arterial or Major Collector
TX	TX 48	TX 48	CAMERON	Other Controlled Access Highway
TX	US 281	US 281	WICHITA	Other Controlled Access Highway
TX	US 290	US 290	HARRIS	Other Controlled Access Highway
TX	US 57	US 57	FRIO	Arterial or Major Collector
TX	MAIN ST	US 57	MAVERICK	Arterial or Major Collector
TX	US 57	US 57	MAVERICK	Arterial or Major Collector
TX	US 57	US 57	ZAVALA	Arterial or Major Collector
TX	SAUNDERS ST	US 59	WEBB	Arterial or Major Collector
TX	US 67	US 67	DALLAS	Other Controlled Access Highway
TX	US 75	US 75	COLLIN	Other Controlled Access Highway
TX	US 75	US 75	DALLAS	Other Controlled Access Highway
TX	US 77	US 77	CAMERON	Arterial or Major Collector
TX	US 77	US 77	KENEDY	Arterial or Major Collector

TX	US 77	US 77	KLEBERG	Arterial or Major Collector
TX	US 77	US 77	NUECES	Arterial or Major Collector
TX	US 77	US 77	WILLACY	Arterial or Major Collector
TX	US 80	US 80	DALLAS	Other Controlled Access Highway
TX	US 90 ALTERNATE	US 90 A	FORT BEND	Arterial or Major Collector
TX	I 410 FRONTAGE RD		BEXAR	Frontage/Service Road
TX	AIRPORT BLVD		BEXAR	Arterial or Major Collector
TX	DALLAS NORTH TOLLWAY		COLLIN	Other Controlled Access Highway
TX	DALLAS NORTH TOLLWAY		DALLAS	Other Controlled Access Highway
TX	PRESIDENT GEORGE BUSH TPKE		DALLAS	Other Controlled Access Highway
TX	AIRWAY BLVD		EL PASO	Arterial or Major Collector
TX	TROWBRIDGE DR		EL PASO	Arterial or Major Collector
TX	HARDY TOLL RD		HARRIS	Other Controlled Access Highway
TX	JOHN F KENNEDY BLVD		HARRIS	Arterial or Major Collector
TX	EAST BLVD		HARRIS	Arterial or Major Collector
TX	LOCKWOOD DR		HARRIS	Arterial or Major Collector
TX	WILL CLAYTON PKWY		HARRIS	Arterial or Major Collector
UT	I 15	I 15	BEAVER	Interstate Highway
UT	I 15	I 15	BOX ELDER	Interstate Highway
UT	I 15	I 15	DAVIS	Interstate Highway
UT	I 15	I 15	IRON	Interstate Highway
UT	I 15	I 15	JUAB	Interstate Highway
UT	I 15	I 15	MILLARD	Interstate Highway
UT	I 15	I 15	SALT LAKE	Interstate Highway
UT	I 15	I 15	UTAH	Interstate Highway
UT	I 15	I 15	WASHINGTON	Interstate Highway
UT	I 15	I 15	WEBER	Interstate Highway
UT	I 215	I 215	DAVIS	Interstate Highway

UT	I 215	I 215	SALT LAKE	Interstate Highway
UT	I 70	I 70	EMERY	Interstate Highway
UT	I 70	I 70	GRAND	Interstate Highway
UT	I 70	I 70	MILLARD	Interstate Highway
UT	I 70	I 70	SEVIER	Interstate Highway
UT	I 80	I 80	SALT LAKE	Interstate Highway
UT	I 80	I 80	SUMMIT	Interstate Highway
UT	I 80	I 80	TOOELE	Interstate Highway
UT	I 84	I 84	BOX ELDER	Interstate Highway
UT	I 84	I 84	DAVIS	Interstate Highway
UT	I 84	I 84	MORGAN	Interstate Highway
UT	I 84	I 84	SUMMIT	Interstate Highway
UT	I 84	I 84	WEBER	Interstate Highway
UT	SR 36	SR 36	TOOELE	Arterial or Major Collector
UT	E 6200 S		SALT LAKE	Arterial or Major Collector
VA	BELTLINE EXPY	I 195	HENRICO	Interstate Highway
VA	BELTLINE EXPY	I 195	RICHMOND CITY	Interstate Highway
VA	I 264	I 264	CHESAPEAKE	Interstate Highway
VA	I 264	I 264	NORFOLK	Interstate Highway
VA	I 264	I 264	PORTSMOUTH	Interstate Highway
VA	I 264	I 264	VIRGINIA BEACH	Interstate Highway
VA	I 295	I 295	CHESTERFIELD	Interstate Highway
VA	I 295	I 295	HANOVER	Interstate Highway
VA	I 295	I 295	HENRICO	Interstate Highway
VA	I 295	I 295	HOPEWELL	Interstate Highway
VA	I 295	I 295	PRINCE GEORGE	Interstate Highway
VA	I 381	I 381	BRISTOL	Interstate Highway
VA	I 395	I 395	ALEXANDRIA	Interstate Highway
VA	I 395	I 395	ARLINGTON	Interstate Highway
VA	I 395	I 395	FAIRFAX	Interstate Highway
VA	I 464	I 464	CHESAPEAKE	Interstate Highway

VA	I 464	I 464	NORFOLK	Interstate Highway
VA	I 495	I 495	FAIRFAX	Interstate Highway
VA	I 564	I 564	NORFOLK	Interstate Highway
VA	I 581	I 581	ROANOKE	Interstate Highway
VA	I 581	I 581	ROANOKE CITY	Interstate Highway
VA	I 64	I 64	ALBEMARLE	Interstate Highway
VA	I 64	I 64	ALLEGHANY	Interstate Highway
VA	I 64	I 64	AUGUSTA	Interstate Highway
VA	I 64	I 64	CHESAPEAKE	Interstate Highway
VA	I 64	I 64	COVINGTON	Interstate Highway
VA	I 64	I 64	FLUVANNA	Interstate Highway
VA	I 64	I 64	GOOCHLAND	Interstate Highway
VA	I 64	I 64	HAMPTON	Interstate Highway
VA	I 64	I 64	HENRICO	Interstate Highway
VA	I 64	I 64	JAMES CITY	Interstate Highway
VA	I 64	I 64	LOUISA	Interstate Highway
VA	I 64	I 64	NELSON	Interstate Highway
VA	I 64	I 64	NEW KENT	Interstate Highway
VA	I 64	I 64	NEWPORT NEWS	Interstate Highway
VA	I 64	I 64	NORFOLK	Interstate Highway
VA	I 64	I 64	RICHMOND CITY	Interstate Highway
VA	I 64	I 64	ROCKBRIDGE	Interstate Highway
VA	I 64	I 64	VIRGINIA BEACH	Interstate Highway
VA	I 64	I 64	WAYNESBORO	Interstate Highway
VA	I 64	I 64	YORK	Interstate Highway
VA	I 66	I 66	ARLINGTON	Interstate Highway
VA	I 66	I 66	FAIRFAX	Interstate Highway
VA	I 66	I 66	FAUQUIER	Interstate Highway
VA	I 66	I 66	PRINCE WILLIAM	Interstate Highway
VA	I 66	I 66	WARREN	Interstate Highway
VA	I 664	I 664	CHESAPEAKE	Interstate Highway

VA	I 664	I 664	HAMPTON	Interstate Highway
VA	I 664	I 664	NEWPORT NEWS	Interstate Highway
VA	I 664	I 664	SUFFOLK	Interstate Highway
VA	I 77	I 77	BLAND	Interstate Highway
VA	I 77	I 77	CARROLL	Interstate Highway
VA	I 77	I 77	WYTHE	Interstate Highway
VA	I 81	I 81	AUGUSTA	Interstate Highway
VA	I 81	I 81	BOTETOURT	Interstate Highway
VA	I 81	I 81	BRISTOL	Interstate Highway
VA	I 81	I 81	FREDERICK	Interstate Highway
VA	I 81	I 81	HARRISONBURG	Interstate Highway
VA	I 81	I 81	MONTGOMERY	Interstate Highway
VA	I 81	I 81	PULASKI	Interstate Highway
VA	I 81	I 81	ROANOKE	Interstate Highway
VA	I 81	I 81	ROCKBRIDGE	Interstate Highway
VA	I 81	I 81	ROCKINGHAM	Interstate Highway
VA	I 81	I 81	SALEM	Interstate Highway
VA	I 81	I 81	SHENANDOAH	Interstate Highway
VA	I 81	I 81	SMYTH	Interstate Highway
VA	I 81	I 81	WARREN	Interstate Highway
VA	I 81	I 81	WASHINGTON	Interstate Highway
VA	I 81	I 81	WYTHE	Interstate Highway
VA	I 85	I 85	BRUNSWICK	Interstate Highway
VA	I 85	I 85	DINWIDDIE	Interstate Highway
VA	I 85	I 85	MECKLENBURG	Interstate Highway
VA	I 85	I 85	PETERSBURG	Interstate Highway
VA	I 95	I 95	ALEXANDRIA	Interstate Highway
VA	I 95	I 95	CAROLINE	Interstate Highway
VA	I 95	I 95	CHESTERFIELD	Interstate Highway
VA	I 95	I 95	COLONIAL HEIGHTS	Interstate Highway
VA	I 95	I 95	EMPORIA	Interstate Highway

VA	I 95	I 95	FAIRFAX	Interstate Highway
VA	I 95	I 95	FREDERICKSBURG	Interstate Highway
VA	I 95	I 95	GREENSVILLE	Interstate Highway
VA	I 95	I 95	HANOVER	Interstate Highway
VA	I 95	I 95	HENRICO	Interstate Highway
VA	I 95	I 95	PETERSBURG	Interstate Highway
VA	I 95	I 95	PRINCE GEORGE	Interstate Highway
VA	I 95	I 95	PRINCE WILLIAM	Interstate Highway
VA	I 95	I 95	RICHMOND CITY	Interstate Highway
VA	I 95	I 95	SPOTSYLVANIA	Interstate Highway
VA	I 95	I 95	STAFFORD	Interstate Highway
VA	I 95	I 95	SUSSEX	Interstate Highway
VA	CLEBURNE BLVD	SR 100	PULASKI	Arterial or Major Collector
VA	LASALLE AVE	SR 167	HAMPTON	Arterial or Major Collector
VA	SR 337	SR 337	NORFOLK	Arterial or Major Collector
VA	SR 42	SR 42	ALLEGHANY	Arterial or Major Collector
VA	US 60	US 60	ALLEGHANY	Arterial or Major Collector
VT	I 189	I 189	CHITTENDEN	Interstate Highway
VT	I 89	I 89	CHITTENDEN	Interstate Highway
VT	I 89	I 89	FRANKLIN	Interstate Highway
VT	I 89	I 89	ORANGE	Interstate Highway
VT	I 89	I 89	WASHINGTON	Interstate Highway
VT	I 89	I 89	WINDSOR	Interstate Highway
VT	I 91	I 91	CALEDONIA	Interstate Highway
VT	I 91	I 91	ORANGE	Interstate Highway
VT	I 91	I 91	ORLEANS	Interstate Highway
VT	I 91	I 91	WINDHAM	Interstate Highway
VT	I 91	I 91	WINDSOR	Interstate Highway
VT	I 93	I 93	CALEDONIA	Interstate Highway
WA	I 182	I 182	BENTON	Interstate Highway
WA	I 182	I 182	FRANKLIN	Interstate Highway

WA	I 205	I 205	CLARK	Interstate Highway
WA	I 405	I 405	KING	Interstate Highway
WA	I 405	I 405	SNOHOMISH	Interstate Highway
WA	I 5	I 5	CLARK	Interstate Highway
WA	I 5	I 5	COWLITZ	Interstate Highway
WA	I 5	I 5	KING	Interstate Highway
WA	I 5	I 5	LEWIS	Interstate Highway
WA	I 5	I 5	PIERCE	Interstate Highway
WA	I 5	I 5	SKAGIT	Interstate Highway
WA	I 5	I 5	SNOHOMISH	Interstate Highway
WA	I 5	I 5	THURSTON	Interstate Highway
WA	I 5	I 5	WHATCOM	Interstate Highway
WA	I 705	I 705	PIERCE	Interstate Highway
WA	I 82	I 82	BENTON	Interstate Highway
WA	I 82	I 82	KITTITAS	Interstate Highway
WA	I 82	I 82	YAKIMA	Interstate Highway
WA	I 90	I 90	ADAMS	Interstate Highway
WA	I 90	I 90	GRANT	Interstate Highway
WA	I 90	I 90	KING	Interstate Highway
WA	I 90	I 90	KITTITAS	Interstate Highway
WA	I 90	I 90	LINCOLN	Interstate Highway
WA	I 90	I 90	SPOKANE	Interstate Highway
WA	SR 167	SR 167	KING	Other Controlled Access Highway
WA	SR 18	SR 18	KING	Other Controlled Access Highway
WA	SR 518	SR 518	KING	Other Controlled Access Highway
WA	US 2	US 2	SPOKANE	Other Controlled Access Highway
WA	WA 543	WA 543	WHATCOM	Arterial or Major Collector
WA	W SEATTLE FWY		KING	Other Controlled Access Highway

WA	PACIFIC AVE		SNOHOMISH	Arterial or Major Collector
WI	I 39	I 39	COLUMBIA	Interstate Highway
WI	I 39	I 39	DANE	Interstate Highway
WI	I 39	I 39	MARATHON	Interstate Highway
WI	I 39	I 39	MARQUETTE	Interstate Highway
WI	I 39	I 39	PORTAGE	Interstate Highway
WI	I 39	I 39	ROCK	Interstate Highway
WI	I 39	I 39	WAUSHARA	Interstate Highway
WI	I 41	I 41	BROWN	Interstate Highway
WI	I 41	I 41	DODGE	Interstate Highway
WI	I 41	I 41	FOND DU LAC	Interstate Highway
WI	I 41	I 41	KENOSHA	Interstate Highway
WI	I 41	I 41	MILWAUKEE	Interstate Highway
WI	I 41	I 41	OUTAGAMIE	Interstate Highway
WI	I 41	I 41	RACINE	Interstate Highway
WI	I 41	I 41	WASHINGTON	Interstate Highway
WI	I 41	I 41	WAUKESHA	Interstate Highway
WI	I 41	I 41	WINNEBAGO	Interstate Highway
WI	I 43	I 43	BROWN	Interstate Highway
WI	I 43	I 43	MANITOWOC	Interstate Highway
WI	I 43	I 43	MILWAUKEE	Interstate Highway
WI	I 43	I 43	OZAUKEE	Interstate Highway
WI	I 43	I 43	ROCK	Interstate Highway
WI	I 43	I 43	SHEBOYGAN	Interstate Highway
WI	I 43	I 43	WALWORTH	Interstate Highway
WI	I 43	I 43	WAUKESHA	Interstate Highway
WI	I 535	I 535	DOUGLAS	Interstate Highway
WI	I 794	I 794	MILWAUKEE	Interstate Highway
WI	I 90	I 90	COLUMBIA	Interstate Highway
WI	I 90	I 90	JUNEAU	Interstate Highway
WI	I 90	I 90	LA CROSSE	Interstate Highway

WI	I 90	I 90	MONROE	Interstate Highway
WI	I 90	I 90	SAUK	Interstate Highway
WI	I 94	I 94	DANE	Interstate Highway
WI	I 94	I 94	DUNN	Interstate Highway
WI	I 94	I 94	EAU CLAIRE	Interstate Highway
WI	I 94	I 94	JACKSON	Interstate Highway
WI	I 94	I 94	JEFFERSON	Interstate Highway
WI	I 94	I 94	MILWAUKEE	Interstate Highway
WI	I 94	I 94	MONROE	Interstate Highway
WI	I 94	I 94	ST. CROIX	Interstate Highway
WI	I 94	I 94	TREMPEALEAU	Interstate Highway
WI	I 94	I 94	WAUKESHA	Interstate Highway
WV	I 470	I 470	OHIO	Interstate Highway
WV	I 64	I 64	CABELL	Interstate Highway
WV	I 64	I 64	GREENBRIER	Interstate Highway
WV	I 64	I 64	KANAWHA	Interstate Highway
WV	I 64	I 64	PUTNAM	Interstate Highway
WV	I 64	I 64	RALEIGH	Interstate Highway
WV	I 64	I 64	SUMMERS	Interstate Highway
WV	I 64	I 64	WAYNE	Interstate Highway
WV	I 68	I 68	MONONGALIA	Interstate Highway
WV	I 68	I 68	PRESTON	Interstate Highway
WV	I 70	I 70	OHIO	Interstate Highway
WV	I 77	I 77	FAYETTE	Interstate Highway
WV	I 77	I 77	JACKSON	Interstate Highway
WV	I 77	I 77	KANAWHA	Interstate Highway
WV	I 77	I 77	MERCER	Interstate Highway
WV	I 77	I 77	RALEIGH	Interstate Highway
WV	I 77	I 77	WOOD	Interstate Highway
WV	I 79	I 79	BRAXTON	Interstate Highway
WV	I 79	I 79	CLAY	Interstate Highway

WV	I 79	I 79	GILMER	Interstate Highway
WV	I 79	I 79	HARRISON	Interstate Highway
WV	I 79	I 79	KANAWHA	Interstate Highway
WV	I 79	I 79	LEWIS	Interstate Highway
WV	I 79	I 79	MARION	Interstate Highway
WV	I 79	I 79	MONONGALIA	Interstate Highway
WV	I 79	I 79	ROANE	Interstate Highway
WV	I 81	I 81	BERKELEY	Interstate Highway
WV	MIDLAND TRL	US 60	CABELL	Arterial or Major Collector
WY	I 25	I 25	CONVERSE	Interstate Highway
WY	I 25	I 25	JOHNSON	Interstate Highway
WY	I 25	I 25	LARAMIE	Interstate Highway
WY	I 25	I 25	NATRONA	Interstate Highway
WY	I 25	I 25	PLATTE	Interstate Highway
WY	I 80	I 80	ALBANY	Interstate Highway
WY	I 80	I 80	CARBON	Interstate Highway
WY	I 80	I 80	LARAMIE	Interstate Highway
WY	I 80	I 80	SWEETWATER	Interstate Highway
WY	I 80	I 80	UINTA	Interstate Highway
WY	I 90	I 90	CAMPBELL	Interstate Highway
WY	I 90	I 90	CROOK	Interstate Highway
WY	I 90	I 90	JOHNSON	Interstate Highway
WY	I 90	I 90	SHERIDAN	Interstate Highway

Volvo and Pilot Company Partner to Build a National Public Heavy Duty Charging Network

11/15/2022

The Volvo Group and Pilot Company, the largest operator of travel centers in North America, have signed a Letter of Intent to develop a national, public charging network to support the scaling of battery-electric Volvo VNR Electric trucks. To accelerate development of the charging network, Pilot Company intends to install high-performance charging infrastructure at selected Pilot and Flying J travel centers across the U.S. and will be open to heavy-duty vehicles of all brands. The strategic partnership will provide fleets with a more seamless electromobility journey by addressing charging infrastructure accessibility and roadblocks, including long project lead times and high installation costs, that can otherwise delay scaled deployment of battery-electric vehicles (BEVs).

“As we work to build a more sustainable, decarbonized transport system, our team firmly believes that partnership is the new leadership. We look forward to working side by side with Pilot Company, and combining our unique industry insights, expertise, and resources to develop a comprehensive, nationwide charging network,” said Peter Voorhoeve, president, Volvo Trucks North America. “Our VNR Electric customers, as well as other fleets looking to adopt battery-electric trucks, will have peace of mind that they can access a reliable and robust, publicly accessible charging network strategically located along major transportation corridors, enabling them to extend their operating radius and decarbonize even more of their routes.”

Through its collaboration with Pilot Company, Volvo will help identify which of the existing Pilot and Flying J travel centers should be prioritized for high-performance charging infrastructure based on current and anticipated battery-electric truck deployment volume, customers charging needs and patterns, and the availability of federal and state funding to support capital costs. This partnership places Pilot Company and Volvo at the forefront of accelerating electrification adoption and developing sustainable and reliable transportation solutions for generations of battery-electric trucks to come.

“Pilot Company and Volvo are wholly invested in transportation solutions that will guide and support the industry through the energy transition,” said Shameek Konar, CEO, Pilot Company. “Joining forces with Volvo, an expert in freight technology, furthers our mutual commitment

Volvo and Pilot Company partner to Build a National Public Heavy-Duty Charging Network

The Volvo VNR Electric, which has a current range of up to 275 miles, was designed by Volvo Trucks North America to enable fleets to perform urban and regional distribution with zero-tailpipe emissions. To date, early adopters of VNR Electric trucks have utilized depot charging to support their daily routes, where trucks return to one location to charge. The introduction of public charging infrastructure that can accommodate medium- and heavy-duty fleets goes hand-in-hand with recent bipartisan support of the goal to increase BEV charging capabilities and reduce the carbon footprint of the transportation industry.

Pilot Company operates a network of more than 750 travel centers throughout North America, covering 44 U.S. states and six Canadian provinces. The company is focused on providing its guests with comprehensive amenities to make road travel easier — including restaurants, shopping, Wi-Fi, and restrooms — and the installation of high-performance charging infrastructure helps further extend the benefits offered to the trucking community.

To learn more about Volvo Trucks North America and the Volvo VNR Electric, visit the company website.

Volvo and Pilot Company partner to Build a National Public Heavy-Duty Charging Network

CAPTION: Volvo Group North America and Pilot Company will develop a national, high-performance public charging network for medium- and heavy-duty battery electric trucks utilizing the existing network of Pilot and Flying J travel centers across the U.S.

Download Press Release Images

Here ›

facility in Dublin, Virginia, which meets the internationally recognized ISO 9001 standard for quality, 14001 standard for environmental care and holds a dual ISO 50001/Superior Energy Performance certification at the platinum level, indicating a sustained excellence in energy management. Volvo Trucks North America provides complete transport solutions for its customers, offering a full range of diesel, alternative-fuel and all-electric vehicles, and is part of the Volvo Trucks global organization.

Volvo Trucks supplies complete transport solutions for discerning professional customers with its full range of medium- and heavy-duty trucks. Customer support is provided via a global network of dealers with 2,200 service points in about 130 countries. Volvo trucks are assembled in 12 countries across the globe. In 2024 approximately 134,000 Volvo trucks were delivered worldwide. Volvo Trucks is part of the Volvo Group, one of the world's leading manufacturers of trucks, buses, construction equipment and marine and industrial engines. The group also provides complete solutions for financing and service. Volvo Trucks' work is based on the core values of quality, safety and environmental care.

VOLVO

Volvo and Pilot Company partner to Build a National Public Heavy-Duty Charging Network

U.S. DEPARTMENT OF
ENERGY

Pathways to Commercial Liftoff: **Virtual Power Plants 2025 Update**

JANUARY | 2025

Comments

The Department of Energy welcomes input and feedback on the contents of this Pathway to Commercial Liftoff Report. Please direct all inquiries and input to liftoff@hq.doe.gov. Input and feedback should not include business sensitive information, trade secrets, proprietary, or otherwise confidential information. Please note that input and feedback provided is subject to the Freedom of Information Act.

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Table of Contents

Purpose of Liftoff Reports

The United States (U.S.) Department of Energy (DOE) has published a series of reports on The Pathways to Commercial Liftoff for emerging clean energy technologies. These Liftoff reports provide a roadmap for how the public and private sector can collectively accelerate the commercialization of the technologies needed to decarbonize the U.S. economy. Given the constantly and rapidly evolving market, technology, and policy environment, these reports are designed to be "living documents" and will be updated as the commercialization outlook on each technology evolves.

Spearheaded by DOE's Office of Technology Transitions (OTT), these Liftoff reports reinforce dialogue across not only DOE, but also other Federal departments and agencies. They build upon learnings from DOE investments and continued engagement with industry stakeholders. DOE continues to solicit input through industry forums, requests for information, and other interactions. Direct public input can be submitted via email to liftoff@hq.doe.gov.

Objectives and Scope of Virtual Power Plant Update

DOE published the **Pathways to Commercial Liftoff: Virtual Power Plants** report in September 2023. Since that publication, Virtual Power Plant (VPP) adoption has grown; new VPP deployments, new insights and analyses into benefits, and new tools and resources from within and outside DOE have emerged. However, deployment still needs to accelerate in the U.S. to reach 80-160 GW of VPPs (10-20% of peak load) that contribute to an affordable, reliable, and secure grid for all Americans.

This Update supplements – but does not replace – the original 2023 VPP Liftoff Report by providing additional real-world examples, new resources, and updated industry insights that support VPP deployment. This report aims to (1) communicate the differential value proposition of VPPs in meeting near-term grid challenges compared to alternatives and (2) provide proven solutions to inspire and inform near-term actions that can accelerate progress towards Liftoff.

Please reference the 2023 VPP Liftoff Report for the following:

- VPP and Distributed Energy Resource (DER) definitions
- VPP value proposition
- Associated business models
- Technology in use
- Deployment potential
- Five imperatives for VPP liftoff, associated challenges, and potential solutions

Terminology

VPPs are aggregations of DERs that can balance electricity demand and supply and provide utility-scale and utility-grade grid services.[i] This report uses the term 'Virtual Power Plants' (VPPs) given it is the predominant term used in the industry, though it recognizes that other organizations use varying terms to describe similar grid assets. The National Association of Regulatory Utility Commissioners (NARUC) uses aggregated DERs (ADERs) to describe groups of DERs capable of providing one or more services to the electric grid through dispatch or control.[ii] Electric Power Research Institute (EPRI) uses the term distributed energy resource aggregations (DERAs). Other industry actors use the term distributed power plants (DPPs). This report's definition of Virtual Power Plants includes grid assets that meet the definition of all these terms, including traditional demand response (DR).

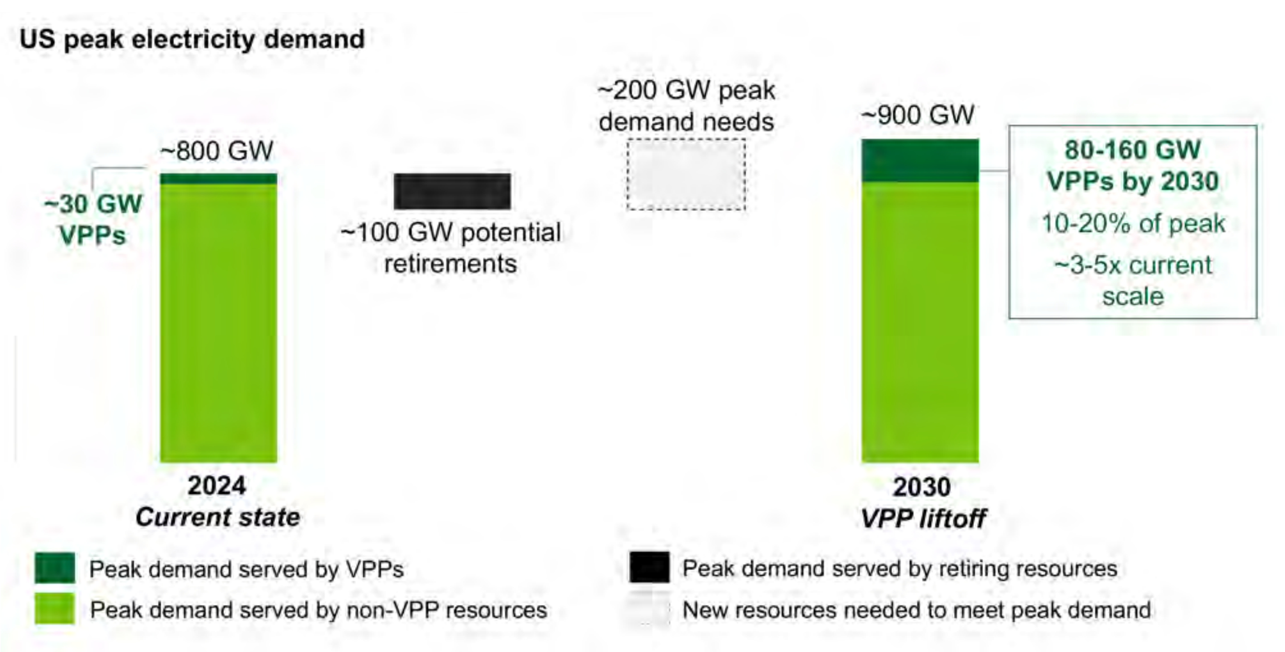
Executive Summary

Virtual Power Plants (VPPs) are solutions that can be deployed at scale in a short timeframe to maximize the use and value of existing grid infrastructure, minimize costs to ratepayers, and ensure a resilient, reliable, and secure grid for all Americans.

Recall from the 2023 Liftoff Report

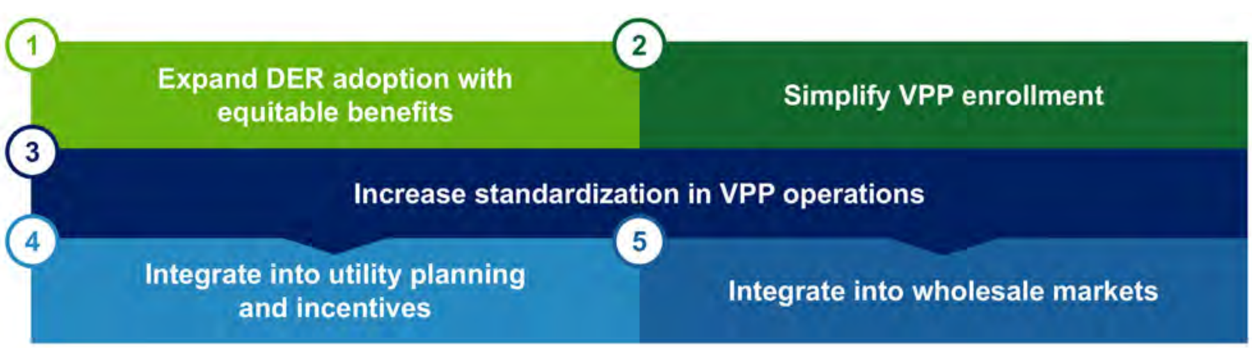
VPPs are aggregations of distributed energy resources (DERs) such as rooftop solar with behind-the-meter (BTM) batteries, electric vehicles (EVs) and electric water heaters, smart buildings and their controls, and flexible commercial and industrial (C&I) loads that can balance electricity demand and supply, as well as provide utility-scale and utility-grade grid services.

VPP liftoff



Deploying 80-160 GW of VPPs (enough to serve 10-20% of peak load) by 2030 could support rapid load growth while reducing overall grid costs. Although VPP scale has grown over the past year to 33 GW across North America[iii], the pace of deployment must accelerate to achieve liftoff.

Achieving liftoff will require progress on five imperatives:



Since DOE published the 2023 VPP Liftoff Report in September 2023, the pressures on the U.S. electric grid have intensified.

- **Reliability:** Peak demand is expected to increase from approximately 800 GW in 2024 to approximately 900 GW in 2030 due to growth in energy-intensive data centers, domestic manufacturing, and electrification of transport and heating.[iv]
- **Affordability:** Utility capital investments for the transmission and distribution grid have grown by 10.8% and 14.6% respectively from 2022 to 2023.[v] Capital investments are only expected to continue growing[vi] to meet rising load growth and replace aging assets, putting upward pressure on future electricity costs for ratepayers. This increases the importance of ensuring cost-effective grid investments to mitigate cost increases for ratepayers.
- **Resilience:** The U.S. experienced a record 28 'billion-dollar'[1] extreme weather events in 2023 that caused $95B of damage and injury.[vii] These extreme weather events are responsible for 75-80% of U.S. power outages for households and businesses.[viii]

VPPs are among the critical solutions to meet the pressing challenges the grid faces today and in the near term to keep electricity rates affordable while maintaining grid reliability and resilience.

Utilities, aggregators, policymakers, regulators, and other industry partners are taking action to implement solutions against each of the five imperatives for VPP liftoff. Replicating these proven solutions across the country could accelerate VPP deployment to reach liftoff by 2030.[2]

Expanding DER adoption with multifaceted benefits

Upfront incentives that stack across available Federal, state, city and tribal programs, inclusive utility investments, and partnerships with community-based organizations are strategies helping all communities today realize the reliability, resiliency, and affordability benefits from DERs and VPPs.

For example, San Diego Community Power's Solar Battery Savings program uses upfront, stackable incentives to provide the opportunity for no-cost solar panels and batteries for underserved communities.

Simplifying VPP enrollment

In addition to the ~30 GW of VPP capacity already enrolled today, enrolling 30-50% of the 150-200 GW of *new dispatchable* DER capacity that is projected to be added to the grid between now and 2030 could achieve liftoff nationally.

Utilities, regulators, and policymakers are harnessing existing and expected DER capacity and achieving best-in-class enrollment rates by pre-enrolling customers in VPP programs with opt-outs (instead of the opt-in method that is most common today), simplifying messaging about program benefits, and offering ongoing participation incentives.

For example, Arizona Public Service's marketplace pre-enrolls customers at point of purchase into their smart thermostat Cool Rewards program (9,290 pre-enrollments processed as of October 2024).

1 Billion-dollar events are weather and climate events that caused more than $1B of damage.

2 For additional information on challenges and potential solutions for each of the imperatives, see Chapter 4 in the 2023 VPP Liftoff Report (pages 38-52).

Increasing standardization in VPP operations

New efforts across the industry are designing standards for utility-aggregator interfaces, aggregator-DER interfaces, cybersecurity responsibilities, and other aspects of VPP operations.

Even in the absence of standards, many utilities are capturing near-term value now with basic VPP configurations that require less than $1M in upfront investment and can be deployed in less than six months to deliver valuable peak shaving benefits. Leading utilities leverage basic VPPs as the foundation for more sophisticated models (which require enabling hardware and software) that deliver distribution grid benefits in addition to bulk system-level peaking capacity.

➔ *Example standardization efforts include the development of a model grid services contract from the North American Energy Standards Board and device interoperability standards from the Mercury Consortium.*

➔ *An example of a rapid, utility-led VPP deployment is National Grid's ConnectedSolutions program, which launched in under four months and now has 250 MW of peak shaving capacity in MA and NY.*

Integrating into utility planning and incentives

Most utilities can implement some form of VPPs today without any policy or regulatory change. However, VPP deployment has been highest in areas where state regulators and policymakers have implemented VPP-supportive actions.

Regulators are motivating utility action that is more in line with ratepayer interest by establishing cost recovery pathways for VPP-related investments, improving system planning, supporting DER deployment and aggregation, and enhancing VPP operation and compensation models. Policymakers are using legislation to accelerate deployment by establishing a direction and removing ambiguity about VPP goals and other program parameters for utility regulators and other stakeholders.

➔ *An example of VPP-supportive regulation is the New York Public Service Commission's Value of Distributed Energy Resources (VDER) mechanism to compensate DERs based on their system value.*

➔ *An example of VPP-supportive legislation is a bill signed by Colorado's legislature in May 2024, SB24-218, that requires the state's largest Investor-Owned Utility (IOU), Xcel Energy, to submit a VPP plan to the Colorado Public Utility Commission.*

Integrating into wholesale markets

CAISO and ISO-NE have fully complied with the requirements of FERC Order 2222[3], theoretically unlocking wholesale market participation from a much wider range of DERs in those regions. Challenges to integrate VPPs into wholesale markets remain, particularly on data access, metering requirements, and participation models. However, market operators, state policymakers, and regulators, can collaborate to learn from each other's experiences and quickly iterate to enable VPPs to meet near-term grid capacity needs at lower costs for ratepayers.

➔ *For example, CAISO, NYISO, PJM, and SPP allow participants that meet certain criteria to use calculated telemetry readings based on sampling rather than requiring direct telemetry for each DER to participate. This allows a greater number of DERs to participate given relaxed telemetry requirements and reduced participation costs.*

Public and private sector stakeholders are taking action. This report includes over 75 examples of actions that utilities, aggregators, OEMs, regulators, policymakers, ISO/RTOs, ecosystem partners, and others are implementing today as well as **over 60 complementary programs and resources** that DOE and its collaborators have established to accelerate deployment. Stakeholders can adopt and adapt demonstrated best practices from across the country and leverage existing tools and resources to achieve VPP liftoff and contribute to a reliable, affordable, and resilient grid.

3 In September 2020, FERC (Federal Energy Regulatory Commission) approved Order 2222, which required the six FERC-jurisdictional Independent System Operators (ISOs) and Regional Transmission Organizations (RTOs) to allow participation of VPPs (referred to in the Order as "DER Aggregations") in wholesale markets. The six FERC-jurisdictional ISO/RTOs are California Independent System Operator (CAISO), Southwest Power Pool (SPP), Midcontinent Independent System Operator (MISO), New York Independent System Operator (NYISO), PJM Interconnection (PJM), and ISO New England (ISO-NE).

Introduction: Why VPPs now?

Key takeaways

- Rapid growth in peak electricity demand by 2030, capital-intensive transmission and distribution (T&D) upgrades to accommodate expected load growth, and outages due to extreme weather events and aging infrastructure are placing disproportionate pressure on grid reliability, affordability, and resilience.
- VPPs are cost-effective solutions for balancing the grid that can be deployed at scale within six months to maximize the use and value of existing infrastructure, minimize costs to ratepayers, and ensure a resilient, reliable, and secure grid for all.

Since the VPP Liftoff Report was published in September 2023, the near-term pressures on the U.S. electric grid have intensified. Forecasts of U.S. peak demand growth have increased sharply in the past year due to a surge in interest in artificial intelligence (AI) applications powered by energy-intensive data centers, hundreds of new domestic manufacturing site developments, and the continued electrification of transportation and heating. This increase in forecasted load growth will require greater utilization of local resources to satisfy electric power requirements. At the same time, recent extreme weather events have heightened awareness of the vulnerability of the grid and the need to invest in resilience. The culmination of these challenges necessitates historic investments to shore up the U.S. power system – costs that may fall on ratepayers already burdened by rising energy costs.

i. Near-term grid challenges

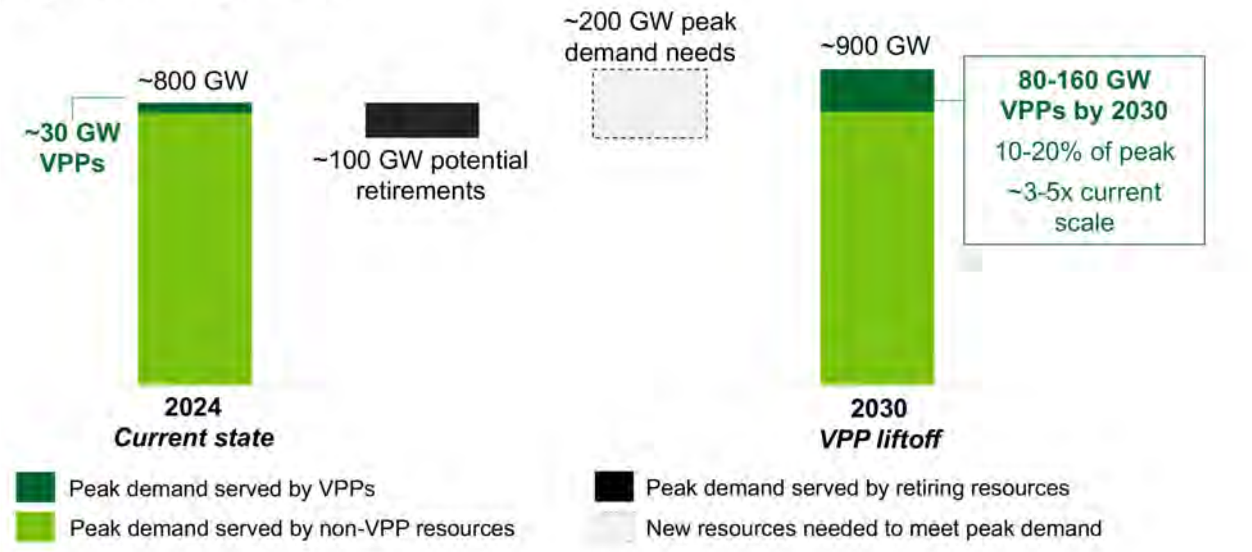
Reliability: *Rapid demand growth*

After two decades of flat electricity demand, the U.S. is returning to a period of rapid demand growth with total electricity demand expected to grow ~15-20% in the next decade.[4,5,ix,x] The 2023 VPP Liftoff report estimated that new resources serving over 200 GW of peak demand would need to be added to the grid by 2030 to meet demand growth and replace retiring resources. Since 2023, retirement schedules and growth forecasts have both shifted, but the net result of roughly 200 GW of peak demand needs by 2030 remains.

4 NERC forecasts from December 2024 suggest total electricity will increase from 150,540 GWh in 2024 to 176,040 GWh in 2034. Total electricity demand is measured over the course of a year and is distinct from peak demand, which is a point-in-time measurement.

5 See the DOE's Electricity Demand Growth Resource Hub for additional information about and DOE resources to support rising electricity demand.

VPP liftoff



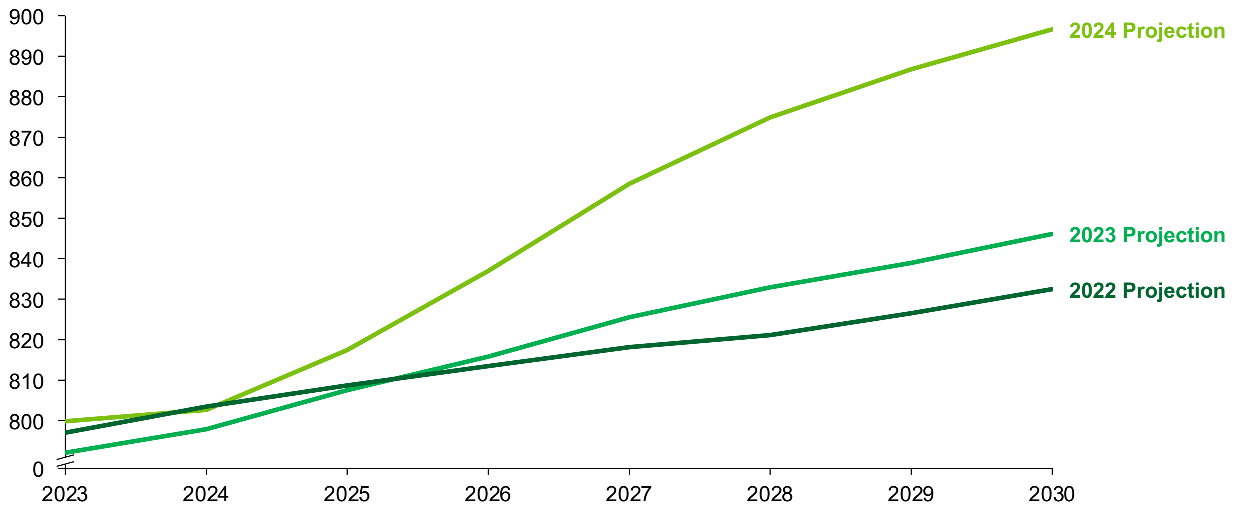
Note: NERC's Electricity Supply & Demand peak hour demand forecasts include 2024 peak summer demand as 803 GW and estimates 2030 peak summer demand to be 897 GW.[xi,xii,xiii] NERC's 2024 Long-Term Reliability Assessment estimates that 52 GW of generators are confirmed to retire by 2029, with anticipated and announced retirements estimated to be close to 100 GW by 2030.[xiv] For this reason, the need is estimated to be ~200 GW of firm capacity (~100 GW new peak demand + ~100 GW peak demand no longer served by retired assets, not accounting for planning reserve margin or the non-firm capacity de-rates of retiring resources). 30-60 GW estimate of VPP capacity in 2023 VPP Liftoff Report was adjusted to ~30 GW based on Wood Mackenzie's North America VPP Market Report,[xv] which estimates that there is 33 GW of VPP capacity in North America with the majority considered to be in the U.S.

Source: NERC 2024 Long-Term Reliability Assessment, NERC 2024 Electricity Supply & Demand data, Wood Mackenzie 2024 NA VPP Market Report

Demand growth reflects economic development, though the specific drivers of demand growth vary by region. At a national level, the three primary drivers of demand growth are data center development (including to support AI applications),[xvi] a surge in manufacturing investments (with over 900 new and expanded manufacturing facilities announced as of December 2024), and end-use electrification (e.g., transport, buildings, industrial).[xvii,xviii]

Demand growth forecasts continue to evolve rapidly. This uncertainty increases the importance of prioritizing the most cost-effective and flexible resources to serve rapidly changing conditions.[xix,xx]

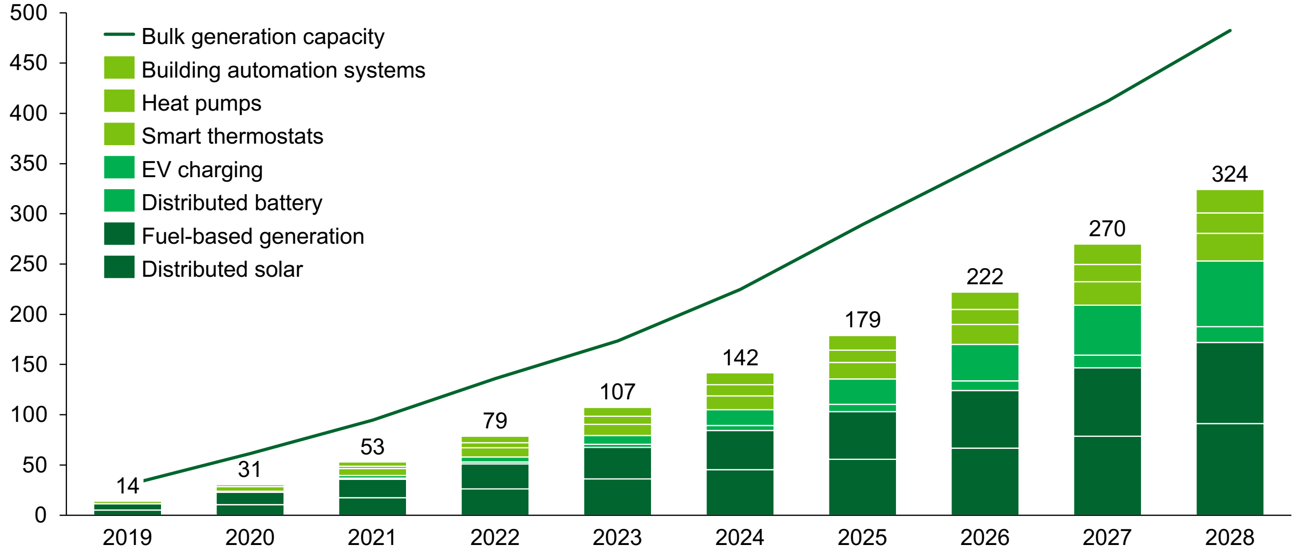
U.S. summer peak hour demand by year (2023-2030), GW



Source: NERC 2024 Electricity Supply and Demand data

Installed capacity of distributed energy resources (DERs) is forecasted to grow nearly as fast as forecasted bulk generation capacity in the next five years, with an incremental 217 GW of DERs expected by 2028.[xxi] DER growth is expected in every state, though the pace varies regionally, with growth likely to be concentrated in specific geographies. Without efficient management of these resources, such as with a VPP, expected growth of DER capacity at the grid-edge[6,xxii] in these regions could strain local, aging distribution systems and increase the cost to deliver electricity.

DER vs bulk generation capacity additions since 2019, GW



Source: Wood Mackenzie 2024 US DER Outlook

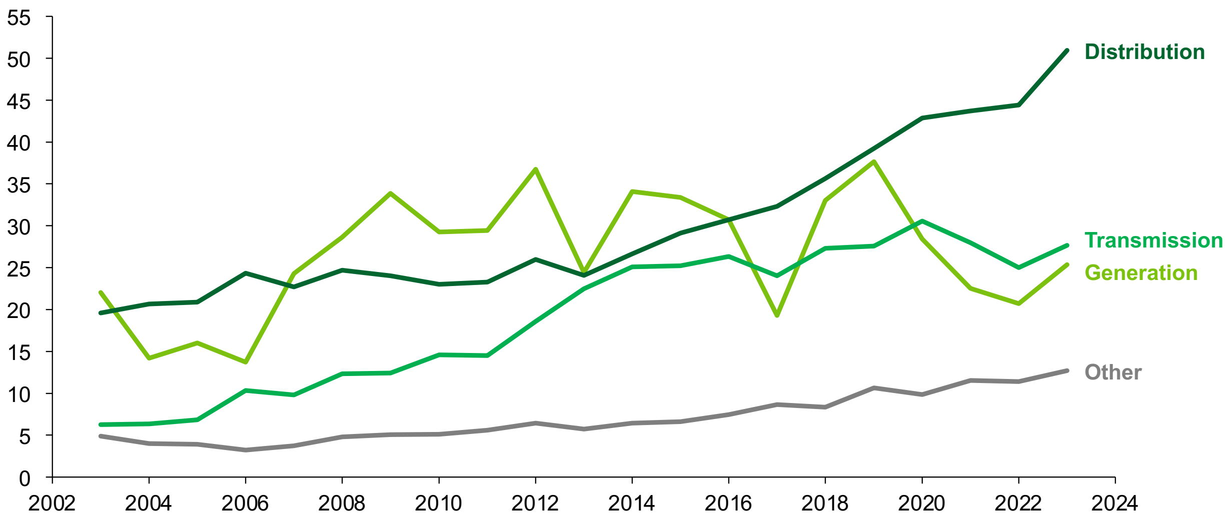
Affordability: *Upward pressure on customer costs from growing capital investments*

Capital investments in transmission and distribution (T&D) systems are growing to meet rising load growth and replace aging assets, impacting affordability. Over the last two decades, total utility spending on electricity generation has fallen, primarily due to lower fuel costs (e.g., growth in low-cost renewables, lower natural gas prices). However, these declines have been offset by a significant increase in T&D investment, particularly distribution investment, led by capital costs to upgrade, replace, and add new infrastructure.[xxiii]

Utility capital investments in the distribution system grew by 14.6% from 2022 to 2023; capital expenditures (versus operating & maintenance expenditures) now comprise the majority of spending for distribution infrastructure.[xxiv] In the U.S. Energy Information Administration's (EIA) 2023 Annual Energy Outlook (AEO 2023) projections, average combined transmission and distribution prices are expected to grow by 12% between 2023 and 2030 after accounting for inflation, even as total electricity prices decline.[xxv] Since the release of AEO 2023, load forecasts have increased and rising load growth will further increase grid investment needs. These higher grid investments put upward pressure on future electricity costs for ratepayers.

6 The grid edge is defined as the area where the electricity distribution system transitions between the utility and the end user. Additional details are included at DOE's Supercharging the Electric Grid Edge web page.

Annual U.S. capital expenditures by sector (2003-2023), billions of 2023 U.S. dollars ($)



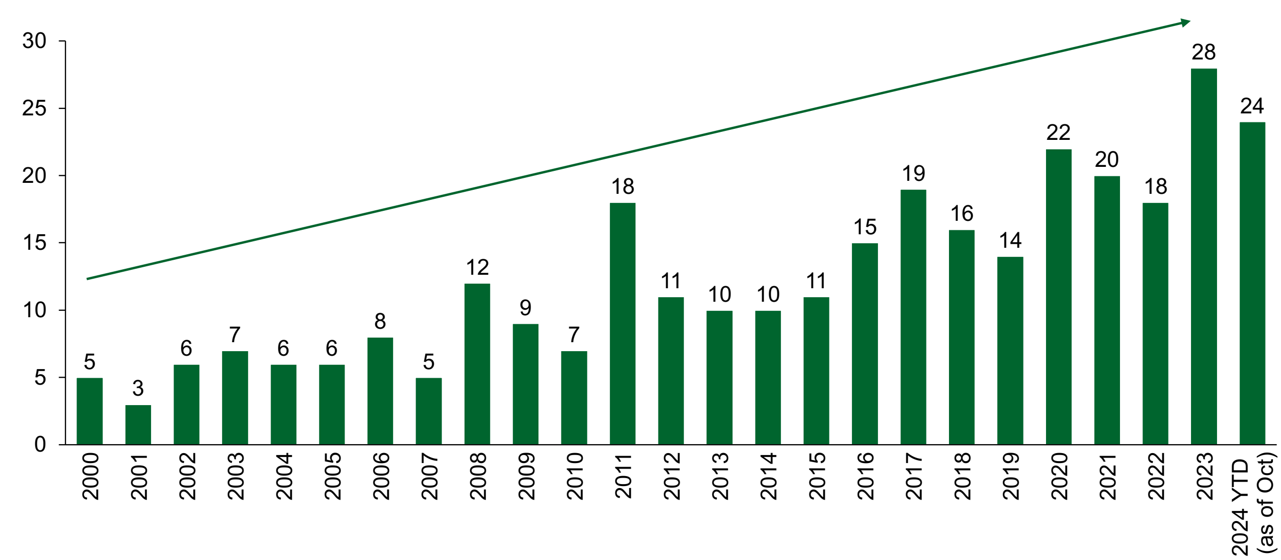
Source: FERC Form 1 (Electric Utility Annual Report)

Rising energy costs have a disproportionate impact on low-income Americans. Nearly one in four households in the U.S. was unable to pay their full energy bill for at least one month in the last year.[xxvi] Maintaining electricity affordability in the face of increasing utility transmission and distribution investments, which have increased from 10% of customer bills in 2005 to 24% in 2020,[xxvii] is particularly important for these households.

Resilience: *Increasingly frequent extreme weather events*

Increasingly frequent extreme weather threatens grid resilience. In 2023 alone, the U.S. experienced a record 28 separate billion-dollar climate disasters that caused $95B of damage and injury.[xxviii,7] 75-80% of U.S. power outages are due to extreme weather events, according to Climate Central.[xxix]

Number of billion-dollar climate and weather events, count / year (adjusted for inflation)



Source: NOAA Billion-Dollar Weather and Climate Disasters

7 Climate disasters disproportionately affect underserved communities, which already often have lower energy reliability than higher income areas.

ii. VPP value proposition

How VPPs address near-term grid challenges

Near-term grid challenge	VPP value proposition	Example
Reliability: Rapid demand growth	**Impact #1: VPPs provide valuable peak shaving benefits** 10-20% of 2030 peak demand could be served by VPPs	• **Portland General Electric's** VPP reduced peak demand load by 2% in 2024; PGE is targeting 25% of peak demand met by flexible load solutions by 2030.
	Impact #2: VPPs are quick to deploy Basic VPPs can be operationalized in <6 months to meet rapid growth	• **National Grid** launched its ConnectedSolutions program in under 4 months to provide peak shaving benefits.
Affordability: Upward pressure on customer costs from growing capital investments	**Impact #3: VPPs are low-cost solutions** VPP peaking capacity is 40%+ cheaper than a conventional peaker plant VPPs can reduce distribution costs by providing greater locational visibility and control VPPs can offset energy bills by compensating customers	• **ConEdison** deferred a $1.2B substation upgrade, spending $200M on DERs and demand reduction measures instead. • **United Power** used 95 MW of flexible DER capacity and improved grid visibility to reduce transformer outages from 25,000 min/year to near 0. • **San Diego Community Power** uses their Solar Battery Savings Program to incentivize customers to adopt residential batteries for daily dispatch to realize $5M of Resource Adequacy savings.
Resilience: Increasingly frequent extreme weather events	**Impact #4: VPPs improve grid reliability and resilience** Solar with batteries and/or fuel generator VPPs can provide backup power during emergencies	• **Duke Energy** spent $14.5M on a microgrid to provide reliable power to a rural town at a lower cost than alternatives. • **Green Mountain Power's** Zero Outages initiative plans to combine traditional resilience approaches with energy storage deployment through batteries and microgrids.

See 2023 VPP Liftoff Report pages 8-12 for detail on the VPP value proposition across resource adequacy, affordability, reliability & resilience, decarbonization & air pollution reduction, T&D infrastructure relief, community empowerment, and versatility & flexibility.[xxx]

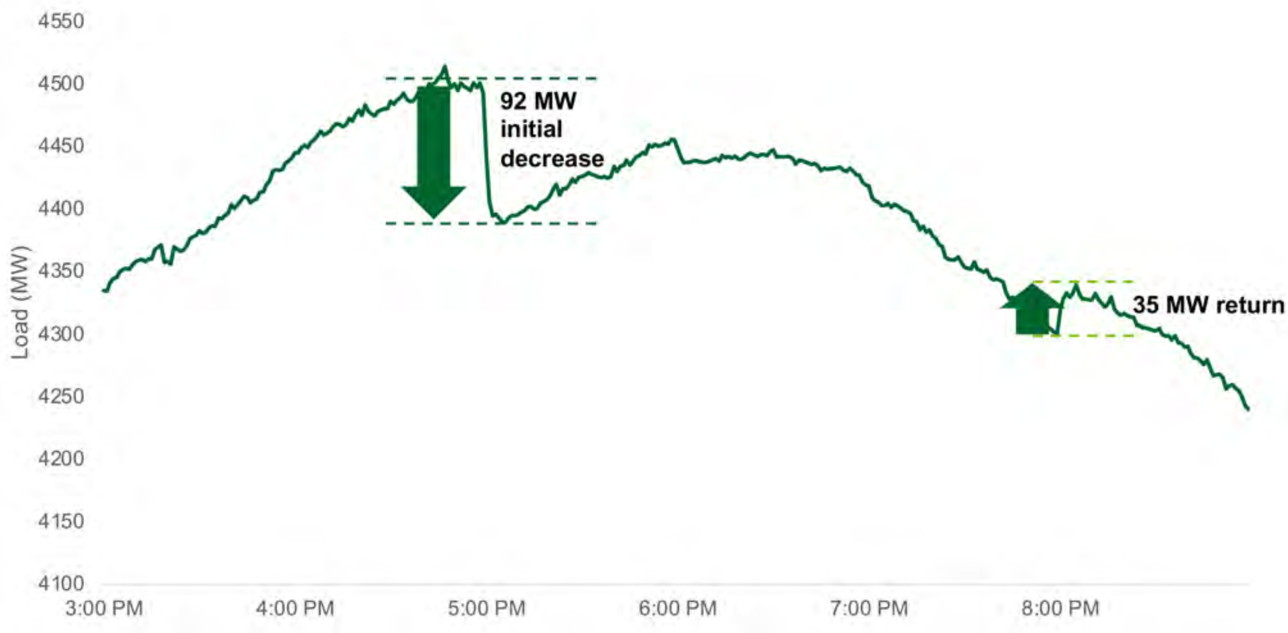
Impact #1: VPPs provide valuable peak shaving benefits

VPPs provide valuable peak shaving benefits to the grid. VPPs can aggregate DERs to serve, shift, and reduce energy demand to address growing peak demand needs and relieve grid capacity constraints. By more efficiently balancing the timing of demand with available supply, VPPs can address system constraints at the generation level (e.g., serve peak demand with storage DERs), at the transmission level (e.g., reduce peak demand when utility-scale supply is limited by transmission constraints), and distribution level (e.g., shift peak demand that threatens to exceed the safety limits of local equipment to earlier or later in the day).

One example of a utility taking advantage of this potential is **Portland General Electric (PGE)**. PGE plans to grow its VPP from serving ~2% of peak demand today to ~25% of peak in 2030.[8,xxxi,xxxii] PGE plans to increase its VPP capacity by encouraging greater participation from new and existing solar and storage assets, flexible customer loads, and customer back-up generation.

8 PGE has been growing their Customer Flexible Load programs and VPP capabilities for over two decades.

Bulk system impact from Portland General Electric's peak shaving program (August 14, 2023)



Source: Portland General Electric

Impact #2: VPPs are quick to deploy

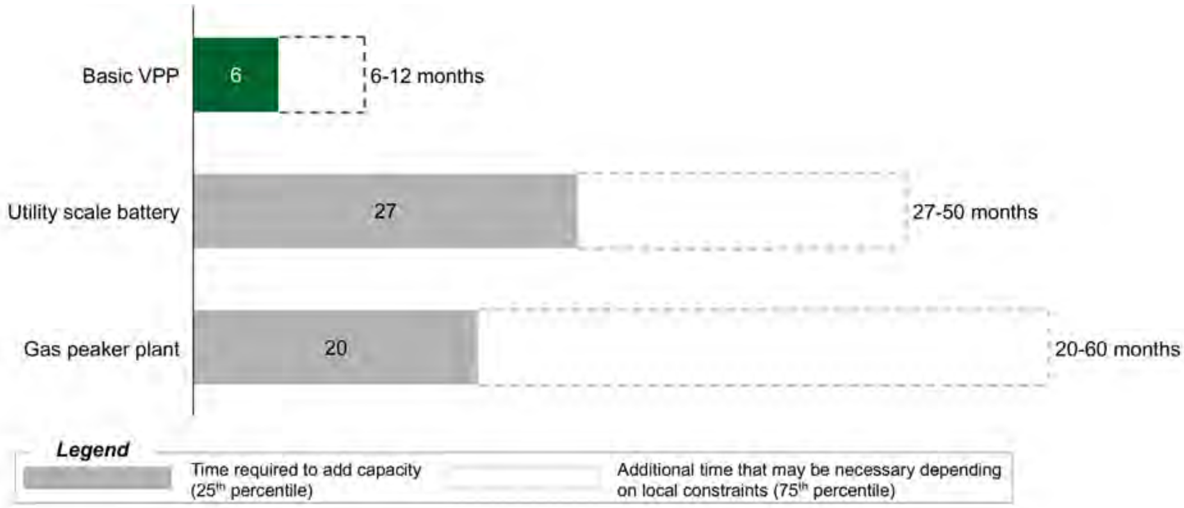
Basic VPPs that shave demand peaks can start operating within six months[xxxiii]; this can buy time for the construction of higher-capacity assets and increase the value of grid assets for which Americans have already paid. Basic VPP configurations[9] can leverage DERs that are *already on the grid* or expected to be deployed to serve as the foundation for fast-launching, large-scale VPP programs. Wood Mackenzie estimates that U.S. consumers and businesses will install 324 GW of new DERs between 2019-2028, representing 137 GW of curtailable capacity[10] if enrolled in VPPs.[xxxiv]

Traditional approaches to increasing grid capacity (utility-scale generation, transmission, distribution) rely on investing in large, centralized physical infrastructure, such as building fossil fuel-powered peaker plants and upgrading transformers. These upgrades are facing lengthening delays for several reasons. New electricity generation facilities are waiting four to six years in transmission interconnection queues before they can connect to the grid to supply power.[xxxv] Long distance greenfield transmission projects often face lengthy permitting timelines, with review periods that average 4.3 years and can extend up to 11 years.[xxxvi] Lead times to procure large transformers (greater than 500 MVA) are averaging three years due to supply chain issues.[xxxvii]

9 For an explanation of basic vs. more sophisticated VPP configurations, reference Chapter 3: Increasing standardization in VPP operations.

10 Curtailable capacity includes flexible capacity from smart thermostats, heat pumps, buildings with energy management systems, and export potential from batteries.

Timeline to add 20 MW of dispatchable peaking capacity, months



Note: Industry participant interviews informed the timeline for basic VPPs, supported by RMI's Reliability Brief from July 2024[xxxviii]. For utility scale battery and gas peaker plant, the timeline includes time from interconnection request to project Commercial Operations (COD) for projects with 2017-2023 CODs; displaying 25th to 75th percentile range. Median values are 40 months for battery and 42 months for gas projects.[xxxix]

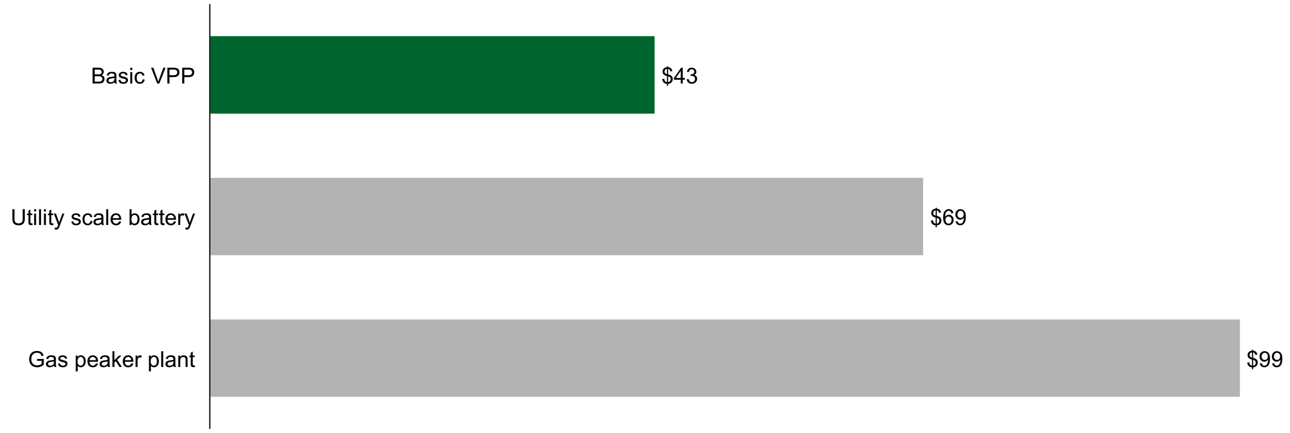
Source: Industry interviews, RMI Reliability Brief, Lawrence-Berkeley National Lab's 2024 Queued Up Report

As an example of how VPPs can address rising electricity demand, **NRG Energy** and **Renew Home** recently announced plans to launch a 1 GW VPP in Texas by 2035, equivalent to 12 gas-fired peaker plants, by leveraging flexible demand from smart thermostats. This announcement comes just months after the Electricity Reliability Council of Texas (ERCOT) revised its 2030 load growth forecasts to 148 GW[xl], **an increase of 40 GW from last year's forecast.**[xli] Rapid peak demand growth requires solutions that can be deployed rapidly.

Impact #3: VPPs are low-cost solutions

VPPs are a cost-effective peak capacity resource relative to traditional investments, both on the bulk power grid and the distribution grid. On the bulk power grid, procuring new system-level peak capacity from a VPP can be lower cost than procuring the same capacity from a natural gas peaker plant or utility-scale battery. These savings, as well as reduced distribution and transmission costs, accrue to all ratepayers (not just VPP participants). An RMI study of an example utility system in 2035 found that a VPP-enabled portfolio reduces net power generation costs by 20% or roughly $140 per household (including non-participating ratepayers) per year compared to a baseline scenario.[xlii] In New York, **ConEdison** deferred a $1.2B substation upgrade in 2014, spending $200M instead on DERs and demand reduction measures as part of the Brooklyn Queens Demand Management Program.[xliii] Beyond these system benefits for all ratepayers, additional financial benefits accrue to customers enrolled in the VPP in the form of incentive payments.

Comparison of net cost to an example utility of providing 400 MW resource adequacy across three options, Net cost per kW-year



Note: Values for 400 MW of peaking capacity are shown in $/kW-yr. The VPP analyzed consists of smart thermostats, smart water heating, home EV managed charging, and BTM battery demand response. Modeled equipment subsidy costs to utility are $75 for smart thermostats, $315 for smart water heaters, and $0 for EV charging and BTM batteries. Marketing costs assumed at $50 per device. Utility studied is assumed to have 50% renewable generation mix, with resource adequacy needs in summer and winter. 8760 hours were considered, and resources must be able to operate in 63 peak hours (when top 400 MW are needed) spanning 7 months, for 7 consecutive hours at a time. Benefits of emissions reduction and resilience are not shown; when included, VPP net cost is lower, though actual emissions impact will vary by local grid mix.[xliv]

Source: Brattle Group's Real Reliability: The Value of Virtual Power Report

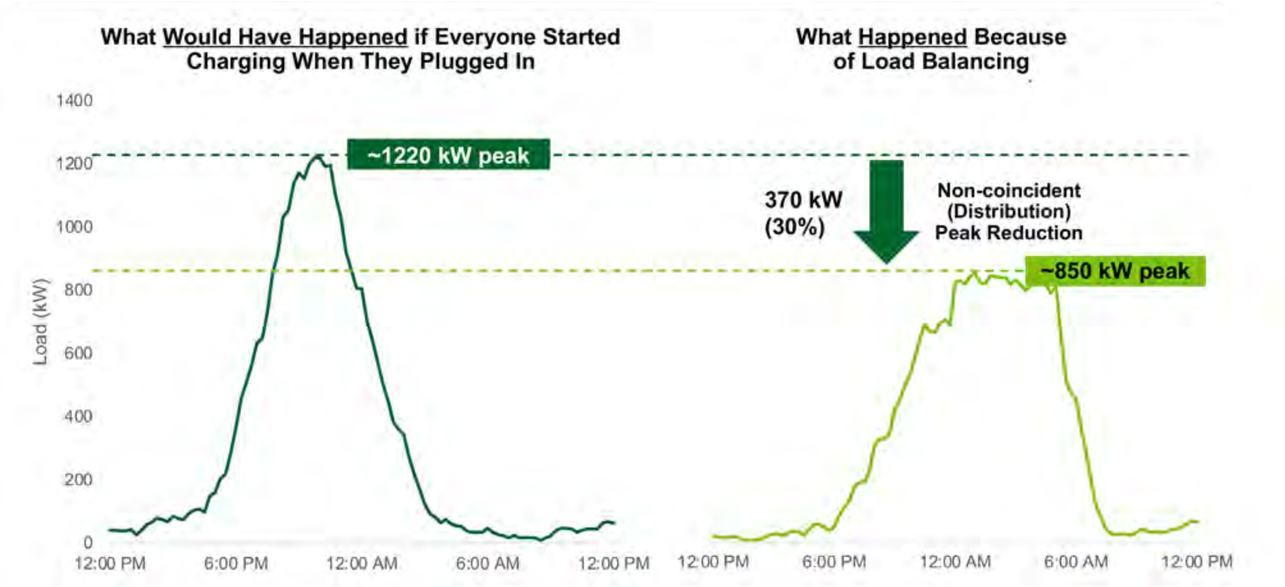
On the distribution grid, VPPs can help utilities defer costly system upgrades by shaving localized peak loads that would otherwise trigger the installation of new equipment. Many utilities facing rising demand are using VPPs as an interim solution until distribution grid capacity upgrades are absolutely necessary, saving ratepayers money in the meantime. A whitepaper co-authored by **AES Indiana** and **Camus Energy** found that deploying visibility solutions to detect where EVs are located on the grid and transitioning to grid-optimized managed charging programs could defer upgrades to 85% of eligible feeders and service transformers for an average of 8.5 years compared to a business-as-usual scenario. Capital cost savings from deferring upgrades were estimated to avoid close to $1B in cost overruns over the next decade, with savings going directly to consumers.[xlv] AES Indiana is *one* utility with 500,000 utility meters. While service areas across the U.S. are diverse, extrapolating to the 150 million meters across the U.S. would imply **significant potential savings[11] by deferring capital investments and optimizing the use of the existing electricity system across generation, transmission, and distribution.[12,xlvi]**

Baltimore Gas & Electric's (BGE) managed charging program demonstrates the peak shaving potential of VPPs on the distribution grid. With a feeder-level participant group of 880 vehicles, BGE's managed charging program created a non-coincident peak reduction of 30% while still serving customer's transportation energy needs. BGE plans to grow its managed charging program from 3,253 residential customers to 30,000 customers by 2027.[xlvii,xlviii]

11 A rough extrapolation of this example to the 150 million meters across the U.S. would imply potential savings of $300 billion over the next decade by deferring capital investments.

12 An [LBNL study mentioned the U.S. building sector alone could avoid over $100B per year] in power sector costs by leveraging demand-side solutions (e.g., smart thermostats, electric heat pumps, smart control systems) by 2050.

Distribution grid impact from Baltimore Gas & Electric's managed charging program



Source: WeaveGrid

Impact #4: VPPs improve grid reliability and resilience

VPPs provide resilience benefits that traditional generation assets cannot provide—and at a lower cost than alternatives. VPPs that include solar and storage or fuel generators at a household or commercial and industrial site provide power with far fewer possible points of failure than power supplied from a distance by a traditional power plant. VPPs also have the potential to help utilities restore power to impacted areas more quickly, reducing the length of outages for customers impacted by severe weather events.

Much of the grid hardening work in disaster-prone areas has been undergrounding power lines. Although this has been effective in some areas, including pockets of Florida during Hurricanes Helene and Milton[xlix], it has come at a high cost. The **Public Service Commission of Wisconsin** estimates that undergrounding a 69-kilovolt line costs ~5x more per mile versus aboveground installation.[l] Alternatively, utilities are using DERs and VPPs at the end of vulnerable transmission or distribution lines to ensure reliable power at a lower cost than undergrounding lines.

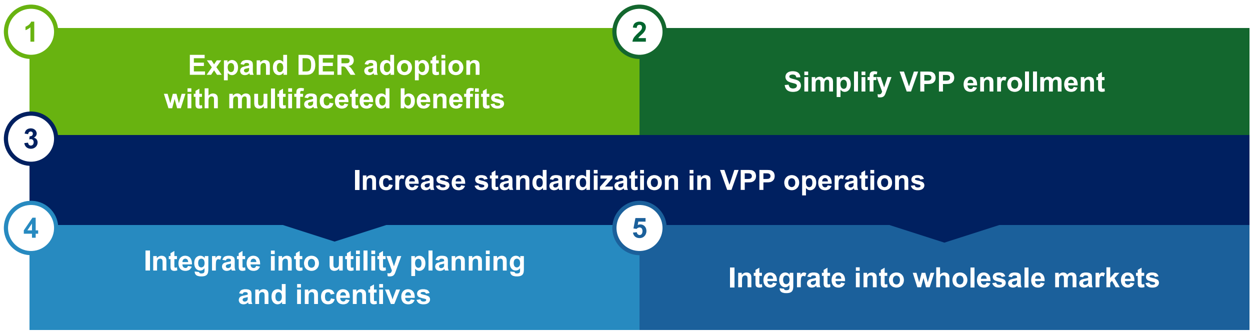
For example, in 2023, **Duke Energy** installed 2 MW of solar power and 4.4 MWh of battery storage along with VPP-enabling technology to create a microgrid in Hot Springs, a town of about 535 residents in North Carolina. With a cost of $14.5M, the microgrid was deemed less expensive than the grid upgrades that would have been required to provide reliable power for the rural town. For the residents of Hot Springs, the microgrid offered resilience; for the surrounding communities, it provided energy and bulk system benefits, such as frequency and voltage regulation and capacity during system peaks.[li] With the Hot Springs microgrid and VPP-enabling investments, Duke Energy restored power to residents quickly after Hurricane Helene in 2024, even though the local substation was severely impacted by flooding.[lii]

iii. Imperatives for VPP liftoff

VPPs are solutions that can be deployed at scale in a short timeframe to maximize the use and value of existing grid infrastructure, minimize costs to all ratepayers, and ensure a resilient, reliable, and secure grid for all Americans.

Deploying 80-160 GW of VPPs (enough to serve 10-20% of peak load) by 2030 could support rapid load growth while reducing overall grid costs. VPPs are not new and have been operating with commercially available technology for years.[liii] While VPP scale has grown over the past year to 33 GW across North America[liv], deployment must accelerate to achieve liftoff by 2030.

As explained in the 2023 VPP Liftoff Report, achieving liftoff for VPPs will require progress on five imperatives:



Utilities, policymakers, regulators, and other industry partners all have a role to play in accelerating action against these five imperatives to address the challenges hampering VPP adoption today.

The potential for VPPs to meet near-term grid needs cost-effectively for American ratepayers represents an urgent call to action for all grid stakeholders to do their part in advancing deployment. Building on the foundation of the 2023 VPP Liftoff Report, the remainder of this Update will explore each of the five imperatives. Starting with a brief overview of the imperative, each chapter and its corresponding appendix will focus on presenting new VPP case studies, new insights into VPP benefits, and new tools and resources from the Department of Energy and broader industry that can support power sector decisionmakers and accelerate progress towards VPP liftoff.

Chapter One: Expanding DER adoption with multifaceted benefits

Key takeaways

- DER adoption today is a fraction of its potential (e.g., 3.5-3.8% of households have rooftop solar, <1% have BTM batteries, and 12.9-13.8% have smart thermostats). Low DER adoption will limit available capacity for VPPs.
- The main barriers to scaling DER adoption include high upfront costs with limited low-cost financing options, split incentives between property owners and tenants, and knowledge gaps on available programs and incentives, all of which disproportionately affect underserved communities.
- Upfront incentives that stack across available Federal, state, city, and tribal programs, inclusive utility investments, and partnerships with community-based organizations are strategies helping communities today participate in reliability, affordability, and resilience benefits from DERs and VPPs.

1.i. DER adoption today

DER adoption today is a fraction of its potential (e.g., 3.5-3.8% of households have rooftop solar[lv], <1% have BTM batteries, and 12.9-13.8% have smart thermostats[lvi,lvii]). Low DER adoption will limit available capacity for VPPs and reduce the speed at which VPPs can be deployed at scale, delaying potential benefits to ratepayers and the grid. Barriers to accessing DERs include high upfront costs with limited low-cost financing options, 'split incentive gaps' between property owners and tenants for single-unit and multi-unit dwellings[13], and knowledge gaps on available incentives and programs. These barriers are even more pronounced for underserved communities.[14]

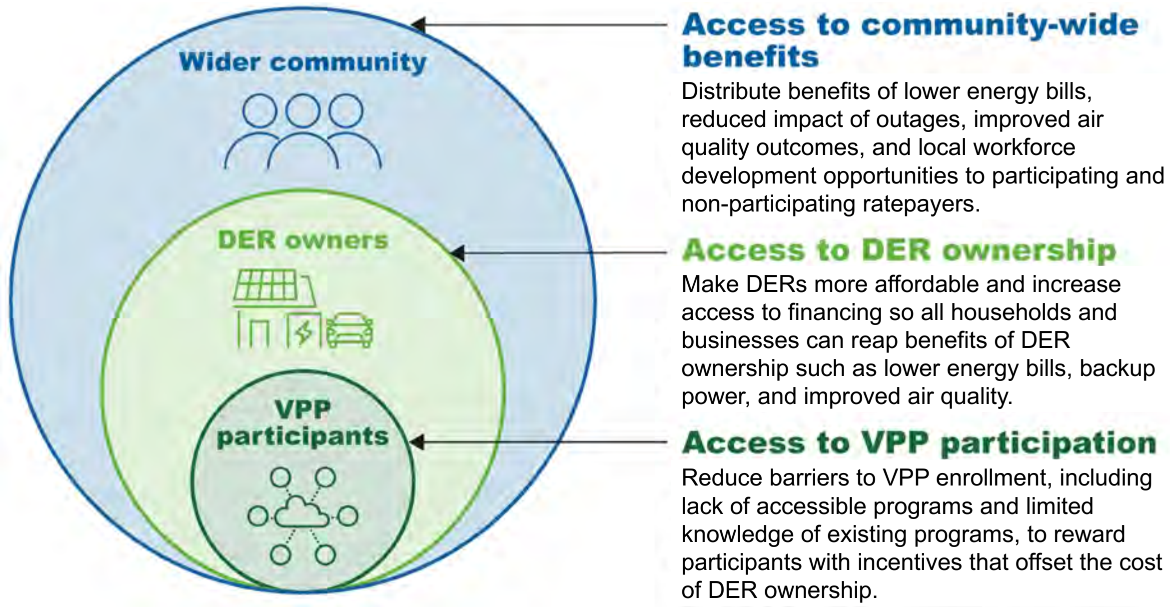
1.ii. Layers of benefits

Ensuring all groups – DER owners, VPP participants, and the wider community – can participate and realize benefits from DER and VPP deployment is critical to realizing reliability, affordability, and resilience benefits for individual households and businesses, and the overall grid.

13 The split incentive gap refers to the tension between property owners, who would be expected to pay for a distributed energy resource, and tenants, who would benefit from lower energy costs. This incentive misalignment is a significant barrier to DER adoption in rented properties.

14 See 2023 VPP Liftoff Report pages 13-17 on the rates of DER penetration and how DER adoption plays a role in VPPs. See pages 39-42 for additional discussion on the barriers for DER adoption and potential solutions

Layers of potential benefits from deploying VPPs



- **Access to community-wide benefits: Retain and redirect cost savings from VPP deployment (vs. alternative CapEx heavy investments) toward reducing all utility customer bills, not just for those participating in VPPs.** Compensating for the total value of all the services VPPs provide to the grid is a way to make sure adoption is beneficial for DER adopters and all ratepayers, but few holistic DER/VPP value frameworks exist today. Additional benefits can be intentionally directed to underserved communities to help address those communities' higher energy burdens[15], increased incidence of outages, and lower air quality outcomes.[16]
- **Access to DER ownership: Make DERs more affordable and increase access to financing so the benefits of DER ownership (e.g., reduced energy bills from efficient appliances, backup power options from batteries and generators, and improved air quality from electric conversions) are accessible to all.** Today, DER adoption is an individual choice – households and C&I facilities choose whether installing these DERs is economical given their circumstances. High upfront and financing costs may limit access to widespread DER adoption.
- **Access to VPP participation: Reduce barriers to VPP enrollment so that more households and businesses can take advantage of VPP participation payments.** Homes and C&I facilities that have installed DERs choose to participate in a VPP by enrolling in available programs. Lack of accessible programs and limited knowledge of existing programs can limit participation.[17]

See Appendix A.i. for a comprehensive set of actions that stakeholders can take to expand access to community-wide benefits, DER ownership, and VPP participation.

1.iii. Case studies of expanding access to DER ownership

Public and private sector actors are taking action to reduce barriers to DER adoption and VPP participation, and to spread the benefits of VPP deployment more equitably across participating and non-participating ratepayers. This section, along with detail provided in Appendix A, shares how two utilities built VPP programs to expand access to DER ownership for their customers.

15 Energy burden is defined as the percentage of household income that goes toward energy costs.

16 According to RMI's Power Shift report, VPPs could avoid 12 million to 28 million tons of carbon dioxide emissions nationwide by 2035, or 2% to 4% of projected U.S. power sector emissions in 2035.

17 Additional detail on simplifying enrollment can be found in *Chapter 2: Simplifying VPP enrollment.*

Case Study: Roanoke Cooperative, NC

***Roanoke Cooperative** uses an inclusive utility investment to reduce upfront cost and financing barriers to adopting water heater control switches and smart thermostats.*

- **Roanoke Cooperative (RC)** launched the Upgrade to $ave program in 2016 to reduce energy bills for the fourth lowest income Congressional district in the U.S.
- The Board of Directors targeted upgrading 1000 homes with energy efficiency and demand response measures. They approved use of the Pay As You Save® (PAYS®) system, an inclusive utility investment model, for the design of the utility program and tariff.[18,lviii,lix]
- RC paid upfront for all cost-effective energy upgrades at a member's residence and recovered its costs through a fixed, monthly cost recovery charge that was lower than the estimated savings from the upgrades on an annual basis.[lx,19]
- To enroll customers, RC assessed the energy savings potential of the building rather than the owner's income or creditworthiness, allowing all members to access low-cost financing options.
- Participating members reduced electricity usage by ~20% because of upgrades and the utility realized peak demand savings of ~20% during summer and winter peaks.
- Including the cost of capital and program operation costs, the utility sees $2M+ NPV over the lifetime of the upgrades.

Detailed case study provided in Appendix A.iii.

Case Study: San Diego Community Power, CA

***San Diego Community Power** leverages upfront, stackable incentives to provide the opportunity for no-cost solar and batteries to qualified priority populations.*

- **San Diego Community Power (Community Power)** launched the Solar Battery Savings program in 2024.
- The program was designed to benefit all customers through upfront incentives to lower the initial cost of home solar and battery storage resources.
- Community Power worked with state and local programs to ensure their incentives could stack with other programs such as California's DAC-SASH and SGIP[20,lxi,lxii] programs and the City of San Diego's Solar Equity program to allow priority populations in particular to cover the entire cost of solar and storage resources through available incentives.

Detailed case study provided in Appendix A.iii.

See Appendix A for 13 case studies that are expanding DER adoption with multifaceted benefits (Appendix A.ii. and A.iii.), 5 additional resources (Appendix A.iv.) and 18 supportive DOE programs (Appendix A.v.).

18 PAYS Essential Elements and Minimum Program Requirements provides additional information on the utility program requirements for a PAYS program and PAYS model tariff shares the tariff design.

19 The program's annual cost recovery is set at less than the estimated savings from the upgrades to ensure immediate reductions in energy costs, and much larger cost reductions once the utility recovers its costs and ends the on-bill charge.

20 DAC-SASH is the Disadvantaged Communities – Single-Family Solar Homes program developed by the California Public Utilities Commission (CPUC) and administrated by GRID Alternatives. This state program provides $8.5 million in incentives annually to help homeowners in disadvantaged communities go solar. SGIP is the Self-Generation Incentive Program developed by the California Public Utilities Commission to provide rebates for qualifying distributed energy systems on the customer's side of the utility meter, including advanced energy storage systems, wind turbines, waste heat to power technologies, pressure reduction turbines, internal combustion engines, microturbines, gas turbines, and fuel cells.

Chapter Two: Simplifying VPP enrollment

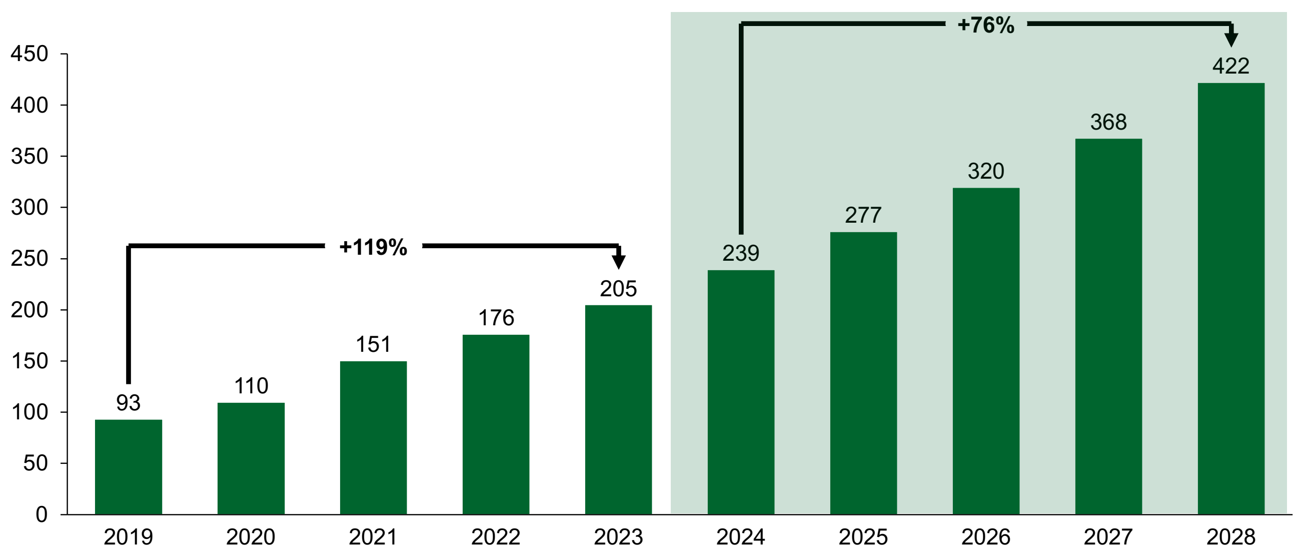
Key takeaways

- VPP deployment can be fast; VPPs can be built and scaled as quickly as customers enroll their devices.
- In addition to the 30 GW of VPP capacity already enrolled today, enrolling 30-50% of the 150-200 GW of *new dispatchable* DER capacity that is projected to be added to the grid between now and 2030 would result in 80-160 GW of VPP capacity nationally.
- Utilities, aggregators, and other industry partners are taking no-regrets (high-impact, low-effort) actions today to improve enrollment, such as communicating concise messaging about program benefits, offering ongoing participation payments, and offering the flexibility to opt out of events.
- These same entities are implementing additional high-impact actions (high-impact, high-effort), but these solutions may require time, effort, and investment to deliver value. For example, automatic enrollment at the point of DER purchase is not widespread today but has been proven to achieve high participation rates without attrition or consumer complaints.

2.i. DER forecasted capacity growth

Across the U.S., DER capacity doubled over the last five years and is expected to nearly double again in the next five years, growing by 217 GW across DER types.

Total DER capacity installed (historical and forecasted), GW

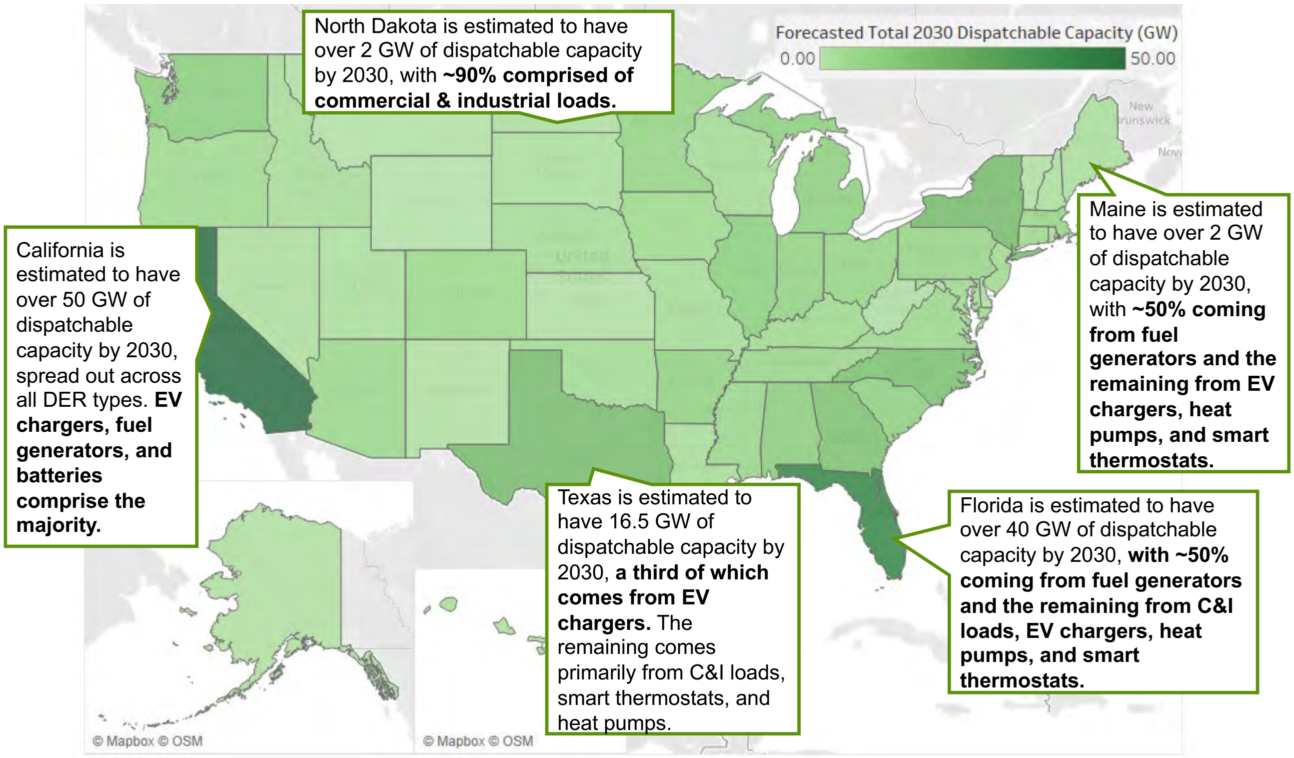


Note: DERs included in capacity projections are smart thermostats, heat pumps, diesel generators, natural gas generators, non-residential solar and storage, residential solar and storage, building automation systems (commercial & industrial loads), and passenger and commercial EV charging.[lxiii]

Source: Wood Mackenzie 2024 US DER Outlook

DER capacity is expected to grow in every state across the U.S., though the magnitude of growth and the types of DERs that come online will vary.

2030 total dispatchable capacity, GW



Note: 2030 total dispatchable capacity is estimated by taking a proportion of total 2030 capacity and applying simplifying assumptions on the proportion that is dispatchable. For solar, batteries, heat pumps, smart thermostats and water heaters, Ohm Analytics estimated 2030 total capacity by state[lxiv]. For EVs and EV charging, NREL's base scenario estimated 2030 total capacity by state.[lxv] For commercial & industrial loads (or building automation systems) and distributed fuel generation, national level estimates from Wood Mackenzie's US DER Market Report[lxvi] were extrapolated to 2030 and allocated to states based on 2022 metering data from EIA.

Source: Ohm Analytics State-Level Residential DER Capacity Forecast, Wood Mackenzie 2024 US DER Market Report, National Renewable Energy Lab The 2030 National Charging Network Report, EIA 2022 Meter Data

Without enrolling available DERs into VPPs, their rapid adoption could strain existing, aging distribution systems that are already near maximum capacity during peak events. Integrating these resources into system planning via VPPs can effectively manage impacts to the distribution system while unlocking additional reliability, affordability, and resilience value for ratepayers (e.g., deferred system upgrades, backup power during emergencies, maximizing use of renewables).

Deploying 80-160 GW of VPP capacity would require enrolling just 30-50% of the dispatchable DER capacity expected to be added to the grid between 2024-2030 – an enrollment rate that is in line with industry estimates for successful VPP programs today.[21] This means 10-20% of peak demand could be served by VPPs in a scenario with baseline forecasts of DER adoption and demonstrated best-in-class VPP enrollment rates.[22] This holds true at the state-level. For example, **Indiana's** state-level peak load for 2030 is estimated to be 19.9 GW and its resource needs are estimated to be 8.5 GW of new generation.[lxvii] Meanwhile, available dispatchable DER capacity is estimated at nearly 8 GW by 2030. Establishing VPP programs and enrolling 25% of total DER capacity in a VPP could meet 10% of peak load by 2030.

21 In Xcel Energy's Northern States Power service territory, over 50% of all eligible residential customers are voluntarily enrolled in some form of air-conditioning load control, with plans for future growth. Otter Tail Power, an investor-owned utility in Minnesota, can reduce its system peak demand by 15% through a portfolio of demand response programs, which are used regularly.

22 See section 4.ii. ('Simplify VPP enrollment') in the 2023 VPP Liftoff Report for detail on the challenges and potential solutions for this imperative (pages 41-43).

Utilities, aggregators, regulators, and policymakers can prioritize no-regrets and high-impact actions to encourage customers to enroll DERs and participate in the clean energy transition.

Total VPP capacity in various enrollment scenarios, GW

Note: 30 GW of VPP capacity today estimated from 33 GW of VPP capacity in North America based on Wood Mackenzie North America VPP Market Report (majority considered to be in the U.S.).[lxviii] Continued current state assumes ~15% of DER capacity additions are enrolled in VPPs, a relatively conservative estimate. Implementing no-regrets levers assumes ~30% of DER capacity additions are enrolled in VPPs, in line with programs today. Implementing high-impact actions assumes ~60% of DER capacity dispatchable additions are enrolled in VPPs, in line with analyses that calculate enrollment potential from point-of-purchase enrollment[23,lxix], with additional upside from automatic enrollments with opt-outs (up to ~90% of DER capacity additions could be enrolled). Analysis shown above only considers capacity potential from enrolling new DERs procured between 2024 and 2030. Enrolling DERs that are already on the grid as of the end of 2024 would be considered upside.

Source: DOE analysis

2.ii. Case studies of simplifying enrollment

Utilities, aggregators, and other industry partners are taking no-regrets actions today to improve enrollment processes with minimal effort. These entities are also implementing high-impact solutions[24], but these levers may require time, effort, and investment to deliver value.[lxx]

23 Uplight, a flexibility management platform, found that over 60% of eligible customers purchasing a smart thermostat through their marketplace enrolled in demand response programs when offered at point of sale.

24 Lawrence Berkeley National Lab and Brattle Group conducted a study working with industry partners to determine the level of effort and the level of impact for 30 enrollment levers. No-regrets actions in this report are defined as levers that were deemed "high-impact" and "low-effort." in that analysis. High-impact solutions are defined as levers that were deemed "high-impact" and "high-effort" in that analysis. See the Distributed Energy, Utility Scale: 30 Proven Strategies to Increase VPP Enrollment for additional detail on 30 strategies to increase VPP enrollment.

Case Study: Minnkota Power Cooperative, ND *(No-regrets action)*

***Minnkota Power Cooperative** enrolled 40% of customer base by communicating financial benefits of enrollment in simple and concise terms.*

- **Minnkota Power Cooperative's** demand response program has enrolled 55,000 customers (40% of customers) and can serve 350 MW, 35% of winter peak load,[lxxi] through the program.[lxxii]
- Minnkota provides clear financial benefits for enrollment and participation – upfront incentives to purchase the DERs and customer eligibility for the off-peak program rate, which is roughly half the standard rate, to enroll in the program.[lxxiii]
- During peak events, Minnkota is able to temporarily control DERs including heat pumps, water heaters, EV chargers, and commercial & industrial loads.
- Minnkota also worked to cultivate widespread buy-in from member distribution co-operatives to message the enrollment benefits, providing customers a uniform messaging approach.[lxxiv,lxxv]

Case Study: Arizona Public Service, AZ *(High-impact action)*

***Arizona Public Service** Cool Rewards enrolled 97,500+ thermostats by establishing an online marketplace that offers pre-enrollment at point of purchase.*

- **Arizona Public Service (APS)** launched **Cool Rewards**, a smart thermostat program, in 2018 after the Arizona Corporation Commission authorized demand response and load management programs for the utility.
- As of November 2024, the Cool Rewards program has enrolled over 97,500 connected thermostats with the ability to shed over 160 MW of load during peak demand events from both residential and small to medium-sized business customers.
- APS established a smart thermostat marketplace on their website where all customers could get an instant $30 rebate at checkout.[lxxvi]
- APS allowed customers to receive an additional $85 off upfront by pre-enrolling into the Cool Rewards program after providing basic information (e.g., name and address).
- Embedding pre-enrollment into the point-of-sale process reduces marketing and recruiting costs for the program. As of the end of October 2024, 9,290 Cool Rewards pre-enrollments were processed through APS marketplace, which was built in partnership with **Enervee**.[lxxvii]

Detailed case study provided in Appendix B.ii.

See Appendix B for 9 case studies that are simplifying VPP enrollment (Appendix B.i. and B.ii.), 6 additional resources (Appendix B.iii.) and 2 supportive DOE programs (Appendix B.iv.).

Chapter Three: Increasing standardization in VPP operations

Key takeaways

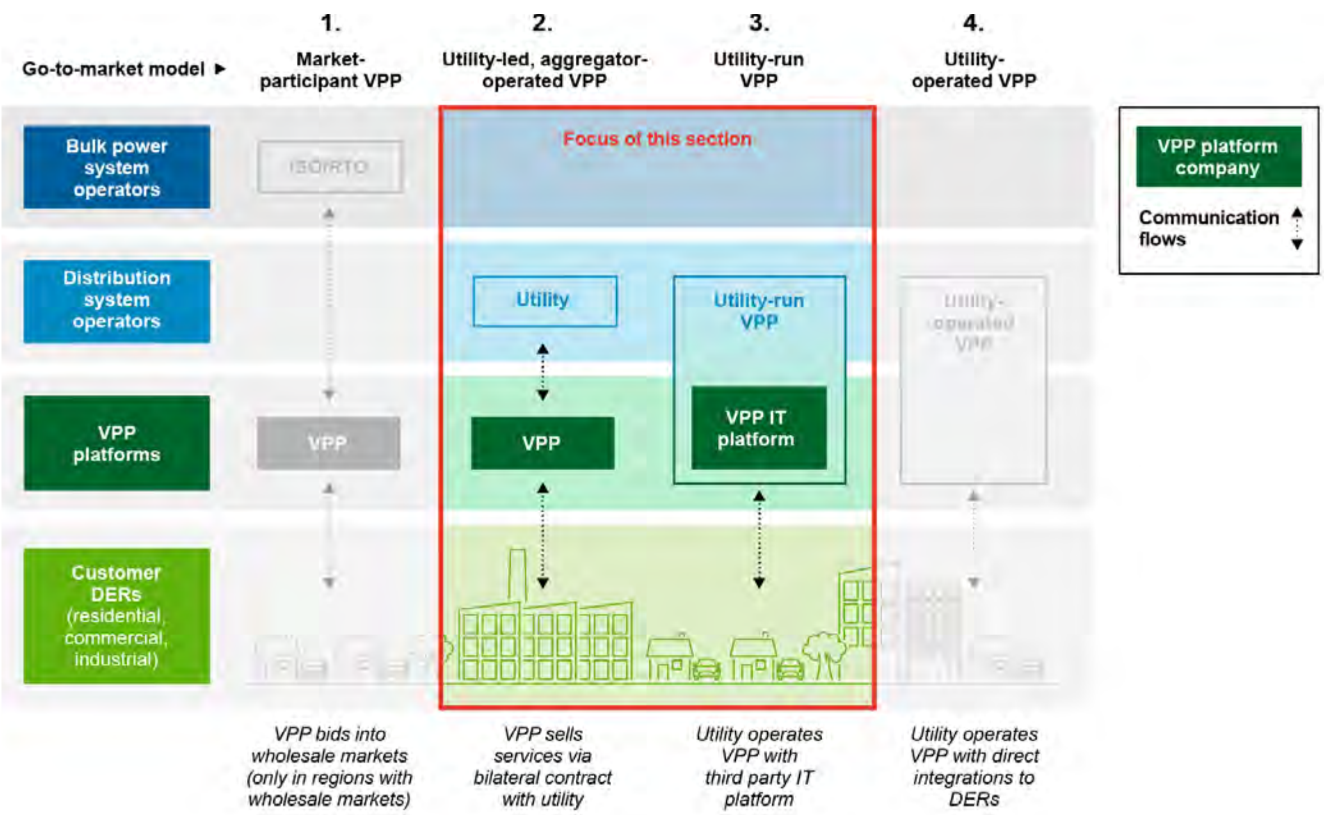
- Increased standardization can reduce the complexity and cost of deploying VPPs. New efforts are underway within and outside of DOE to align on industry standards for utility-aggregator interfaces, aggregator-DER interfaces, cybersecurity, and other aspects of VPP operations.
- Even in the absence of standards, many utilities today use basic VPP configurations to reduce system-level peak demand. This kind of VPP can be deployed at scale within six months with less than $1M in upfront investment and can create a foundation for more sophisticated VPP models that deliver a broader range of benefits.
- More sophisticated VPPs can deliver distribution grid services and unlock additional value streams (e.g., deferral of distribution system upgrades). These solutions may require the installation of additional hardware and software that provide (1) higher-resolution visibility into distribution grid conditions through sensors and improved data analytics and (2) more frequent and localized dispatch of DERs.

3.i. Variation in utility-led VPP operations

A lack of technology interoperability and other operational standards across utilities, state and tribal governments, and regional markets has made it difficult to repeat and scale proven VPP models nationally, but this has not prevented a proliferation of successful, albeit bespoke, VPP deployments. VPP platform companies and related service providers have had to customize individual VPP deployments to adapt to the protocols and systems of specific utilities, align to the program budget structures of specific state utility regulators, and abide by the rules of specific wholesale markets, minimizing positive economies of scale nationally.

Although the flexibility and adaptability of VPPs as a technology category is part of the value proposition, their variability has created the false impression that individual VPPs are inherently complex. In fact, an individual VPP can be simple for utilities and grid operators to deploy and operate (*see ConnectedSolutions case study in Section 3.iv.)*. This is particularly true when the orchestration of the DER aggregation is managed by third party aggregators and delivered to utilities as a single resource without integrating the aggregation platform into utility systems. The complexity arises when looking *across* VPPs at the many different ways operators structure and send data, define grid services, and design software interfaces in the absence of standardized approaches.

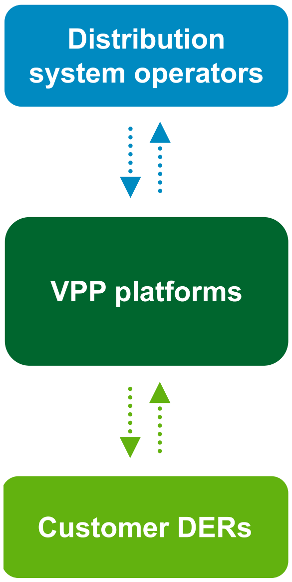
VPP market participation models[25]



3.ii. Standardization efforts recently launched or expanded

In the past year, DOE and other industry actors have launched or expanded efforts to standardize critical areas of VPP operations to reduce complexity and cost of implementation and increase reliability of performance.[26]

Recent efforts to increase standardization in VPP operations



	Focus area of recent standardization efforts	*Example initiatives (not exhaustive)*
1	**VPP platform to utility communication interface**	• FlexIT (EPRI) • TSO-DSO-DER Aggregator operational platform (DOE)
2	**Grid services definitions**	• Distribution System Transformation resources (DOE)
3	**Aggregator service contracts**	• Standardized services contract (NAESB, DOE)
4	**VPP platform to DER communication interface**	• Mercury Consortium (Kraken, industry) • Consortium for Energy Efficiency (industry-led)
5	**Meter data format and access rules**	• Green Button Standard (industry-led)
6	**VPP resource definition**	• Guide for VPP specifications (IEEE Working Group 2030.14, *forthcoming*)
7	**Shared DER registry**	• DER registry model (Collaborative Utility Solutions, DOE)
8	**Cybersecurity for DERs**	• DER Cybersecurity Best Practices (DOE) • UL 2941 cybersecurity certification standard for DERs (DOE, industry)

25 For a simple explanation of U.S. electricity market structures that influence VPP market participation models, see the 2023 VPP Liftoff Report.

26 See section 4.iii. ('Increase standardization in VPP operations') in the 2023 VPP Liftoff Report for detail on the challenges and potential solutions for this imperative (pages 43-47).

Successfully developing standards that are universally applicable will require diverse expert input from technology manufacturers, software developers, service providers, load serving entities, and other practitioners. Industry groups and community organizations can also play an important role by convening stakeholders to contribute to these efforts, and by packaging insights for policymakers and regulators to incorporate into their decision-making processes.

Area of operations	Description	Example standardization initiatives
VPP platform to utility communication interface	VPP platform providers must be able to send and receive information to and from a utility using an interface and data language compatible with utility IT systems, which vary from one utility to the next.	▸ **EPRI** launched the FlexIT initiative to deliver technical specifications for providing DER discovery and visibility, and to establish standards for the core utility-to-VPP/aggregator interactions involved in the provision of T&D grid services.[27,lxxviii] In addition to writing a standard and accompanying guidance, the initiative aims to build a mock utility and mock aggregator interface with reference code to test for interoperability.[lxxix] ▸ The **DOE Office of Electricity** is developing guidelines for a TSO-DSO-DER Aggregator operational platform as well as corresponding coordination requirements.
Grid services definitions	Grid services definitions make up the taxonomy and functional criteria of grid services procured for safe and reliable bulk power system, distribution system, and grid edge services. Today, different grid operators set their own definitions.	▸ **DOE's Office of Electricity** has published working definitions of grid services for bulk power, distribution, and grid edge services as part of its library of Distribution System Transformation resources.
Aggregator service contracts	The contract governing the delivery of grid services from a third-party aggregator for a utility includes terms and conditions around customer engagement plans, dispatch schedules, dispatch capacity limits, performance evaluation methods, settlement processes, and more. Given the rapidly evolving market, there has been little convergence to date on the structure of these contracts.	▸ The **North American Energy Standards Board (NAESB)**, in partnership with **DOE's Office of Electricity**, is developing a standardized services contract for VPP providers for distribution market interactions.[lxxx]

27 This initiative builds on past efforts such as the IEEE 2030.11 Guide for Distributed Energy Resources Management Systems (DERMS) Functional Specification, which DOE has supported.

VPP platform to DER communication interface	VPP platform providers' IT systems connect to and communicate with DERs through application programming interfaces (APIs) that must be compatible with the specific manufacturer-installed software.[28] Without interoperability standards (i.e., standardized software interfaces), each VPP platform must write brand-specific APIs and maintain them as manufacturers update their software.	▸ The Mercury Consortium, led by VPP platform **Kraken** and its partners, launched in 2024 to increase adoption of existing standards for flexible demand devices[29] and address gaps in testing and certification[30] of those standards as they are built into devices. Such standards may include OpenADR, CTA-2045, IEEE 2030.5, and MATTER. ▸ The Consortium for Energy Efficiency, an organization of utilities administering ratepayer-funded efficiency programs across North America, has adopted new specifications for heating, ventilation, and cooling (HVAC)[lxxxi] and water heating[lxxxii] equipment to require that equipment meet the relevant industry standard for "communication, infrastructure, and system functionality as these relate to the implementation of energy management strategies" starting in 2026.[31,lxxxiii]
Meter data format and access rules	The Green Button[32,lxxxiv] initiative is an industry-led effort to provide utility customers with easy and secure access to their energy usage information in a consumer-friendly and computer-friendly format.[lxxxv] Since its launch in 2012, utility implementation of the data and access standards has been voluntary, and many non-utility grid service providers point to insufficient implementation as a major obstacle to sharing grid data that could accelerate grid modernization.	▸ Additional utilities (**Consumers Energy** in Michigan[lxxxvi], **Louisville Gas & Electric** in Kentucky[lxxxvii], and **Entergy** in Texas[lxxxviii]) representing over two million customers have adopted the Green Button standard since 2023.

28 Problems can arise when VPP platforms do not properly integrate with devices. For example, in a practice called "screen scraping," an aggregator might write code that integrates with a consumer app (e.g., the EV brand app) rather than the device software itself (e.g., the EV telematics). This practice could violate terms of the device software, lead to bugs when the consumer app is updated and the code is not, and overall does not offer high-fidelity information exchange required for grid operations.

29 IEEE 1547 is a common communication standard for generation-capable devices. Complying with this standard requires following specified rules (e.g., IEEE 2030.5, SunSpec Modbus) for how DER capabilities are set and monitored, such as voltage regulation settings, power factor settings, and power export limits. These rules specify a structure for data to enable interoperability among system components made by different manufacturers. In contrast, flexible demand devices are generally less standardized in their communication protocols and data formats.

30 Testing and certification of products and their software are important to validate that standards are properly incorporated. Beyond testing and certification, incentives (carrots) or enforcement and penalties (sticks) would help increase standards adoption.

31 This action also means that the federalFederal tax credit for this equipment will only be available to DR-ready equipment. In 2023 alone, over 850,000 households claimed this credit for electric HVAC or water heating equipment.

32 Green Button is based on the Energy Services Provider Interface (ESPI) data standard released by the North American Energy Standards Board (NAESB) in the fall of 2011. The data standards development process was facilitated by the National Institute of Standards and Technology (NIST). The ESPI standard consists of two components: 1) a common XML format for energy usage information and 2) a data exchange protocol which allows for the automatic transfer of data from a utility to a third party based on customer authorization.

VPP resource definition	The term 'Virtual Power Plant' commonly refers to a category of resources rather than one narrowly defined asset. Even so, the term is interpreted differently across different stakeholders today.	▸ **IEEE Working Group 2030.14** is developing a guide for VPP functional specification for alternate and multi-source generation.
Shared DER registry	Recruiting VPP participants can be costly for a utility or aggregator. A DER registry would serve as an opt-in database of existing DERs in a given jurisdiction (the registry could be implemented state-wide or market-wide, where applicable) that logs information on the DER location, type, and functional ability to provide grid services. A primary goal of the registry is to accelerate the identification of DERs and enrollment into VPPs.	▸ **Collaborative Utility Solutions**, with support from **DOE**, developed and launched a **functional DER registry model**[lxxxix] that can be adopted and implemented by states and tribes and shared by their utilities so that each jurisdiction does not need to build their own independently. This model registry uses a common information model (CIM) for all users that covers critical inputs for the integration of DERs into grid operations.
Cybersecurity for DERs	Most DERs installed in homes and businesses today are connected to communications and control software and networks, and are interconnected with the electric grid. This increase in connection points widens the attack surface that could be exploited by malicious actors. Cybersecurity strategies ranging from data encryption to system governance can be engineered into utility and aggregator systems in many ways to secure grid operations and protect customers.	▸ **DOE's Office of Cybersecurity, Energy Security, and Emergency Response** is continuing to develop and disseminate cybersecurity "baselines" and **best practices for DERs** and VPPs to safeguard against risk. ▸ **DOE and industry partners** initiated the **UL 2941 cybersecurity certification standard for DERs** in 2023 to map hardware and software security requirements from industry best practices and provide information for industry stakeholders.

Three additional areas of VPP operations that market participants say sorely need more standardization are discussed in the context of FERC Order 2222 implementation in *Chapter 5: Integrating into Wholesale Markets*. They include electricity consumption data access, DER metering and telemetry, and DER aggregation participation models.

See Appendix C for 2 additional resources (Appendix C.iv.) and 17 supportive DOE programs (Appendix C.v.).

3.iii. VPP performance attributes

Not all variation in VPP configurations is counterproductive; new innovations in VPP design and implementation have increased the delivered benefits of VPPs across the country. The "right" configuration of VPP hardware and software will be determined by the desired performance attributes of the VPP, which are a function of the needs and priorities of the utility.

Relatively basic VPPs that deliver bulk system peaking capacity can be launched in a short timeframe (<6 months) with minimal upfront cost (<$1M), while providing high-value peak shaving benefits to ratepayers and the grid. These basic VPPs can build additional capabilities over time and establish a foundation for more sophisticated models in several ways.[33] Grid services, frequency of dispatch, and scale can all increase incrementally if and when needed.[34] Within the utility, operating a basic VPP at scale produces a wealth of historical DER and participant behavior data that can be used to train predictive models of VPP performance; this can help a utility set appropriate incentive payment levels, set event frequency limits to prevent participant attrition, test automatic enrollment effectiveness, and more.
Building the VPP's dispatch 'track record' can also help grid planning teams better understand the value of the resource and model the VPP resource into future generation, transmission, and distribution investment scenarios.[35] Outside of the utility, customers become familiar with VPP participation options and participants grow accustomed to potential changes in behavior (if any). Regulators also gain familiarity and comfort with VPPs as a reliable tool to manage the grid more affordably and reliably.

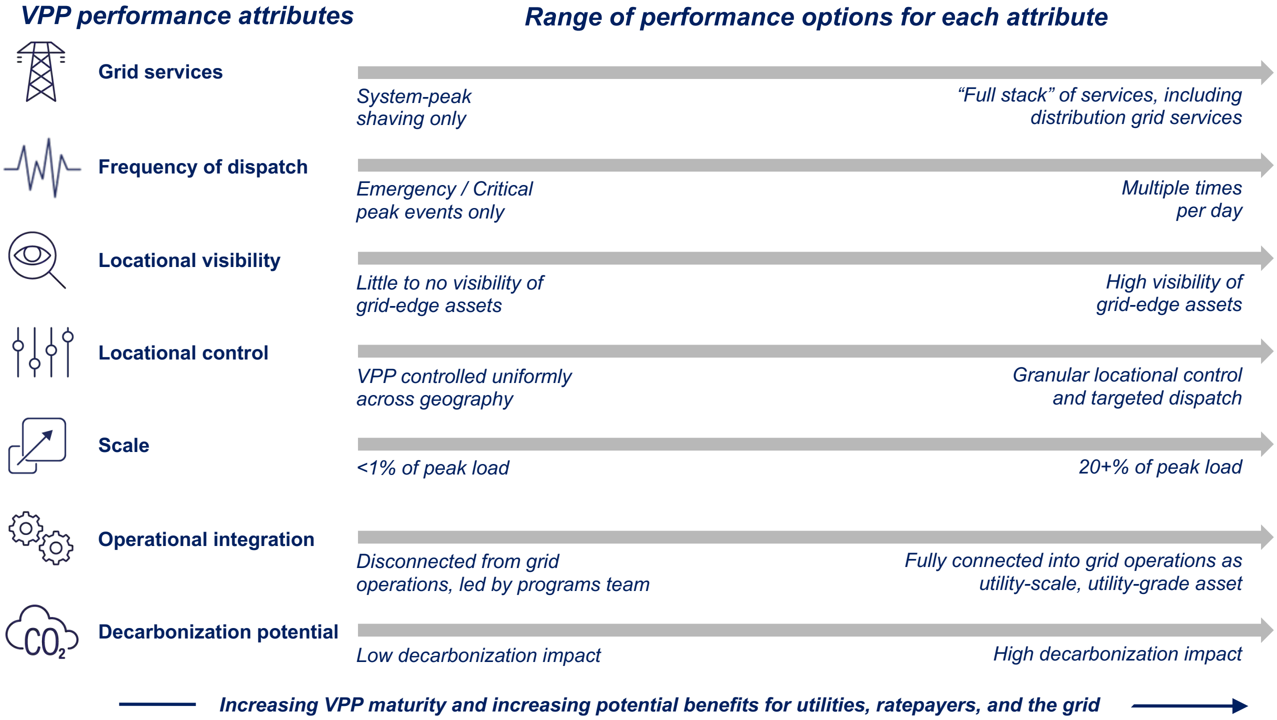
The progression from basic to more sophisticated utility-led VPP configurations can be assessed along at least seven performance attributes. A given VPP may not necessarily advance along all attributes in unison; rather, its specific performance requirements will be dictated by utility needs and priorities.

33 Capex-light, basic VPP-related investment may be low-risk for utilities because they avoid locking into one technology for long periods of time. Utilities can carefully analyze potential investments in durable equipment, and in particular metering infrastructure. While some VPPs rely on meter data for performance measurement, others operate independently of advanced meters by integrating DERMS software directly into DER software-based controls (e.g., smart thermostats, batteries) and collecting data directly from the device for performance measurement and settlement. Any significant investment in advanced metering infrastructure should involve a long-term technology and functionality roadmap that weighs the costs and benefits of different system architectures. This is particularly important in light of recent metering technology advancements that equip meters with new computing and communication capabilities with an associated cost increase from roughly $150-200 per meter to double that price or more.

34 Adding capabilities to existing programs that already have customers enrolled has advantages over adding new and separate programs, particularly in jurisdictions that only allow enrollment in a single program per meter.

35 The need to build a track record of performance data has often been cited as a reason to pilot a VPP before deploying it at scale. This has held back VPP growth when programs stay in the pilot stage without a path to scale in regulatory or utility management plans. This can be prevented by implementing first-time VPPs without an end-date or capacity limit, establishing go/no-go milestones as safeguards against poor performance, continuously monitoring performance indicators, and allowing for ongoing improvements to operational parameters.

VPP performance attributes and corresponding range of performance options



Each of these seven performance attributes is described in more detail below.

Grid services: System peak shaving or shifting is the most basic functionality of a VPP, but DER aggregations can provide additional services such as energy, frequency response, black start, and more[36,xc] with the right mix of DERs and the right underlying software and hardware.

Frequency of dispatch: While some basic VPPs are called only during critical grid events, more sophisticated VPPs can be dispatched more often – potentially multiple times per day – to support normal grid operations.

Locational visibility: For VPPs to go beyond system-level benefits and provide distribution grid benefits, a utility must understand where it faces distribution grid constraints or problems that VPPs might alleviate. This requires heightened situational awareness of conditions on the distribution grid, which is not common among distribution system operators today.[37,xci]

36 For a full list of grid services and definitions, see Bulk Power, Distribution, and Grid Edge Services Definitions from DOE's Office of Electricity.

37 A variety of grid technologies can enhance situational awareness. This includes advanced distribution management systems (ADMS), which are software platforms that integrate numerous utility systems and provide automated management of distribution grid performance. ADMS often collects data from supervisory control and data acquisition (SCADA) systems. Monitoring and management systems for distribution grid assets, up to and including a customer's meter are sometimes referred to as a "*Grid* DERMS" (distributed energy management system). This is distinct from an "***edge*** DERMS," described below. These few examples illustrate the variety of possible enabling technology configurations.

Locational control: Locational control goes hand-in-hand with locational visibility. For a VPP to react to, or prevent, a location-specific distribution grid constraint with services from a local DER aggregation, the VPP requires granular control of DER sub-aggregations within the overall resource. It also requires an understanding of how a DER's physical location – i.e., street address – maps to the topology of the grid, to ensure the right DERs are called upon to drop load (or export energy).[38]

Scale: As VPP capacity (MW or MWh) grows relative to system peak demand, grid operators rely on VPPs for a higher percentage of grid resources (generation supply and T&D capacity). More sophisticated VPPs manage a higher percentage of system peak demand.

Operational integration: The extent to which VPPs are incorporated into the planning process and regular operations of a utility's distribution, transmission, and generation teams varies widely. Historically, many basic VPPs have been managed by customer programs teams with little to no impact to other functional groups within utilities; this limits the potential benefits of the VPP for the broader utility system. In contrast, leading utilities who operate more sophisticated VPPs have incorporated them into integrated planning processes and operations (*discussed further in Chapter 4: Integrating into utility planning & incentives)*. In other words, these utilities consider VPPs in the option set alongside traditional resources when making decisions in capital planning, ratemaking, and maintenance schedules.

Decarbonization potential: Most VPPs dispatch to optimize one variable: costs. They reduce costs by decreasing demand during system peak hours to avoid high energy prices, or decrease local peak to defer a costly equipment upgrade. More sophisticated algorithms also consider the avoidance of greenhouse gas emissions, thereby optimizing around multiple desired outcomes.

As the descriptions above illustrate, most VPP performance attributes relate to *how* technology is used rather than *what* technology components (hardware and software) are used. An important exception may be among utilities who need to make incremental investments to implement technology such as ADMS and related tools to gain situational awareness at the grid edge and enable location-specific distribution grid services from VPPs. These systems create and transmit the data about grid conditions that dictate VPP operations and dispatch.[39]

Utilities that have launched active managed EV charging VPPs are leading examples of utilities investing in the capability to optimize distribution grid conditions. Rather than setting EV charging schedules (or calling events ad hoc) only in response to day-ahead energy prices from wholesale markets, these VPPs are *also* managing charging in response to real-time grid conditions based on data collected from distribution grid equipment.[40] Examples include programs operated by VPP provider **WeaveGrid** with utility partners **Baltimore Gas & Electric**, **Pacific Gas & Electric**, and others, and other programs operated by **EnergyHub** with utility partners such as **Eversource**.[xcii]

38 An "edge DERMS," refers to a software platform that controls or sends signals to equipment behind the customer's meter (i.e., directly to DERs or DER owners). The edge DERMS aggregates independent DERs and orchestrates them to act as a utility-scale resource. While an edge DERMS may know the address of the DER, it must be integrated into the utility's system (i.e., the ADMS or Grid DERMS) to know how the behavior of each DER impacts the distribution system.

39 Managing the enrolled DERs of a VPP to enhance distribution grid operations typically requires automated dispatch of DERs because a given utility may have thousands or tens of thousands of load limits to monitor across its distribution system – more than can be managed manually. Automation based on granular locational conditions often requires tight integration between the utility system and the edge DERMS, which requires investment from the utility.

40 For in-depth explanations and case studies of multi-layered optimization in EV managed charging programs – including optimization for distribution grid congestion and optimization for renewable energy generation–see the State of Managed Charging in 2024 report from the Smart Electric Power Alliance.

3.iv. Case studies of utility-led VPP operations

VPPs can be deployed in less than six months with less than a million dollars of investment to avoid higher costs of traditional assets. Examining and comparing the operations of multiple utility-led VPPs can help illustrate the differences between a relatively basic versus more sophisticated VPP and provide context for areas where increased standardization can streamline implementation. This section, along with detail provided in Appendix C, explains how three real, utility-led VPPs operate to demystify the communication technology that enables a VPP and to compare their relative performance across the seven attributes outlined in the previous section. In doing so, the case studies may help stakeholders pinpoint where increased standardization is most needed (and where it is not).[41]

National Grid's 'ConnectedSolutions' in Massachusetts, Green Mountain Power's 'Energy Storage System' (ESS) Leasing program in Vermont, and Rocky Mountain Power's 'Wattsmart' in Utah each employ different information technology (IT) and operational technology (OT) configurations in their VPPs. Each has proven to be cost-effective and reliable for the utility and customers, and each is growing its capacity as more participants choose to enroll.

Case Study: National Grid, ConnectedSolutions, MA and NY

National Grid established a multi-device VPP *within 4 months with <$500k upfront investment that now provides up to 250 MW of peak shaving benefits.*

- **National Grid** developed and launched its ConnectedSolutions 'bring-your-own-device' (BYOD) VPP in less than four months to provide low-cost, low-emissions peaking capacity in Massachusetts and New York.[42]
- In this configuration, National Grid contracts with **EnergyHub**, an edge DERMS vendor that integrates multiple DER software systems into one platform. The heterogenous aggregation is controlled as one cohesive, utility-scale resource.
- National Grid sends notices to EnergyHub in advance of peak hours to dispatch demand reductions from the customer-owned DER aggregation that EnergyHub manages on National Grid's behalf.
- National Grid required little change to its internal organizational operations to implement the VPP. System integration is low; a National Grid employee logs into EnergyHub's online portal to send instructions and collect data.

41 While this section focuses on utility-led VPPs, *Chapter 5: Integrating into wholesale markets* focuses on VPPs that sell grid services into wholesale markets and includes discussion of variation across ISO/RTOs.

42 For additional detail on the policy and regulatory context in which ConnectedSolutions was implemented, including the energy and non-energy benefits included in the cost-effectiveness test for the program, see the case study annex (page 66) of NARUC's ADER Resources in 2024: The Fundamentals.

Case Study: Green Mountain Power, Energy Storage System Leasing Program, VT

Green Mountain Power launched a utility-owned and operated battery VPP *that offers backup power for participants, peaking capacity, emissions reduction, and transmission benefits for the grid, and lower costs for all customers.*

- **Green Mountain Power** fully launched the Energy Storage System (ESS) Leasing program in 2020 to improve system reliability in the face of extreme weather while reducing costs for all customers.[43]
- GMP operates the program with **Tesla** technology. Tesla supplies the battery hardware (Powerwalls) and acts as the software platform that aggregates and orchestrates battery dispatch.
- Tesla uses real-time load data provided by Green Mountain Power via an API to strategically dispatch batteries to shave peaks on the distribution system.

Case Study: Rocky Mountain Power, WattSmart, UT

Rocky Mountain Power developed a battery VPP *that integrates directly into its grid operations system and enables many grid services.*

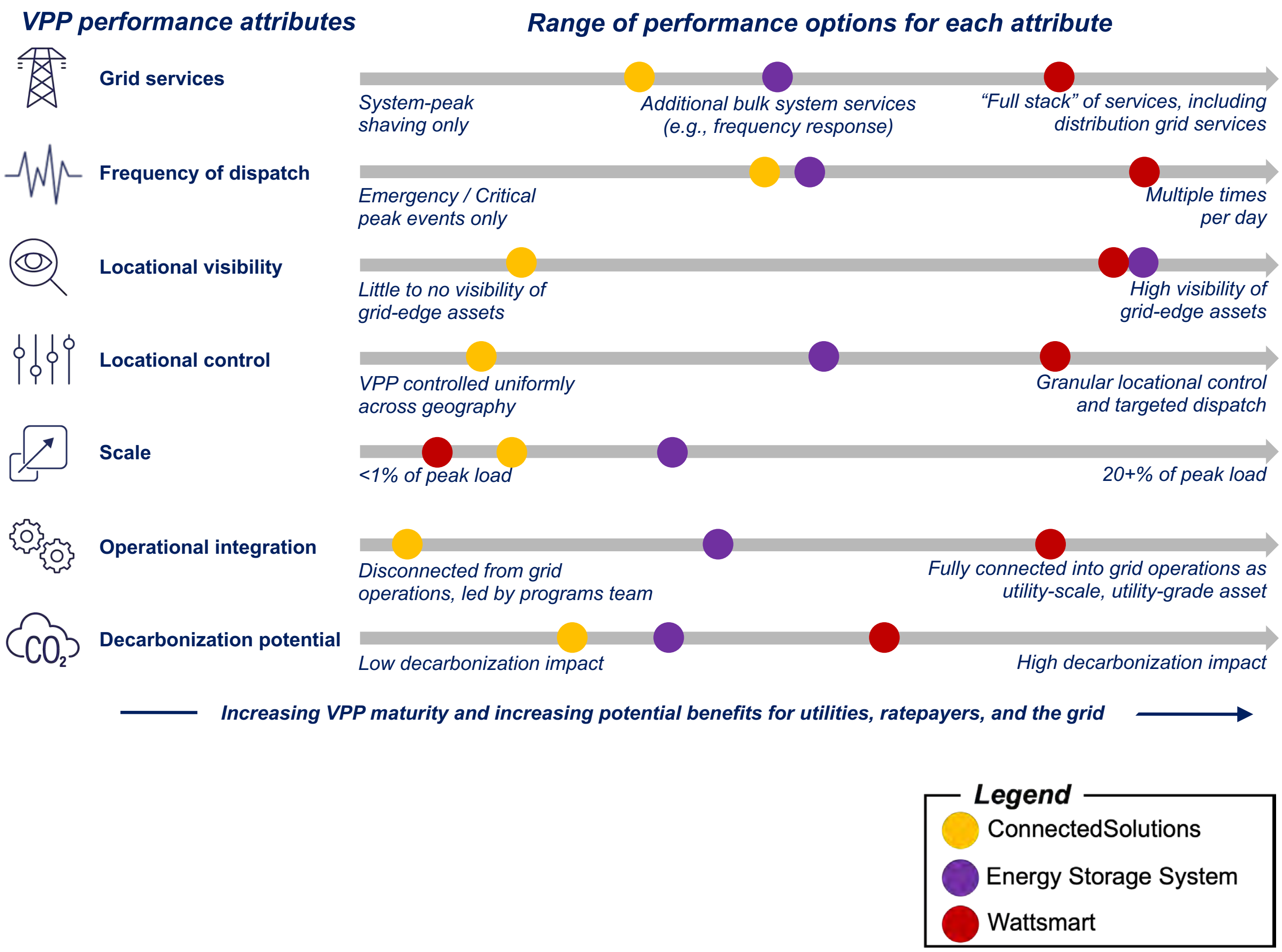
- **Rocky Mountain Power** developed its Wattsmart battery VPP in partnership with **sonnen** to deliver high-value grid services cost-effectively and increase battery adoption among customers.
- RMP creates significant value for the grid by obtaining a "full stack" of valuable grid services from the batteries, paying participants upfront and ongoing performance incentives.
- Unlike VPPs used only during peak hours or peak seasons (summer, winter), RMP may use its batteries 365 days of the year, 24 hours per day.
- RMP's grid operations team directly dispatches the batteries using a distributed battery grid management system (DGBMS) that integrates battery controls directly into the utility's energy management system without any intermediate software layers.
- The network of batteries can respond automatically to grid signals in as little as three seconds (sonnen and Core+ batteries) and no slower than 50 seconds (other brands). RMP personnel can override automated dispatch at any time.
- The Wattsmart VPP is growing rapidly, with a near-term goal of reaching 100 MW by recruiting customers with solar arrays (>80,000 in Utah) and offering battery incentives to motivate customers to 'firm' their renewable power.

See Appendix C for detailed case studies that include program overviews, communication protocols & operations, and IT and OT components for each of the three VPPs referenced in this section.

43 For additional detail on the policy and regulatory context in which GMP implemented its VPP, including the monetized and non-monetized benefits of the program, see the case study annex (page 63) of NARUC's ADER Resources in 2024: The Fundamentals.

As the ConnectedSolutions example demonstrates, VPPs can be quick and extremely cost-effective to implement for system-level peak shaving benefits.[44,xciii] ESS and Wattsmart demonstrate that VPPs can deliver a wider range of grid services with incremental IT and OT capabilities that integrate VPP operations into utility systems. Each of the examples is designed to meet the needs of the specific utility and its customers. Below, the examples are compared along the seven performance attributes.

VPP performance for three utility-led VPPs



44 LUMA's Customer Battery Energy Sharing program in Puerto Rico is another example of a VPP providing peaking capacity (over 10 MW) without incremental investments in grid modernization; LUMA operates its VPP without a DERMS and without advanced metering infrastructure.

Chapter Four: Integrating into utility planning & incentives

Key takeaways

- Across the U.S., VPP deployment has been highest in the states with supportive state regulatory and/or policy actions.
- Many state utility regulators – public utilities commissions (PUCs) and public service commissions (PSCs) – have opened regulatory proceedings within the last 18 months to advance VPP adoption. Examples include requiring longer-term distribution grid planning that incorporates consideration of VPPs and establishing or revising compensation mechanisms to better align utility financial incentives to positive grid and customer outcomes.
- Legislative changes to utility regulations or policy are not necessary for investor-owned utilities to deploy VPPs today, but can accelerate deployment by establishing a direction and removing ambiguity about VPP goals and other program parameters (e.g., types of DERs, desired grid services). Examples include Colorado and Maryland legislative actions.
- Regulators and policymakers approaching VPPs today can draw from the menu of 22 policy actions underway across the U.S. to inform program design and integrate VPPs into utility planning and incentives.

Note: This chapter discusses state regulatory and policy actions that are most relevant for investor-owned utilities (IOUs) regulated by state PUCs/PSCs. Governing bodies of other utilities (e.g., member boards of co-ops, city councils overseeing public power, tribal utility authorities) can also look to these levers for consideration, but the historical financial disincentives impacting IOUs may be less relevant to nonprofit cooperatives and municipally run utilities.

4.i. Utility financial incentives and VPP deployment

In the era of flat electricity demand over the last two decades, VPP deployment by investor-owned utilities (IOUs) was in part stifled by a lack of financial incentives because it meant lower utility profits. Under conventional regulatory models, IOUs can earn an authorized return on equity (typically 9-11% annually) on capital investments; thus, IOUs deploying a low-capex VPP to add system capacity instead of a traditional capex-heavy investment (e.g., a peaker plant) would have realized lower profits.[45]

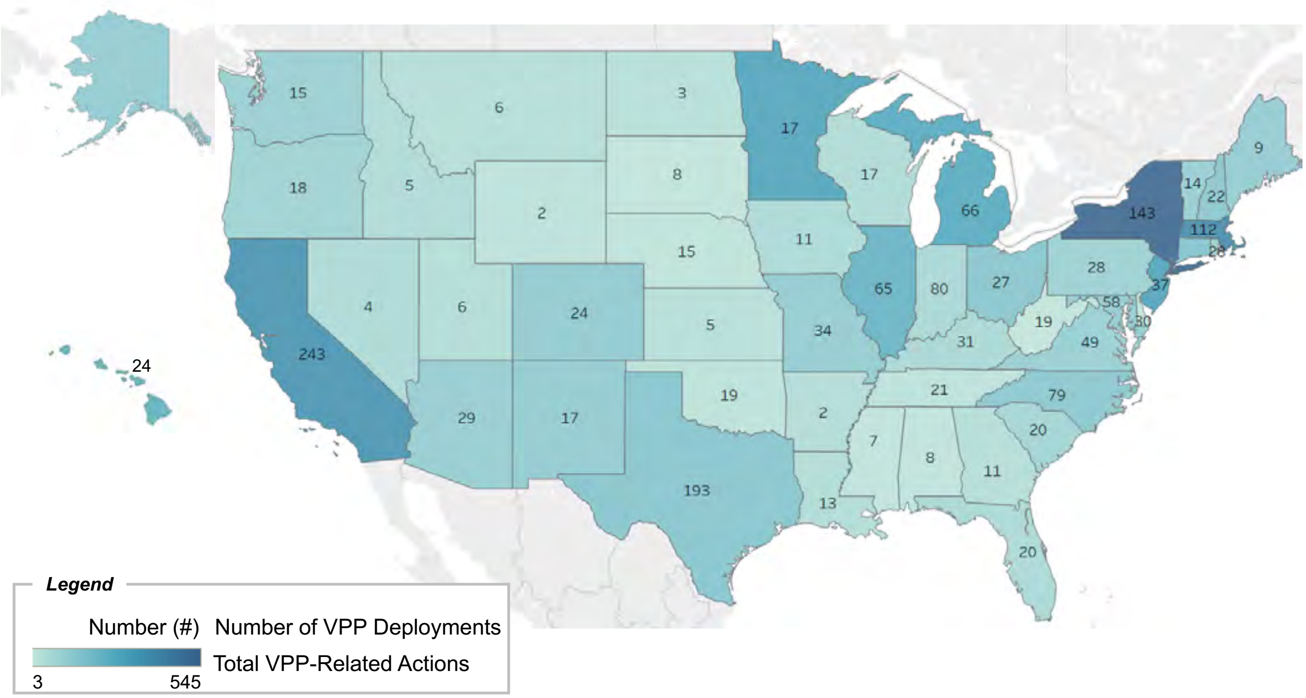
Today, rising electricity demand and the need to replace aging grid infrastructure means many utilities have rapidly growing capital needs. In this context, IOUs can deploy VPPs to help meet system needs and interconnect more load,[46,xciv,xcv] while creating room in their budgets for necessary capital-intensive investments elsewhere (e.g., transmission expansion, new bulk power generation assets). Additionally, state regulators and policymakers are applying pressure to limit capital expenditure and increasingly pushing back on utility investment plans to ensure any increase in customer bills is fully warranted. For example, in December 2023, the **Illinois Commerce Commission** rejected **Ameren Illinois** and **Commonwealth Edison**'s multi-year integrated grid plans over concerns that the utilities did not adequately "consider affordability and cost-effectiveness [criteria] so that customers are not unfairly asked to shoulder undue costs."[xcvi]

45 See page 48 of the 2023 VPP Liftoff report for additional detail on utility compensation structures.

46 For example, since 2017, Arizona Public Service (APS) has been developing demand response and load management programs (with approval from the Arizona PUC) to aggregate DERs into VPP programs, helping manage growing load (as discussed in APS' 2019 IRP Draft). In Minnesota, Northern States Power Company (doing business as Xcel Energy) introduced the concept of distributed capacity procurement (DCP) in comments for an IRP filing (Docket No. E002/RP-24-67) and said the program could provide 400 – 1,000 MW of capacity; actual plans with specifics would be included in the future IRP.

While IOUs can start implementing VPPs without any regulatory or policy changes, supportive regulatory and policy action is accelerating VPP deployment. Across the U.S., localities where state regulators or policymakers have taken VPP-supportive actions have seen the highest number of total VPP deployments to date.

Number of VPP deployments (as of July 2024) vs. state policy/regulatory VPP-related actions (2020-Q3 2024), count



Note: Number of VPP deployments based on Wood Mackenzie data as of July 2024.[xcvii] Wood Mackenzie defines a VPP deployment as: "The association of a vendor aggregation and a DER program. Aggregation is broadly defined to consist of DERs or loads directly under vendor management, or under the management of a downstream device partner. Example: If three vendors partner on a VPP that is monetized through two programs, there will be six deployments recognized." State regulatory and policy actions based on North Carolina Clean Energy Technology Center and includes data from Q1 2020 – Q3 2024.[xcviii] VPP-related state policy/regulatory actions include all types of actions tracked by DSIRE Insight (studies, policy, incentives, deployment, rates) that include the technology tag: demand response, grid modernization, smart grid, storage, AMI, DER, distribution system planning, data access, VPPs.
Source: Wood Mackenzie 2024 NA VPP Market Report, North Carolina Clean Energy Technology Center Policy & Regulatory Actions

State regulators and policymakers play a critical role in enabling a statewide VPP approach to support easier scale up across utility jurisdictions. While several utilities have pursued VPP deployments before any policy or regulatory action, state policy and regulatory efforts have been important to supporting broader adoption by integrating VPPs into standard utility processes (including planning and cost recovery) and aligning utility and ratepayer incentives. As discussed in the 2023 VPP Liftoff Report, increased VPP standardization will accelerate VPP integration in utility planning and incentives.[47]

47 See page 35 of the 2023 VPP Liftoff Report for additional discussion on the imperatives.

4.ii. Supportive regulator actions for integration into utility planning and incentives

All state regulators have the authority to pursue actions that could support VPP deployment.[48] As part of their mandate to ensure affordable and reliable electricity service, PUC/PSCs can proactively direct utilities to fairly consider VPPs alongside ongoing conventional capital investments (e.g., bulk power generation, transmission, distribution) to meet grid needs. In many states, PUCs' legacy organizational models, limited staff capacity, and reactive cultures have resulted in limited proactive engagement with utilities before they submit investment plans (e.g., providing proactive guidance on considering VPPs).[xcix] This is starting to change as mounting load growth, affordability, and reliability pressures on the grid are motivating several state PUCs to proactively provide direction and establish programs that can influence IOU investments, including VPP deployments.

Supportive regulator actions for VPP integration into utility planning and incentives *(not exhaustive)*

Utility cost recovery	System planning	DER deployment	DER aggregation	VPP operations
Establishing utility cost recovery methods for VPP-related investments	Improving grid planning processes to better integrate VPPs as a solution	Implementing or revising programs to increase DER deployments, which enhance VPP potential	Developing DER aggregation models and deployment requirements to enable VPPs	Supporting VPP operations to proactively address common VPP deployment barriers
• Massachusetts • Michigan • Vermont	• Georgia • Massachusetts • Minnesota	• Colorado • Michigan • New York • South Carolina	• California • Colorado • Texas	• Connecticut • Massachusetts • New York • Rhode Island

See Appendix D.i. for a menu of additional regulatory and policy options that regulators and policymakers can consider alongside case studies of how those options have been implemented to date.

Example types of actions that PUCs have pursued recently to drive uptake of VPPs include:

1. **Utility cost recovery: Establishing utility cost recovery methods for VPP-related investments.** PUCs are implementing performance incentive mechanisms (PIMs)[49,c] and clarifying what types of VPP-related investments are eligible for cost recovery (e.g., including DERs in utility rate base,[50,ci] capitalizing software costs).

2. **System planning: Improving grid planning processes (e.g. integrated distribution system planning) to incorporate VPPs as a solution.** PUCs can implement integrated distribution system planning to require objective-driven planning (e.g., grid reliability improvements, customer empowerment), planning over long-term time horizons (e.g., 10+ years), and consideration of comprehensive solutions to address grid needs (e.g., DERs, VPPs).[51,cii] Today, 21 states and the District of Columbia require utilities to file integrated distribution system plans[ciii];

48 State regulators include public utility and public service commissions (PUC/PSCs) that regulate most investor-owned utility (IOU) planning, operations, and retail compensation as relates to VPP deployment and the distribution system. PUC/PSCs review and approve IOU capital investment plans and have authority over determining IOU capital return rates, customer rate designs, and other distribution system plans. See VPP Liftoff report page 20 of the 2023 VPP Liftoff Report for additional info on state regulator roles and responsibilities.

49 Performance incentive mechanisms (PIMs) is a type of performance-based regulation (PBR). PBR is a regulatory model that financially rewards utilities for positive ratepayer outcomes, rather than returns on capital expenditures. See NARUC's PBR Overview to learn more. See RMI's PIM Database for a longer suite of examples of PIMs that PUCs and utilities have implemented.

50 Proposals for utilities to own behind-the-meter devices, such as batteries or generators, have drawn criticism from some industry participants who say that although such an approach may lead to faster scale-up of VPPs, it may lead to higher electricity prices for customers because of the utility's monopoly power, lack of competition to drive down prices, and its guaranteed financial return on the devices when included in the rate-base.

51 See Lawrence Berkeley National Lab's Integrated Distribution System Planning resource hub, which includes an interactive planning framework, a map and detail on existing planning requirements by state, and information on technical assistance and resources available to PUCs and policymakers.

broader use of integrated distribution system planning practices could promote a more proactive utility investment approach to better consider and use DERs and VPPs. Regulatory approaches requiring or directing utilities to invest in grid orchestration platforms (e.g., DERMS) as part of broader grid modernization efforts can help distribution utilities manage an increasingly complex and digital grid, which also establishes the technology foundation for future VPP deployments.[52]

3. **DER deployment: Implementing or revising programs to increase DER deployments, which enhance VPP potential.** PUCs are studying and establishing methods to increase DER deployments, such as streamlining interconnection processes, establishing customer incentives, and testing pay-for-performance compensation mechanisms and DER-supportive tariffs. DERs can support net cost savings for customers and increase the resources available for DER aggregation.
4. **DER aggregation: Developing DER aggregation models and deployment requirements to enable VPPs.** PUCs are requiring utilities to develop pilots or consider how to aggregate DERs into a VPP program to be used as a grid asset.
5. **VPP operations: Supporting VPP operations to proactively address common VPP deployment barriers.** PUCs are increasingly influencing VPP operations to maximize system value, including by engaging on data access challenges[53] and establishing tariff structures that better compensate VPPs for their full suite of grid benefits (e.g., capacity, reliability, decarbonization impacts, etc.) and enabling value stacking (including stacking across both retail and wholesale market revenue streams).

Specific state examples illustrate how PUCs are putting these types of actions into practice.

Case Study: Colorado PUC, CO

***Colorado PUC** established a performance incentive mechanism to accelerate DER interconnection, helping improve DER deployment to support VPP potential.*

- **Colorado PUC** approved a performance incentive mechanism for **Xcel Energy** to speed up interconnection of DERs (Order 23AL-0188E) in October 2023.[civ]
- The PIM requires Xcel to refund customers 4% of the interconnection fee per day delayed beyond Xcel's internal timeline targets (e.g., 50 days).
- If Xcel interconnects the DER faster than the target timeline, the value would be credited against any penalties accrued for exceeding the target.
- The PIM aims to align Xcel incentives with ratepayer interests to support DER interconnection, enabling faster DER deployment and supporting greater VPP potential at scale.

52 See DOE's Innovative Grid Deployment Liftoff report for additional information on other grid modernization technologies and foundational platforms available to support modernizing distribution grids.

53 See *Chapter 5.iv* for additional detail on VPP-related data access challenges and potential solutions.

Case Study: New York State PSC, NY

***New York State PSC** implemented a value compensation methodology to reward DERs for a range of delivered grid benefits.*

- In 2017, **New York State PSC** implemented a Value of Distributed Energy Resources Value Stack (VDER, or the Value Stack) to better compensate and incentivize DERs for provided grid value.
- The Value Stack includes six values to determine DER compensation:
  - Energy Value (Locational Based Marginal Price, LBMP)
  - Capacity Value (Installed Capacity, ICAP)
  - Environmental Value (E)
  - Demand Reduction Value (DRV)
  - Locational System Relief Value (LSRV)
  - Community Credit (CC)
- This model allows for value stacking across multiple revenue streams (including wholesale market revenues) to fully reward DERs for delivered grid benefits.
- The Value Stack provides location-specific compensation to reward VPPs that have the greatest impact on alleviating distribution system constraints.

Detailed case study provided in Appendix D.ii.

State by state, PUC/PSCs have different policy contexts and starting points of regulatory frameworks that can be used – or adjusted – to encourage VPP deployment. [54] When motivated to support VPP deployment, PUC/PSCs can leverage components of the real-world examples described above to tailor regulatory actions that are appropriate for their state's context and grid objectives.

Regulators have reported success with directing a few staff members to develop simple VPP regulatory frameworks (e.g., a smart thermostat program) and then adding resources and scaling up over time towards more complex regulatory efforts as impacts are proven out and lessons are learned.[cv]

Regulatory approaches will likely continue evolving over time as VPP program design and underlying technology also evolve. To enable continuous improvement, PUCs could consider establishing processes that enable and encourage evolution. For example, the **Hawaii PUC** built in iteration to revisit elements of DER programs (e.g., incentive levels, operational characteristics) every three years with stakeholders to keep pace with an evolving grid.[55] The **Connecticut Public Utilities Regulatory Authority (PURA)** implemented a "regulatory sandbox" program that fosters new grid technology deployments and informs enabling regulation.[56,cvi]

54 For policymakers/regulators considering implementing a VPP initiative, RMI/VP3 defined a set of guiding policy principles that can help inform initial actions to maximize long-term benefit (See Appendix D.v. for the full set of policy principles.

55 See additional detail about Hawaii's DER program evolution in NARUC's Aggregated DER in 2024: The Fundamentals (page 69).

56 Connecticut PURA established the Innovative Energy Solutions Program in 2023 to encourage grid innovation, including defining features such as a four phase process from ideation to scale up, cost recovery guidance, and screening and performance metrics.

4.iii. Supportive policymaker actions for integration into utility planning and incentives

Legislative changes to utility regulations or related policy are often not *necessary* for investor-owned utilities to deploy VPPs or for regulators to take action, but they can be an *accelerant*. Legislation and other policy measures can shorten design and deployment timelines by removing ambiguity about VPP goals and other program parameters or aligning expectations with state energy and climate goals.

At the state level, policymakers (e.g., legislators, governors, tribal governments) can empower PUC/PSCs in states where regulators may not consider it their role to proactively shape VPP programs and/or the processes underpinning their deployment (e.g., filing dockets, RFIs, etc.). In these states, policymakers can accelerate regulatory processes, potentially by years, by providing direction and focus while giving PUCs and utilities room to determine the most effective regulatory frameworks. Similarly, tribal governments can also provide direction to tribal utilities to advance VPP-supportive actions. In Colorado, Massachusetts, and New York, actions by policymakers built on previous PUC actions to strengthen and provide explicit support to grid modernization and VPP supportive efforts.

Three types of actions that state policymakers have recently taken to support VPP deployments include:

1. **Establishing grid modernization policies and VPP-enabling requirements to enhance system planning: Washington State** passed HB 1589 in March 2024 that required utilities to submit integrated system plans. VPP-enabling features include requiring plans to align with state clean energy goals and emission reduction targets.

2. **Requiring utilities and PUCs to develop VPP programs and/or supportive tariff mechanisms: Colorado** passed SB24-218 in May 2024 that requires the state's largest IOU (Xcel) to submit a VPP plan to the PUC. This built on ongoing actions by the **Colorado PUC** to advance VPP programs as part of an effort to serve rising demand while mitigating costs for ratepayers.

3. **Clarifying VPP stakeholder roles and requirements: Texas** legislators passed SB 1699 to establish third-party aggregation requirements for DERs and to authorize the **TX PUC** to establish rules and requirements for DER aggregators.

See Appendix D for a menu of 22 regulatory and policy options to support VPPs (Appendix D.i.), detailed case studies on New York PSC's Value of DER (VDER) Value Stack compensation method and Massachusetts legislation on grid modernization planning requirements (Appendix D.ii.), 6 additional resources (Appendix D.iii.), 9 supportive DOE programs (Appendix D.iv.), VPP policy principles from the Virtual Power Plant Partnership (VP3) (Appendix D.v.), and a summary of existing benefit-cost assessment frameworks available to support VPPs from NARUC (Appendix D.vi.).

Chapter Five: Integrating into wholesale markets

Key takeaways

- In the last decade, wholesale markets have been the primary mechanism to provide and monetize grid services from distributed flexible loads – particularly commercial and industrial loads.
- FERC Order 2222 has the potential to unlock wholesale market participation from an enormous amount of DER capacity. At a time when capacity markets are tight (e.g., PJM), VPP participation in wholesale markets has never been more important for system affordability and reliability.
- Although industry actors have been excited about the potential impact of Order 2222, slow implementation timelines, varied approaches across ISO/RTOs, and obstructive state, ISO/RTO, and utility rules have blocked the full integration of VPPs into wholesale markets.
- Technology, regulatory, and policy solutions are emerging domestically and internationally to remove barriers for VPP integration into wholesale markets. Industry collaboration is needed to share learnings and accelerate implementation.

5.i. VPP wholesale market participation today

In the last decade, wholesale markets have been the primary mechanism to provide and monetize grid services through demand response for distributed loads – particularly commercial and industrial loads. Today, 29 GW of demand response participates in wholesale markets.[cvii]

All seven of the U.S. ISO/RTOs allow wholesale market participation from VPPs that manage demand without exporting power to the grid. Well-established demand response aggregators such as **CPower** continue to focus their business strategy on wholesale markets, which offer large potential revenue streams from the energy, capacity, and ancillary services markets as well as greater long-term revenue certainty given the durability of wholesale markets. In comparison, individual utility-level VPP programs tend to have short-term contracts (1-2 years), which creates greater revenue uncertainty for aggregators.[57]

See Appendix E.i. for a detailed case study on how Leap aggregates demand response to participate in the CAISO market.

While total revenue potential across wholesale markets is large, each ISO/RTO has a unique set of rules and processes that require deep expertise to navigate, creating barriers for new entrants. As a result, participating in wholesale markets may provide lower levels of compensation than current utility-led VPPs receive today. Additionally, most ISO/RTOs only allow large-load demand response and do not yet allow DERs that store or generate energy (e.g., distributed storage and solar PV) to export power to the grid. This limits the value that DERs can bring to wholesale markets to a fraction of their technical functionality.

Streamlining wholesale market integration and allowing the full range of potential grid services from installed DERs could help address increasing capacity constraints that are causing price spikes and diminishing reserve margins across the U.S. For example, **PJM**, an RTO that coordinates wholesale electricity markets in all or parts of 13 states and the District of Columbia, held a capacity auction in summer of 2024 that resulted in final capacity prices nearly 10x higher than the previous year's auction.[58,cviii,cix,cx,cxi]

57 Uncertainty around grid services revenue increases the cost of capital for industry actors investing in VPP participant recruitment and/or DER deployment. Longer-term contracts with greater revenue predictability can reduce the overall cost of VPP deployment, resulting in higher savings to pass on to customers.

58 In early 2024, PJM updated its capacity accreditation methodology to reflect the marginal contribution each resource can provide to system resource adequacy given the anticipated resource mix. As a result, many supply resources (including solar PV, gas, coal, hydropower, demand response) had lower capacity that could bid into the capacity market, resulting in lower capacity. Simultaneously, many existing power plants were forecasted to retire, further constraining supply and increasing PJM capacity prices.

As a result, PJM ratepayers will be responsible for $14.7 billion in capacity costs for the 2025-2026 delivery year, as compared to $2.2 billion for the 2024-2025 delivery year.[cxii,cxiii] In early 2024, PJM updated its capacity accreditation methodology for all supply resources, including demand response. PJM's accreditation is based on PJM's existing requirement that DR resources be available for dispatch only between 10am-10pm during the summer and between 6am-9pm during the winter, even though DR resources could also perform outside these windows – effectively derating demand response because of PJM's rules rather than technological reality.

5.ii. Overview of FERC Order 2222

FERC Order 2222 has the potential to dramatically accelerate national action towards integrating VPPs into wholesale markets, which could maximize the value of DERs in restructured regions and help address rising affordability and reliability challenges to meet demand growth. Issued in September 2020, Order 2222 *requires* the six FERC-jurisdictional ISO/RTOs[59] to establish participation models that enable DER aggregations to participate in energy, capacity, and ancillary services wholesale markets.[60,cxiv]

In issuing the Order, FERC recognized that a much wider range of DERs can provide wholesale market services, including those that export power and smaller individual assets.[61] The Order is meant to offer a path to expand supply-side participation by DERs beyond demand response and place downward pressure on prices in markets with high demand and low supply. However, successful implementation of Order 2222 will require coordinated action from a broad range of stakeholders including ISO/RTOs, utilities, aggregators, regulators, and policymakers across the country.

5.iii. ISO/RTO Order 2222 compliance status

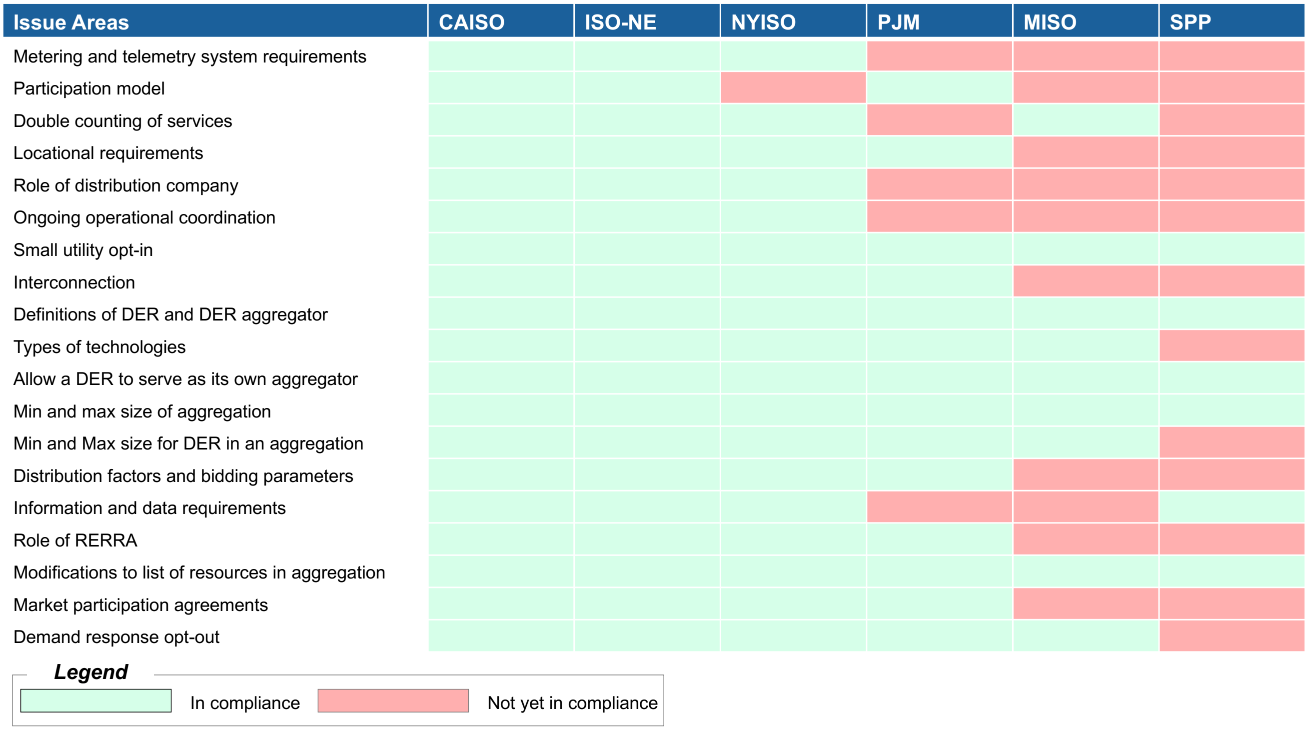
ISO/RTO compliance with FERC Order 2222 requirements has been varied: CAISO, NYISO, and ISO-NE are leading implementation while PJM, MISO, and SPP are seeking to implement much of their Order 2222 compliance proposals several years later. Although all six FERC-jurisdictional ISO/RTOs have filed compliance proposals with FERC, and FERC has issued orders on these filings, **CAISO** and **ISO-NE** are the only ISO/RTOs that have fully complied with the requirements of FERC Order 2222 as of December 2024.[cxv,cxvi]

59 FERC does not have ratemaking jurisdiction with respect to ERCOT in Texas.

60 Specifically, Order 2222 requires each ISO/RTO to (a) develop tariff provisions that ensure that market rules facilitate the participation of DER aggregations, (b) allow DER aggregations to participate directly in ISO/RTO markets, and (c) establish DER aggregators as a type of market participant that can register DER aggregations.

61 FERC declined requiring ISO/RTOs to adopt minimum capacity requirements for individual distributed energy resources to participate in the markets, given those resources would only participate in the markets through a DER aggregation which would act as a single resource. However, some market operators have adopted minimums for individual DERs. For example, NYISO proposed a minimum capacity of 10 kW for each individual DER in any aggregation for a VPP to be eligible to participate, which would exclude many residential DER types.

Order 2222 compliance status



Source: Lawrence Berkeley National Lab DER Participation in Wholesale Markets Report, FERC filings

ISO/RTO compliance plans exhibit individualized, disparate approaches to DER wholesale market participation, resulting in a patchwork of rules and requirements that make it difficult for aggregators to scale across jurisdictions. Order 2222 did not provide a technical implementation roadmap, leaving it up to the ISO/RTOs to make their own decisions on VPP integration standards and protocols. Market operators are taking different approaches to compliance with varying rules, baselining methodologies, grid services definitions, and operational protocols. For example, **ISO New England** requires telemetry readings to be actual data for all assets while **PJM** allows telemetry readings to be calculated based on a sample of DERs.[cxvii]

While some variation is expected given varying market conditions and needs, the degree of variation across regions is introducing delays in scaling up proven VPP models nationally to address near-term grid needs. For example, one industry analysis estimated that standardizing ISO/RTO metering and settlement approaches alone could create $75B in savings due to reductions in data computing, storage, and management costs.[cxviii]

Even in achieving Order 2222 compliance, ISO/RTOs could still limit VPP participation. For example, separate from its compliance with Order 2222, **NYISO** proposed a minimum capacity of 10 kW for each individual DER in any aggregation for a VPP to be eligible to participate, which would exclude many residential DER types.[62,cxix] In California, even though **CAISO** has reached full compliance with Order 2222, **California Public Utilities Commission (CPUC)** does not recognize aggregations of DERs as qualified to provide resource adequacy, which is one of the major barriers for aggregators that want to directly participate in CAISO's resource adequacy construct.[cxx]

62 In a September 2022 presentation, NYISO wrote, 'Given the NYISO's current technical resources and capabilities for initial DER deployment, allowing small (<10 kW) DER will require a substantial amount of additional manual work to complete tasks that are core to the timely participation of DERs.'

5.iv. Common challenges for integration into wholesale markets

VPP aggregators, ISO/RTOs, and utilities have noted three key issue areas that impact VPP integration into wholesale markets.[cxxi]

Common issue areas to VPP integration into wholesale markets

Data access	Metering and telemetry	Participation models
Lack of access to high quality customer energy data, grid data, and information about the ownership and location of DERs	Varied requirements for measuring and reporting data	Different approaches to how DER aggregations can bid into markets and the grid services they can provide

These common issues increase costs and complexity for all available assets to participate to their fullest potential

1. **Data access: Lack of access to high quality customer energy data, grid data, and information about the ownership and location of DERs limits aggregators' ability to establish and operate reliable VPPs that can participate in wholesale markets.**

   Hourly and daily customer energy data is required for aggregators to complete wholesale market processes such as receiving customer consent to access data, calculating baselines and performance, and implementing settlement procedures. Most ISO/RTOs require VPP aggregators to use customer energy data from utility-owned meters, yet most utilities limit third-party data access, citing cybersecurity and data privacy concerns. Aggregators must follow varied and often lengthy processes to access customer energy data from utilities, which makes it difficult to know if, when, and in what format data will be shared across utilities even within the same ISO/RTO region.[63] Aggregators have had limited success in improving data access rules despite filing complaints and requesting improvements.[64,cxxii,cxxiii] FERC has stated that customer usage data access is not within FERC's jurisdiction, leaving it to individual ISO/RTOs, states, tribes, or utilities to determine data access policies.[cxxiv]

2. **Metering and telemetry: Each ISO/RTO is developing individual frameworks to determine how to measure and report DER energy data, which increases the complexity and cost for aggregators to deploy and scale VPPs.**

   As relates to Order 2222, "metering" refers to the rules that determine how DER aggregations measure energy injection and withdrawal; "telemetry" refers to how aggregations report the real-time data needed to provide grid services. ISO/RTOs require VPPs to use meter data for planning, operations, and settlement purposes. While the technological capabilities exist to capture this data, such as with

63 For example, sometimes aggregators must email utilities with a form requesting a customer's data. In other cases, utilities have portals where aggregators can access the data directly.

64 For example, CPower, an aggregator who works closely with utilities and supports utility programs, brought a complaint before FERC (EL23-104) showing that lack of data access limits demand response participation in wholesale markets. CPower argued that PJM rules limit the participation of aggregators by refusing to allow statistical sampling for measurement purposes. If statistical sampling were allowed, CPower could measure behavior of a representative sample of customers in their aggregation who have advanced metering infrastructure (AMI) and extrapolate the performance to the full aggregation. PJM, however, requires measurement from every individual meter for interval metered customers, which dramatically reduces CPower's capacity contribution because utilities in the region block access to data from many meters where customers could otherwise participate. FERC denied the complaint and noted that customer usage data access is not within their jurisdiction. Additional detail provided here: CPower Statement Regarding September 19 FERC Decision - CPower Energy; Order Denying Complaint re Enerwise Global Technologies, LLC v. PJM Interconnection, L.L.C. under EL23-104

advanced metering infrastructure (AMI)[65] or metering manufactured into devices, most utilities do not measure demand at this granularity and ISO/RTO telemetry requirements can be too costly or complex for certain asset types.

For Order 2222 compliance, FERC did not provide strict guardrails for either metering or telemetry, approving each ISO/RTO's framework so long as they justify how their requirements are just and reasonable and do not pose an unnecessary and undue barrier to individual DERs joining an aggregation. This has led to a wide variety of approaches that are seeking to balance data granularity with the costs of reporting high frequency data. For example, **NYISO** requires six-second telemetry for every DER asset that is at least 100 kW, regardless of the service provided. **PJM** allows one-minute scans for resources that do not provide regulation services and entirely exempts DERs under 10 MW from telemetry reporting.[cxxv]

3. **Participation models: ISO/RTOs are taking different approaches to develop market participation rules that define how DER aggregations are allowed to bid into wholesale markets and the grid services they can provide, making it difficult for aggregators to replicate similar models across markets.**

   ISO/RTOs have multiple choices in determining market participation rules that define how aggregations bid into the market. An ISO/RTO can choose between requiring aggregators to comply with rules already established for existing supply resources (e.g., applying rules for utility-scale batteries to aggregations of residential behind-the-meter batteries), creating new participation models specifically for DER aggregations, or using a hybrid approach.

   There are trade-offs between these approaches. For example, leveraging models for existing supply resources could avoid slow, expensive processes to create new participation rules, but may restrict participation from aggregations that have multiple types of DERs. Creating a single, new participation model for DER aggregations could simplify aggregator choice on how to participate in a wholesale market but may require all types of DER aggregations to comply with the same rules (e.g., battery-only aggregation may have the same rules as an aggregation with batteries, thermostats, and commercial & industrial loads).[66] Offering a hybrid approach, as **NYISO** and **ISO-NE** are currently suggesting, allows aggregators to choose the option that is highest value to their business model.[cxxvi]

Outside these three challenges, additional issue areas include how to coordinate and compensate dual participation of DERs across wholesale and retail markets[67] (i.e., avoiding 'double counting' for the same service), locational requirements on aggregating DERs across eligible pricing nodes, and ongoing coordination between distribution utilities, market operators, and aggregators.

65 AMI or 'smart meters' are used to measure a customer's energy consumption during set time intervals. AMI includes technologies to measure and communicate energy use and other data and notifications at intervals that are granular enough to support grid and market operations.

66 ISO-NE created multiple DER aggregation participation models to address the drawbacks of creating only one new participation model that would apply to every type of DER aggregation.

67 There is still a role for utilities to play to compensate VPPs for distribution benefits separately and in addition to wholesale market compensation to cover the full value stack of potential services. A VPP that delivers benefits to the transmission system and to the distribution system (even if during the same event) can be fairly compensated for both.

5.v. Supportive actions for VPP integration into wholesale markets

ISO/RTOs, state regulators, utilities, and aggregators can collaborate to streamline learnings and converge on comparable approaches that address common issues, enabling VPPs to better meet near-term grid capacity needs at lower costs for ratepayers.

There are multiple solutions available globally that could be adopted to support VPP integration into wholesale markets.

Case Study: Australian Energy Market Operator (AEMO)

***Australian Energy Market Operator** established a centralized, standardized DER registry to provide visibility to DER specifications and location to eligible entities.*

- In 2020, the **Australian Energy Market Operator (AEMO)** established a centralized DER registry to better manage the grid, improve system reliability as the grid becomes more decentralized, and deliver energy at a more affordable price.
- The register provides a common, standardized information fact base with visibility to DER specifications (e.g., type, capabilities, resource ownership) and location.
- Customers, AEMO, distribution utilities, DER industry, and other third parties (such as emergency services) can access the register.
- Entities are required to provide data in certain formats and timelines; for example, utilities are required to provide DER information in accordance with the DER Register Information Guidelines under the National Electricity Rules to ensure standardization, and DER installers are required to submit data within 20 days of installation.[68,cxxvii,cxxviii,cxxix]

Case Study: Ontario Independent Electricity System Operator (IESO)

***Ontario Independent Electricity System Operator (IESO)** created market-wide standards for meter registration to standardize data collection and reduce IT costs*

- **Ontario IESO** has established market-wide standards for meter registration across numerous distribution utilities and 5 million smart meters.[cxxx]
- Market rules require that each metering installation used for settlement purposes is on a list of pre-approved meters established by IESO that meet specific performance standards (e.g., accuracy, security).
- Establishing a market-wide approach to metering simplifies and standardizes data collection while reducing IT costs to develop, manage, and protect the database.
- This spurred additional engagement with various grid stakeholders to expand third-party access to this database, including for demand response aggregators.[cxxxi,69]

See Appendix E for 6 case studies on actions ISO/RTOs have been taking domestically and internationally to integrate VPPs into wholesale markets (Appendix E.iii.), 6 additional resources (Appendix E.iv.) and 3 supportive DOE programs (Appendix E.v.).

68 The Australian Energy Market Commission made a rule obligating AEMO to establish this register in the National Electricity Market in September 2018. AEMO engaged with a wide range of partners, including utilities and industry groups, to design the register and align on the corresponding data sets and data collection processes.

69 Another example is ConnectedSolutions, which has metering authority across multiple utilities in Massachusetts. Common program design across utilities enables standardization of data access, dispatch, monitoring and verification, and DERMS while providing economies of scale for enrollment.

In parallel with ISO/RTO implementation of Order 2222, state policymakers and regulators can act to build enabling VPP regulations and policies that further integrate VPPs into wholesale markets. Example actions include:

- **Lifting state-level 'opt outs' on Order 719:** FERC Order 719 was introduced in 2008 to allow demand response to participate in wholesale markets alongside traditional supply-side resources.[cxxxii] However, states were allowed to 'opt out,' by prohibiting third-party aggregators from directly contracting with customers. These 'opt outs' have greatly limited DER market participation in these states. **Missouri PSC** ruled to partially lift its FERC Order 719 opt out in October 2023 by allowing energy customers above 100 kW (commercial & industrial loads) to enter **MISO's** demand response market.[cxxxiii] By starting with commercial and industrial loads, Missouri state regulators and utilities could test and learn to inform more complex future policies and VPP integration approaches. **Michigan** and **Wisconsin** have also partially lifted their initial 'opt out' of Order 719. Ten states still have 'opt outs' in place for Order 719.[70]
- **Determining the state regulator's role in Order 2222 implementation:** **Pennsylvania PUC** issued an Advanced Notice of Proposed Rulemaking in February 2024 to investigate the PUC's role in Order 2222 implementation. Topics identified for stakeholder input included DER interconnection rules, metering requirements, data sharing protocols, and cost allocation processes.[cxxxiv]
- **Requiring utilities to meet data sharing standards:** **Connecticut PUC** created a Data Access and Privacy Framework to clarify data requirements for IOUs deploying AMI, including data sharing expectations with third-party aggregators.[cxxxv] In response, **Eversource** agreed to adopt Green Button Connect to enable third-party data access.[cxxxvi] Similarly, **Rhode Island PUC** is requiring **Narragansett Electric Company** to submit a plan about data access (including for VPPs) as part of the utility's planned investment into AMI.[cxxxvii]

70 The ten states that continue to fully opt out of Order 719 are Arkansas, Indiana, Iowa, Kentucky, Louisiana, Minnesota, Mississippi, Montana, North Dakota, and South Dakota.

Closing

The U.S. electric grid is increasingly under stress from rising peak demand, climbing utility investments in aging distribution systems and other assets, and increasingly frequent blackout-inducing extreme weather events. "**Virtual Power Plants" or "VPPs" are cost-effective solutions that can be deployed at scale in a short timeframe to maximize the use and value of existing grid infrastructure, minimize costs to ratepayers, and ensure a resilient, reliable, and secure grid for all Americans.**

VPP awareness and deployment is growing, as demonstrated by the 75 case studies, 50 DOE supportive programs, and 20 resources highlighted in this report. Just in the last year, utilities and aggregators have launched increasingly sophisticated VPPs that provide distribution grid benefits in addition to system peak shaving; state regulators and policymakers have implemented VPP-supportive policies; and industry groups have released new solutions to address gaps identified in the 2023 VPP Liftoff Report.

Momentum is building, but the success of many of these efforts hinges on further action and continuous improvement. Many of the case studies presented in this report are early indications of progress, and their full impacts remain to be seen. By tracking, disseminating, and acting upon lessons learned from VPPs across the country (and internationally), stakeholders can accelerate near-term VPP deployment in the pursuit of a more resilient, reliable, and low-cost energy future.

Appendices

Each Appendix directly relates to the five chapters in the main report. Each chapter of the Appendix includes additional case studies of how various industry actors are taking action on the five imperatives today, detailed overviews of select case studies, key resources to support the work of practitioners, and example supportive actions from the Department of Energy.

Appendix A: Expanding DER adoption with multifaceted benefits

A.i. Levers to expand access to VPP participation, DER ownership, and community-wide benefits

This section provides a list of barriers to expanding access to VPP participation, DER ownership, and community-wide benefits as well as supportive actions that various stakeholder groups can take to address these barriers.

Access to VPP participation

Primary barriers	Levers by stakeholder group
Low awareness of VPP participation opportunities	» **Utilities, policymakers, philanthropy organizations:** Fund and educate community organizations to educate consumers on VPP participation opportunities and consumer benefits » **DER OEMs, DER retailers, utilities, community organizations:** Publicize VPP participation opportunities and educate consumers on their benefits
Qualifying DER too expensive	» **Utilities:** Prioritize integration of low-cost DERs for VPP programs
Community mistrust *(especially for underserved communities due to historic divestment)*	» **Utilities, aggregators:** Partner with trusted community organizations and inform program launch with thoughtful community outreach » **Utilities:** Set equity targets for customer programs; track and publicly report progress against key metrics » **Policymakers:** Require strong customer protections for VPP programs
Lack of reliable connection	» **Policymakers:** Ensure allocation of available broadband grants[71] to rural communities
Lack of flexibility in energy usage[72]	» **Utilities, aggregators:** Offer flexible, opt-out options for DER orchestration

Access to DER ownership

Primary barriers	Levers by stakeholder group
High upfront DER costs with limited low-cost financing options	» **Policymakers, utilities:** Provide upfront, tiered incentives with caps » **Policymakers, regulators, utilities:** Allow incentive stacking to unlock cheapest cost » **Utilities, regulators, policymakers:** Leverage inclusive utility investments to provide access to low-cost financing options
Split incentives between property owners and tenants	» **Utilities, regulators:** Include multi-family housing, especially affordable multi-family housing, in DER programs » **Utilities, regulators:** Develop tariffs to share benefits of DER programs between property owners and tenants
Additional home integration costs	» **Utilities, policymakers:** Ensure upgrade costs (e.g., minor construction) qualify for financing and incentive programs
Lack of education on DERs and available incentives	» **Utilities, policymakers, philanthropy organizations:** Fund and educate community organizations to conduct outreach to match appropriate incentive programs to eligible consumers, particularly in underserved communities

71 Broadband access is important for VPPs that rely on Wi-Fi connection to the device (either directly to the aggregator platform, or through a consumer app that in turn connects with the aggregator's platform). Some VPPs use other communication mechanisms; for example, radio frequency has been used in water heater programs for decades.

72 Low-income communities and other underserved communities may not have the ability to shift or reduce their energy usage as they are already trying to minimize energy usage to reduce utility bills. Lack of flexibility might impact their desire to enroll in a VPP which may cede control of their device at times that may be inconvenient to their circumstances.

Access to community-wide benefits

Types of VPP benefits	Levers by stakeholder group
Reduced pollution burden	» **Utilities, regulators:** Consider VPP deployment prior to approving construction of a new fossil fuel-powered peaker plant » **Utilities, regulators:** Deploy VPPs in communities which have a disproportionate number of fossil fuel plants sited nearby to reduce usage of existing polluting infrastructure
Reduced impact of outages	» **Utilities, regulators:** Target VPP deployment to communities with higher rates of system outages » **Policymakers, regulators:** Prioritize VPP deployment in disaster recovery and resiliency work » **Utilities:** Explore deploying microgrids for vulnerable parts of the grid, wherein the microgrid's DERs can either be islanded for resilience (e.g., at local community centers) or used for bulk grid services to help offset their cost
Lower utility bills	» **Utilities, regulators:** Share cost savings from VPP deployment with all ratepayers[73] » **Utilities:** Spread VPP economic benefits out over the year to minimize large swings in energy bills and ensure consistent bill reductions
Local workforce development	» **Policymakers, regulators:** Partner with Registered Apprenticeship Programs and local technical schools to create pipeline of high-quality workforce in local communities for DER installation » **Utilities:** Partner with a local contractor base for DER installation

A.ii. Case studies by lever

This section provides case studies of VPP and related deployments that showcase the real-life applications of the levers identified in Appendix A.i. Two of the case studies, Roanoke Cooperative's Upgrade to $ave program and San Diego Community Power's Solar Battery Savings program, have detailed overviews provided in Appendix A.iii.

Access to VPP participation

Lever	Example
Prioritize integration of low-cost DERs for VPP programs	Shifted Energy's 2.5 MW VPP in Hawaii installs smart, programmable water heaters for VPP participation.[cxxxviii] **Allowing low-cost DERs such as water heaters to participate creates more inclusive programs** for priority populations.[cxxxix] Shifted Energy has partnered with local community organizations to reach more than 3,000 families, including low-income residents in areas where trust in the utility is low and would otherwise prevent customers from enrolling in VPP programs that offer energy bill savings.[74,cxl,cxli]
Fund trusted community organizations and inform program launch with thoughtful community outreach	Mass Saves, a collaborative of Massachusetts' electric and natural gas utilities and energy efficiency service providers[cxlii], established the Community First Partnership to increase participation in energy efficiency programs. This **partnership funds community-based organizations, who have the knowledge of and relationships with local communities, to conduct targeted outreach** for these programs, prioritizing renters, low- and moderate-income households, customers who speak languages other than English, and small businesses in participating communities.[cxliii] Mass Saves itself is funded by energy efficiency charges on all customers' gas and electric bills.[cxliv]

73 Utilities that set participant incentive levels high enough to attract large-scale participation, but low enough to be measurably cheaper than alternative grid investments can pass on the savings to all customers by avoiding or deferring unnecessary increases in the ratebase.

74 Smart thermostats are also effective DERs to prioritize for equity considerations, given their affordability and short payback periods.

Access to DER ownership

Lever	Example
Use inclusive utility investments to provide accessible financing options	Roanoke Cooperative (RC) launched the Upgrade to $ave program in 2016 to reduce energy bills for the fourth lowest income Congressional district in the U.S. The Board of Directors targeted upgrading 1000 homes with energy efficiency and demand response measures. They approved use of the Pay As You Save® (PAYS®) system, an inclusive utility investment model, for the design of the utility program and tariff.[75] **RC paid upfront for all cost-effective energy upgrades at a member's residence and recovered its costs through a fixed, monthly cost recovery charge that was lower than the estimated savings from the upgrades on an annual basis.**[cxlv,76] Participating members reduced electricity usage by ~20% because of upgrades and the utility realized peak demand savings of ~20% during summer and winter peaks. *Detailed case study provided in Appendix A.iii.*
Provide upfront incentives that stack with available programs	San Diego Community Power (Community Power) is a Community Choice Aggregator that launched the Solar Battery Savings program in 2024. **The program was designed to benefit all customers through upfront incentives[77] to lower the initial cost of home solar and battery storage resources** and provided ongoing performance incentives for battery power provided during on-peak periods. Community Power **worked with state and local programs to ensure their incentives could stack with programs** such as California's DAC-SASH and SGIP programs[78] and the City of San Diego's Solar Equity program to allow priority populations to cover the entire cost of solar and storage resources through available incentives. *Detailed case study provided in Appendix A.iii.*
Include multi-family housing in DER programs and share benefits between property owners and tenants	Solar energy company PearlX partnered with SolarEdge, a distributed solar OEM, on Project TexFlex to make community solar and storage programs accessible to tenants in multifamily communities around Texas.[cxlvi] PearlX addresses the split incentive challenge associated with rental units by paying the property owner for the right to install the solar and batteries and passing on benefits of lower energy bills and backup power during outages to renters. PearlX manages the assets, providing flexibility and capacity services to the energy market. This approach uses a non-credit based underwriting method, which allows tenants to access the rewards of solar generation and battery storage without having to provide their credit score. Pilot results indicate solar energy supplied 46% of participating tenant's daily energy consumption, reducing grid demand for ERCOT, and **saving tenants $60 per month on their energy bills on average**.[cxlvii] PearlX is now exploring expanded offerings to help build resilience for multifamily communities while also providing new amenities to residents and supporting the grid.

75 PAYS Essential Elements and Minimum Program Requirements provides additional information on the utility program requirements for a PAYS program and PAYS model tariff shares the tariff design.

76 The program's annual cost recovery is set at less than the estimated savings from the upgrades to ensure immediate reductions in energy costs, and much larger cost reductions once the utility recovers its costs and ends the on-bill charge.

77 Upfront incentives can be more effective at overcoming initial barriers to DER adoption than incentives paid at a later date, such as rebates. This is because customers would have to pay the upfront cost of the resource and wait to receive the rebate with limited visibility and certainty on when the incentive would be provided. Even rebates that cover 100% of the cost of the underlying asset may not be effective, especially for underserved communities.

78 DAC-SASH is the Disadvantaged Communities – Single-Family Solar Homes program developed by the California Public Utilities Commission (CPUC) and administrated by GRID Alternatives. This state program provides $8.5 million in incentives annually to help homeowners in disadvantaged communities go solar. SGIP is the Self-Generation Incentive Program developed by the California Public Utilities Commission to provide rebates for qualifying distributed energy systems on the customer's side of the utility meter, including advanced energy storage systems, wind turbines, waste heat to power technologies, pressure reduction turbines, internal combustion engines, microturbines, gas turbines, and fuel cells.

Include affordable multi-family housing in DER programs and share benefits between property owners and tenants	PowerTree is working with a 40-unit low-income apartment building in central California to provide BTM solar and batteries. PowerTree works with the property owner to install these assets behind-the-meter and orchestrate them to optimize energy usage. **Renters immediately benefit from lower energy bills, and property owners benefit from a slight increase in rent**, which increases the cash flows of the property and the equity value of the building. The savings in energy bills offset the rent increase, with households able to save $700 in total per year on net given 60% to 100% of tenant load is served from the onsite solar and storage, and an average 31% peak reduction for the building.
Address necessary home upgrades for income-eligible homes	Missouri utility Evergy is using $1M of their Income-Eligible Single Family[79] budget to **help homes that have been deferred for weatherization upgrades to receive the necessary repair work to qualify for existing programs.** Evergy is leveraging a partnership with nonprofit Bridging the Gap to make the necessary structural or home health repairs through local minority contractors. Evergy is also providing income-qualified customers (200% Federal poverty level) free energy-savings items, such as adhesive weather strips, 2-pipe insulation pieces, and switch and outlet gaskets on their online Offer Center to provide a multi-channel approach in increasing home eligibility for their programs.
Bundle the DER purchase and installation process to streamline customer experience	SMUD partnered with Uplight Marketplace to provide instant rebates for EV chargers with bundled installation offers and prequalified installation incentives. Chargers with upfront rebates at the point of purchase are 3 to 5 times more likely to sell on the marketplace than a non-rebated charger. Uplight partnered with Qmerit, a national network of electricians certified to install Level 2 chargers, to schedule charger installations when customers purchase the charger from their utility website. **40% of customers who received quotes scheduled and completed their charger installation by Qmerit.**
Conduct outreach and education to match appropriate incentive programs to eligible consumers	A team from Colorado School of Mines is working to upgrade 16 homes in a manufactured home community[80] in Lake County, Colorado by providing new insulation, LED lighting, high-efficiency furnaces, with plans to install electric heat pumps and batteries in the next few months. Funding was provided by the Weatherization Assistance Program (WAP) and DOE grants. The team **surveyed every participating unit to ensure qualification for the program before the time-intensive application process was started**. Their team is now working to help residents subscribe to Xcel Energy's community solar garden which will credit homeowners on their energy bills for solar energy provided, reducing energy bills.[cxlviii]

79 Evergy has a Low-Income Single-Family program to provide assistance for income-qualified households to overcome structural or home health barriers that otherwise prevents the resident from receiving needed weatherization upgrades.

80 Manufactured homes are energy-intensive, and residents of these homes report high energy insecurity. Many manufactured homeowners are unable to access home equity loans to finance major renovations, making it difficult to adopt distributed energy resources and energy efficiency upgrades.

Access to community-wide benefits

Lever	Example
Deploy VPPs in underserved communities to reduce usage of existing polluting infrastructure	Dominion Energy initiated its Electric School Bus Program in 2019 to assist public school districts in Virginia in overcoming the challenges associated with electric school bus adoption and to advance bi-directional EV Charging and Vehicle-to-Grid (V2G) capabilities. The initial pilot phase of the program commenced in 2019, during which Dominion Energy collaborated with 15 public school districts in Virginia to deploy 50 electric school buses across Dominion Energy Virginia's service regions and underserved communities. Since 2021, funding from the Virginia Department of Environmental Quality (DEQ) and the EPA Clean School Bus Program have provided additional resources to promote electric school bus adoption, with a focus on rural, low-income, and poor air quality districts. Currently, public schools in Virginia that receive EPA funding can partner with Dominion Energy, which will cover the costs of chargers, infrastructure, and installation to support the electric school buses. In return, Dominion Energy is granted the ability to use the buses and chargers for V2G during summer vehicle dwell times. **The program enables school districts and underserved communities to benefit from electric school buses, including improved air quality (with air quality inside a diesel bus being five times worse than outside the bus), decreased noise pollution, and reduced operational and maintenance costs for schools (up to a 60% reduction in costs)**.[cxlix]
Target VPP deployment to communities with higher energy burdens and / or higher rates of system outages[81]	Nimiipuu Energy, a tribally owned energy company, is installing solar and battery systems in tribal homes of the Nez Perce Tribe[cl] to eliminate / lower power bills, decrease dependency on grid supplied power (specifically power generated by the Snake River Dam), and build tribal energy independence. Each home is receiving a rooftop solar array and two Tesla Powerwalls. Tribal nations have reported experiencing outages over six times more frequently than the national average.[cli] **Building this community-owned VPP is meant to provide income for the Tribe while eliminating / lowering power bills for residents**.[clii]
Prioritize VPP deployment in disaster recovery and resiliency work[82]	In 2017, Hurricanes Irma and Maria devastated Puerto Rico's grid and communities. **Since then, significant efforts to prioritize DER adoption in disaster recovery have led to high levels of residential solar PV and battery storage resources.** Puerto Rico's electric utility provider, LUMA, launched the Customer Battery Energy Sharing Program (CBES) in late 2023. Serving primarily residential customers through a number of aggregators[cliii], CBES includes over 7,000 participants and provides 28 MW of available capacity. The program compensates participants via aggregators $1.25/kWh for battery energy supplied during events. Last year, 53 events were called, dispatching 23 MWh of energy. LUMA plans to propose a permanent version of the program by early January 2025.[cliv,clv]
Explore VPP islanding for community centers, especially in disaster-prone areas	In Louisiana, the Community Lighthouse Project has built solar and storage systems on churches to transition these buildings into self-sustaining microgrids. Churches such as First Grace United Methodist Church **operate during times of emergency to provide a haven for their communities**.[clvi]

81 Another great example is California's SGIP program which offers rebates for installing energy storage technology that can work during an outage at residential and non-residential buildings. The program prioritizes communities that live in high fire-threat areas, communities that have experienced two or more utility Public Safety Power Shut-off events, and low income and medically vulnerable households.

82 According to the U.S. News and World Report, racial minorities may have a higher social vulnerability to natural disasters in the U.S. based on a "National Risk Index."

A.iii. Detailed case studies

Detailed case study #1: Roanoke Cooperative's Upgrade to $ave Program

Inclusive utility investment reduces upfront cost barriers to adopting water heater control switches and smart thermostats.

VPP summary			
Utility	Roanoke Cooperative (RC)	**VPP size** *(as of November 2024)*	1.75 MW (with plans to double, 2.5-3% of system peak)
Utility type	Rural electric cooperative (distribution cooperative)	**Type of DERs**	Water heater control switch, smart thermostat, efficiency[83]
Market structure	Within organized market (PJM), utility does not own generation	**Upfront investment cost**	$4.5M including efficiency and flexible demand
Location	North Carolina	**Time to operationalize**	12 months
Size of utility	14,000 member-owners (60-70 MW system peak)	**Number of customers enrolled in VPP**	750 (5%)
Compensation structure	• Upfront incentive: $950 (smart thermostat and water heater control switch were provided for free) • Performance incentive: $4 monthly bill credit for participating customers (Roanoke Cooperative Smart Grid Device program)		
Grid services	• Peak shaving (summer and winter)		

Utility objectives with VPP program *(not exhaustive)*

- **Reduce energy bills** by upgrading 1000 homes (7% of member base) with energy efficiency (EE) and demand response (DR) measures to reduce system-wide peak demand and deliver services at lower cost
- **Enable widespread accessibility** by addressing barriers of high upfront costs of resources, low credit scores limiting traditional low-cost financing options, and limited willingness to take on debt

83 Although energy efficiency upgrades are not considered distributed energy resources in this report, investments in EE help reduce demand for individual households and across the system.

Program summary

Roanoke Cooperative (RC) launched the Upgrade to $ave program in 2016 to reduce energy bills for the fourth lowest income Congressional district in the U.S., where average annual energy costs are more than 6%[84] of the median income. The Board of Directors targeted upgrading 1000 homes with energy efficiency and demand response measures. They approved use of the Pay As You Save® (PAYS®) system, an inclusive utility investment model, for the design of the utility program and tariff.[85]

In this program, RC paid upfront for all cost-effective energy upgrades at a member's residence and recovered its costs through a fixed, monthly cost recovery charge on the bill of participating members that was lower than the estimated savings from the upgrades on an annual basis.[clvii,86] To enroll customers, RC assessed the energy savings potential of the building rather than the owner's income or creditworthiness, allowing all members to access low-cost financing options.[87]

Participating members reduced electricity usage by ~20% because of upgrades and the utility realized peak demand savings of ~20% during summer and winter peaks.[88] Including the cost of capital and program operation costs, the utility sees $2M+ NPV over the lifetime of the upgrades for those already installed, excluding the continuing cash flow value from exercising demand response.[clviii]

Other programs are exploring similar solutions to improve accessibility to DERs:

- Duke Energy's Improve and Save program is leveraging Roanoke's experience to offer inclusive utility investments in heat pumps while it is also piloting a VPP called Power Pair.[clix]
- Illinois' Commerce Commission is guiding development of the Equitable Energy Upgrade Program required by the state's Climate and Equitable Jobs Act with essential elements that are similar to Pay As You Save® and it includes the potential to accelerate the adoption of rooftop solar and storage for low-income customers.

Key success factors to expand DER adoption with multifaceted benefits *(not exhaustive)*

Leverage innovative financial solutions, such as a utility investment that deploys money-saving distributed energy upgrades at customer locations, including demand flexibility

Partner with a trusted organization that has instituted these programs before to maximize operational efficiency and member-owner benefits

Build significant consumer protections into program design to ensure installation quality, realization of energy savings, and associated reduction in energy bills, with protocols to suspend or adjust cost recovery charge, if needed[clx]

84 Communities where energy costs are more than 6% of income are typically considered communities with high energy burdens. The national average, in comparison, is 2.9%.

85 PAYS Essential Elements and Minimum Program Requirements provides additional information on the utility program requirements for a PAYS program and PAYS model tariff shares the tariff design.

86 The program's annual cost recovery is set at less than the estimated savings from the upgrades to ensure immediate reductions in energy costs, and much larger cost reductions once the utility recovers its costs and ends the on-bill charge.

87 After running the program for 2 years, REC transferred program management to EEtility, an operator that was managing Ouachita Electric Cooperative's PAYS® program, which was producing better results. EEtility introduced several best practices that improved energy savings by 46%, peak load reductions by 71%, and member acceptance of offers by 17%. Best practices included targeted outreach to homes with high energy use per square foot and direct installation of low-cost upgrades for homes that were initially deferred from enrollment due to structural repair needs. At no cost to the residents, these homes received LED lights, smart strips, aerators, water heater blankets, and AC coil cleaning.

88 Roanoke is leveraging North Carolina Electric Membership Cooperation's (NCEMC) DERMS platform, which is an OATI product, to shed or shift demand from the distributed energy resources.

89 Inclusive utility investments have emerged as a more equitable solution with strong consumer protections that has been implemented by 23 utilities in 10 states, with most choosing to apply the Pay As You Save® (PAYS®) system to implement.

Detailed case study #2: San Diego Community Power's Solar Battery Savings Program

Upfront, stackable incentives provide opportunity for no-cost solar and batteries to qualified priority populations.

VPP summary			
Utility	San Diego Community Power	**VPP size** *(as of November 2024)*	7.3 MW (0.4% of system peak)
Utility type	Community Choice Aggregator	**Type of DERs**	Solar, BTM battery
Market structure	Within organized market (CAISO), utility does not own generation	**Upfront investment cost**	$11.5M with 45% ($5M) as cost-neutral through RA savings
Location	California[90]	**Time to operationalize**	12 months
Size of utility	1 million customer accounts	**Number of customers enrolled in VPP** *(as of November 2024)*	1,600[91] (~0.2%)
Compensation structure	» Upfront incentive: • Market Rate: $350/kWh for storage • Underserved Community Rate (e.g., CARE/FERA and/or Communities of Concern): Up to $450/kW-AC for solar and up to $500/kWh for storage » Performance incentive: $0.10/kWh of battery power discharged during on-peak periods		
Grid services	» Daily load cycling (charging during the day, discharging during daily two-hour peak window)		

Utility objectives with VPP program *(not exhaustive)*

- **Improve outcomes for underserved communities** by allocating 50% of budget for solar and storage incentives to Communities of Concern
- **Decarbonize power supply** by charging batteries with solar during the day and using daily during peak hours to reduce emissions
- **Lower costs and energy bills** by utilizing battery during on-peak periods to realize $5M of resource adequacy savings, which reduces on-peak consumption system-wide and lowers utility bills for all customers

90 San Diego Community Power operates in seven cities in San Diego County in California.

91 This program was launched in August 2024. The program hit its budget cap of ~$11.5M in **3 months** (August – November), indicating high customer interest. 1,600 customers have been approved to enroll in the program as of November 2024, with 200 customers fully operationalized and providing daily dispatch from their batteries.

Program summary

San Diego Community Power (Community Power) launched the Solar Battery Savings program in 2024 to support customers and the solar and storage industry in the transition from net energy metering (NEM) to net billing tariff (NBT).[92] Community Power (CP) used a portion of the expected savings in the transition from NEM to NBT and resource adequacy savings from leveraging batteries during times of peak demand to fund the program.

The program was designed to benefit all customers through upfront incentives[93] to lower the initial cost of home solar and battery storage resources and provided ongoing performance incentives for battery power provide during on-peak periods. Community Power tailored incentives to provide priority populations[94] (i.e., CARE/FERA[clxi] and / or Communities of Concern[clxii]) with higher incentives to meet their needs and improve equity outcomes, embedding equity goals and metrics into program design from the start. Community Power worked with state and local programs to ensure their incentives could stack with programs such as California's DAC-SASH and SGIP programs and the City of San Diego's Solar Equity program to allow priority populations to cover the entire cost of solar and storage resources through available incentives. Prioritizing a no-cost solution for the most energy burdened communities is critical to ensure realization of direct and immediate benefits.

Community Power also led contractor outreach and training prior to program launch to ensure workforce development opportunities offer accessible training, education, and contracting opportunities to a local contractor base. Community Power continues to accept new contractor applicants and tracks participation of all approved contractors, including minority-owned, for the solar and battery storage installations.

Other programs are deploying similar solutions to improve accessibility to DERs:

- New Mexico's Home Electrification and Appliance Rebate (HEAR), funded by the Inflation Reduction Act of 2022, was launched as a coupon-style incentive program to provide upfront discounts of up to $1,600 off insulation, air sealing, and ventilation for low-income, single-family homeowners.
- New York utility Orange & Rockland partnered with Sunrun, a distributed solar provider, to launch a 2 MW VPP in NY with **over 300 solar and storage systems, 50% of which are in areas designated as a 'disadvantaged community**' by the state. Participating customers who were installing solar from Sunrun received upfront incentives to install a free or heavily discounted home battery when enrolling in the 10-year program.[clxiii,clxiv,95]

Key success factors to expand DER adoption with multifaceted benefits *(not exhaustive)*

- **Redirect system cost savings to all customers**
- **Provide higher, upfront incentives** to priority populations to minimize or eliminate costs of adopting distributed solar and behind-the-meter batteries that can stack with available state and Federal programs
- **Partner with a local contractor base for DER installation** to build local workforce development opportunities through these programs (38% of over 50 local contractors approved are disadvantaged business enterprises or DBEs; 6% are represented by a union)

92 Net billing tariff provides greater economic value for installing solar and storage rather than stand-alone solar.

93 Upfront incentives can be more effective at overcoming initial barriers to DER adoption than incentives paid at a later date, such as rebates. This is because customers would have to pay the upfront cost of the resource and wait to receive the rebate with limited visibility and certainty on when it would come through. Even rebates that cover 100% of the cost of the underlying asset may not be effective, especially for underserved communities.

94 CARE (California Alternative Rates for Energy) and FERA (Family Electric Rate Assistance) are California-specific programs to provide discounts to low-income customers on their electric and natural gas bills. Communities of Concern are disadvantaged communities identified by the Cities of San Diego and Chula Vista through their Climate Equity Index reports.

95 The VPP was initiated by O&R and approved as a demonstration project by the NY Department of Public Service. O&R conducted targeted outreach to underserved communities by mailing brochures to every customer living in an area designated as a 'disadvantaged community'.

A.iv. Key resources for practitioners

- **Clean Energy Financing Toolkit for Decisionmakers** (EPA) provides an overview of available financing programs and policies that state, local governments, and other industry actors use to support investments in clean energy (including inclusive utility investments).
- **Practical Guide for Distributional Equity Analysis for Energy Efficiency and Other Distributed Energy Resources** (May 2024, DOE) shares an analytical framework for utilities, regulators, communities, and other stakeholders to answer questions about the equity implications of utility investments and to embed implications alongside traditional cost-effectiveness analyses.
- **US DER Resource Outlook 2024** (June 2024, Wood Mackenzie) provides analysis of DER deployment and market size from 2019-2028.

A.v. Actions from the Department of Energy

- **Loans and Loan Guarantees** to support VPP projects with a focus on low- to moderate-income communities, including lowering the cost of financing for VPP-eligible DERs
- **Home Energy Rebates** to reduce the cost of efficiency retrofits and electrification measures in homes and other buildings, providing low and moderate-income families up to $14,000 for products like electric heat pumps, electric stoves, and more
- **Weatherization Assistance Program** for energy efficient and electric technologies in low-income households, including improved insulation to help reduce total energy bills
- **Low-Income Energy Affordability Data (LEAD) Tool** to help states consider strategic deployment of funding relative to energy burden and household income, among other building characteristics
- **Clean Energy Funding and Technical Assistance** to provide no cost technical assistance to tribal entities and funding for planning and deployment of energy solutions
- **Technical Assistance for New and Stretch Code Adoption** for adoption and enforcement of new and stretch building codes
- **Training for Residential Energy Contractors** to fund state energy offices so they can train, test, and certify residential energy efficiency and electrification contractors
- **Energy Efficiency Grants** for energy efficiency audits, upgrades, and retrofits, including for deployment of DERs, for residential and commercial buildings
- **Energy Efficiency Revolving Loan Fund Capitalization Grants** to fund states to provide loans and grants for energy efficiency, upgrades, and retrofits, including distributed solar
- **Residential and Commercial Workforce Training Programs** that include training on smart tech and grid network systems
- **Community Power Accelerator** to provide training, resources, and technical assistance to developers

and organizations and connect them to investors, lenders, and philanthropies to finance and deploy solar and storage projects in communities across the country

- **National Community Solar Partnership** to expand access to affordable community solar; expanded program provides technical and financial assistance for developers interested in hosting or participating in a VPP from DOE National Labs
- **Clean Cities and Communities** to deploy affordable, efficient, and clean transportation fuels and energy efficient mobility systems, including EVs and EV charging
- **SolSmart** to provide no-cost technical assistance to local governments to make it easier for residents and businesses to go solar in their community
- **Charging Smart** to equitably expand electric vehicles (EVs) and EV charging infrastructure in rural, urban, and suburban communities by reducing soft costs (i.e., permitting, inspection, and load service requests)
- **Distributed Wind Smart** to develop and share best practices in zoning, planning, inspection, community engagement, and financing for distributed wind
- **Renewables Advancing Community Energy Resilience (RACER) Funding** to fund projects that enable communities to use solar and solar-plus-storage to prevent disruptions in power and rapidly restore electricity if needed
- **SolarAPP+** to automate and expedite permitting for residential rooftop PV and PV plus energy storage systems for solar contractors

Appendix B: Simplifying VPP enrollment

B.i. Case studies by lever

This section provides case studies of VPP and related deployments that showcase additional no-regrets and high-impact actions that are simplifying enrollment. One of these case studies, Arizona Public Service's Cool Rewards program, has a detailed overview provided in Appendix B.ii.

No-regrets actions

Lever	Example
Communicate program benefits in simple and concise terms *(especially financial benefits)*	Minnkota Power Cooperative's demand response program has **enrolled 55,000 customers (40% of customers) and can serve 350 MW, 35% of winter peak load,**[clxv] through the program.[clxvi] Minnkota is able to temporarily control DERs including heat pumps, water heaters, EV chargers, and commercial & industrial loads during peak events. To encourage enrollment and participation, Minnkota provides clear financial benefits – upfront incentives to purchase the DERs and eligibility for the off-peak program rate, which is roughly half the standard rate.[clxvii] Minnkota cultivated widespread buy-in from member distribution co-operatives to message the same.[clxviii,clxix]
Offer ongoing performance-based incentives to encourage continued participation	California's Demand Side Grid Support (DSGS) program **has enrolled over 265,000 participants with 515 MW of capacity in two years.** Customers can enroll by submitting an application to their DSGS provider.[clxx] The program is managed by Olivine which includes a 200 MW storage VPP, one of the largest in the world, to provide power back to the grid. Participants are paid based on net load reductions provided, with some earning $2/kWh of energy shared with the grid. The VPP was activated 16 times in 2024 to avoid a grid crisis during four heatwaves in the summer.[clxxi]
Offer a compelling value proposition to customers, with minimal additional effort on their part	One major Southern California utility partners with a program administrator to **deploy backup generation, solar, and battery storage assets with a 94% enrollment rate sustained over four years**. The program targeted communities that experienced the highest level of power outages and Public Safety Power Shutoff (PSPS) events on specific circuits and transmission lines. Deployment services included customer outreach campaigns by mail, email, telephone, and in-person to conduct in-home consultations to encourage eligible customers to apply and enroll in the program. Households were provided the assets for free, and the program administrator partnered with a local group of vendors to support the full customer lifecycle from first call to site visit and installation through five years of preventive maintenance and service.[96] As a continuation of this program, the utility instituted a VPP pilot program to use these resources (including smart thermostats, well-pump controllers, and water heaters) to shed load during peak hours.
Offer flexibility to opt out of events	Rocky Mountain Power's Cool Keeper program has enrolled **over 100,000 customers (~8.3% of customers, 280 MW of flexible load),**[clxxii] **with more than 98% of program participants satisfied with the program.** The program allows participants to opt out of events and un-enroll at any time at no additional cost by calling a phone number specific to the program.[clxxiii] Easy opt-out mechanisms put customers at ease when enrolling for programs and ensures appropriate customer protections are in place.
Leverage a multi-channel marketing approach	Ontario's Independent Electricity System Operator's (IESO) Save on Energy Peak Perks Program **has enrolled over 125,000 devices with over 100 MW of peak load reduction in less than one year.** The program leveraged a multi-channel marketing approach, including in-app messages by partnering with OEMs to get extra program visibility beyond standard in-app marketing, emails, and microsites. IESO worked with a marketing agency to spread the word through influencers and social media to enroll customers.[clxxiv] In 2024, the program delivered a maximum load shed of 133 MW during its first event.

96 Another example is SMUD who leveraged higher customer incentives to encourage participation in their Partner+ program. These incentives are meant to compensate customers for mandatory participation in the year-round use of their solar and storage systems.

High-impact actions

Lever	Example
Minimize customer time and effort to enroll in programs	EnergyHub, an edge DERMS provider with more than 1.3 million devices under management, **saw a 70% increase in "Enroll" button clicks on average by redesigning their utility microsite navigation and eliminating six clicks** from the path to enrollment. This increased accepted devices per month by over 1,000 across the programs that used the new template.[clxxv]
Offer point-of-purchase enrollment	APS launched Cool Rewards, a smart thermostat program, in 2018 after the Arizona Corporation Commission authorized demand response and load management programs for the utility. As of November 2024, the Cool Rewards program has enrolled over 97,500 connected thermostats with the ability to shed over 160 MW of load during peak demand events. **APS established a smart thermostat marketplace on their website** where *all* customers could get an instant $30 rebate at checkout and an additional $85 off upfront by pre-enrolling into the program.[clxxvi] As of the end of October 2024, 9,290 Cool Rewards pre-enrollments were processed through APS marketplace. Embedding enrollment into the point-of-sale process reduces marketing and recruiting costs for the program. *Detailed case study provided in Appendix B.ii.*
Enroll customers in multiple programs at once	AES Indiana partnered with Uplight Plus to pilot a subscription energy bundle by offering budget billing, digital payments, and green energy enrollment *all in one package*. Within the first three months of launching Uplight Plus with a pilot population of 2,000 residential customers, **AES Indiana saw a 26% increase in autopay enrollment and a 67% increase in green energy program enrollment**.[clxxvii]
Allow customers to set control ranges	Maryland utility Baltimore Gas & Electric partnered with WeaveGrid, a managed EV charging provider, to pilot a distribution-level charging program with over 3,000 residential customers. **WeaveGrid prioritizes optimizing EV charging for customers based on who has the lowest state of charge and who has the earliest departure time to maximize customer satisfaction.** 92% of charging load managed through the program complied with the charging schedule set by BGE and WeaveGrid, optimizing benefits for customers and the grid. The Maryland PSC approved BGE's proposal to expand the pilot to a full program with 30,000 participants by 2027.[clxxviii]

B.ii. Detailed case studies

Detailed case study #1: Arizona Public Service's Cool Rewards Program

Clear incentives and simple messaging allow APS to shed up to 160 MW of load (~2% of peak demand) by enrolling 97,500+ thermostats in the Cool Rewards program.

VPP summary			
Utility	Arizona Public Service	**VPP size** *(as of 2024)*	160 MW (2% of system peak)
Utility type	Investor-owned utility	**Type of DERs**	Smart thermostat
Market structure	Not in organized market, utility owns generation	**Upfront investment cost**	*Not available*
Location	Arizona	**Time to operationalize**	12 months
Size of utility	1.4 million customers (8.2 GW system peak)[clxxix]	**Number of customers enrolled in VPP**	72,000 (5%)
Compensation structure	» Upfront incentive: $50 one-time enrollment credit and $30 credit towards the purchase of a smart thermostat » Performance incentive: $35 annual participation credit		
Grid services	» Peak shaving, load shifting, location-based demand response		

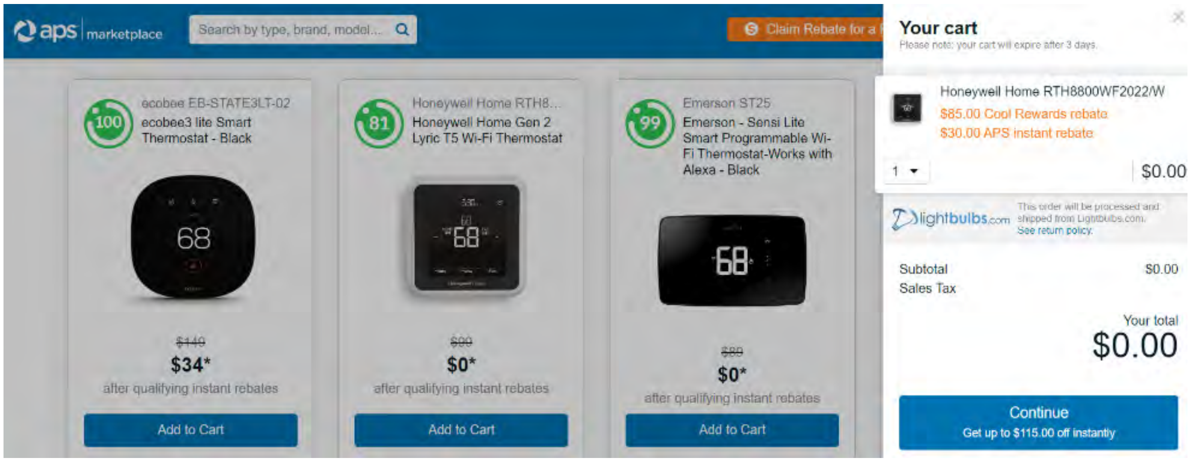
Utility objectives with VPP program (not exhaustive)

- **Reduce customer costs during times of peak demand** to ensure affordability of energy bills, especially given time-of-use rates[clxxx]
- **Decarbonize power supply** by achieving a resource mix that is 65% clean energy by 2030 by maximizing demand-side resource potential[clxxxi]
- **Maximize potential of demand-side resources** by meeting 19% of coincident peak demand by 2038 through optimizing energy efficiency, distributed resources, and demand response programs

Program summary

APS launched a smart thermostat program in 2018 after the Arizona Corporation Commission authorized demand response and load management programs for the utility. The Cool Rewards program is at the forefront of APS' VPP portfolio[97], incorporating smart thermostats for both residential and small to medium-sized business customers. As of November 2024, the utility had enrolled over 97,500 connected thermostats with the ability to shed over 160 MW of load during peak demand events.

97 APS' Cool Rewards program is one part of a broader VPP portfolio (193 MW as of November 2024) that mainly consists of smart thermostats, battery storage, and behavioral demand response, all working together to support the grid.



APS simplified the enrollment and participation process to maximize value from the demand response program, while minimizing customer inconvenience. APS established a smart thermostat marketplace on their website where all customers could get an instant $30 rebate at check-out.[clxxxii] With simple and clear messaging, APS allowed customers to receive an additional $85 off upfront by pre-enrolling into the Cool Rewards program after providing basic information (e.g., name and address).[98] Embedding enrollment into the point-of-sale process reduces marketing and recruiting costs for the program. As of the end of October 2024, 9,290 Cool Rewards pre-enrollments were processed through APS marketplace, which was built in partnership with Enervee.[clxxxiii]

APS offers virtual assistance for customers needing support with installing their smart thermostat after purchase. For those unable to install virtually, in-home installation support is also available. These partnerships help ensure thermostats are properly installed, connected, and ready for use, enhancing customer value.

APS ensures ongoing participation by prioritizing customer comfort, allowing flexible opt-outs, offering ongoing incentives, and communicating social impacts of participation. To ensure customer comfort, some thermostat manufacturers may lower a customer's thermostat(s) temperature a few degrees to pre-cool the home before the peak event, increase the thermostat by a couple of degrees during a conservation event, and return the thermostat to its original setting or schedule after the event.

Customers can easily opt out of events by directly changing the thermostat setting. In 2023, APS launched the Cool Rewards Promise which reinforces that the customer will always remain in control of their thermostat and can adjust or opt-out at any time. APS provides annual participation incentives, which APS increased from $25 to $35 per year after receiving customer input and has seen a corresponding increase in enrollment. APS also communicates the social impacts of the program by sending messages such as, "This summer, your participation made a positive difference for our environment and community" to encourage continued participation.

Key success factors to simplify VPP enrollment *(not exhaustive)*

- ✔ **Capture customers at point of purchase by establishing an online marketplace,** clearly communicating financial benefits to purchase a smart thermostat ($30 instant rebate) and additional upfront incentives to pre-enroll in the Cool Rewards program ($85 enrollment credit and first year participation credit)
- ✔ **Provide installation support** to help customers easily connect their smart thermostat
- ✔ **Launch the Cool Rewards Promise** to remind customers of the event's purpose, ensuring they remain in control of their device
- ✔ **Communicate social impacts** to keep customers engaged in the program after enrollment

98 Uplight, a flexibility management platform, found that over 60% of eligible customers purchasing a smart thermostat through their marketplace enrolled in demand response programs when offered at point of sale.

B.iii. Key resources for practitioners

- **Distributed Energy, Utility Scale: 30 Proven Strategies to Increase VPP Enrollment** (December 2024, Lawrence Berkeley National Lab) discusses 30 proven strategies to scale VPPs by maximizing enrollment with concrete case studies and proof points.
- **Insights into Scaling Virtual Power Plants** (January 2025, Lawrence Berkeley National Lab) provides a publicly available inventory of VPPs in the U.S.
- **North America Virtual Power Plant (VPP) Market Report** (July 2024, Wood Mackenzie) provides an overview of the state of the VPP market today in the U.S. and Canada, including technology trends, VPP offtake, and wholesale market and regulatory landscape.
- **VPP Flipbook** (July 2024, RMI and VP3) includes discussion of 22 VPP programs in operation across the U.S., including details on effective VPP program design and implementation.
- **Utility VPP Comparison Matrix** (June 2024, RMI) shares program design information for 22 VPP programs featured in the RMI VP3 Flipbook.
- **National Roadmap for Grid-Interactive Efficient Buildings** (May 2021, DOE) includes an overview of grid-interactive efficient buildings (GEB), and the barriers and solutions to accelerating GEB deployment across the country.

B.iv. Actions from the Department of Energy

- **V2X MOU** to establish partnership and business case demonstration projects that identify interconnection standards, market access needs, and interoperability approaches for EV charging and discharging with public and private sector engagement
- **Computational tools**[99] developed and applied by National Laboratories to help regulators and utilities determine how to apply DERs, including microgrids, to better serve equity and resilience needs

99 Page 69 of the 2023 VPP Liftoff Report includes detailed information on the modeling tools available from select DOE-partnered national laboratories.

Appendix C: Increasing standardization in VPP operations

This section provides an explanation of the communication protocols and IT/OT components and configurations for three VPP programs: National Grid's 'ConnectedSolutions' in Massachusetts and New York, Green Mountain Power's 'Energy Storage Solutions' in Vermont, and Rocky Mountain Power's 'Wattsmart' in Utah. The purpose of the case studies is to demystify the communication technology that enables a VPP and help stakeholders understand where increased standardization will be valuable – e.g., interoperability of DER and VPP software, grid services definitions, etc.

To reference the framework that shares the possible go-to-market models, see page 23 of this report in Section 3.i.

Go-to-market model:	**① Utility-led, aggregator-operated VPP**	**①③ Utility-run VPP and market-participant VPP**	**③ Utility-run VPP**
Case study:	**ConnectedSolutions**	**Energy Storage System**	**Wattsmart**
Bulk system operators	**ISO New England**	GREEN MOUNTAIN POWER	ROCKY MOUNTAIN POWER
Distribution system operators	**National Grid**	GREEN MOUNTAIN POWER	ROCKY MOUNTAIN POWER
VPP platforms	EnergyHub	TESLA	sonnen
Customer DERs (residential, commercial, industrial)	• 10 Smart thermostat brands • 17 Battery brands • 19 EV and EV supply equipment brands • 7+ Commercial & industrial aggregators	ESS program: • Tesla Powerwalls or equivalent compatible equipment	• Any battery that meets functional criteria, including sonnen. • Four additional battery manufacturers under testing and review.

C.i. Detailed case study #1: ConnectedSolutions

VPP overview

National Grid's ConnectedSolutions Program

Multi-device VPP established within 4 months with <$500k upfront investment cost provides up to 250 MW of system-level peak shaving benefits.

VPP summary			
Utility	National Grid	**VPP size** *(as of 2024)*	250 MW (2% of system peak)
Utility type	Investor-owned utility	**Type of DERs**	Residential DERs: Smart thermostats, batteries. Commercial DERs: HVAC, manufacturing loads, bidirectional EV chargers, water heaters, thermal storage, batteries.
Market structure	Within organized market (ISO-NE and NYISO), utility does not own generation	**Upfront investment cost**	$500k
Location	Massachusetts and New York	**Time to operationalize**	4 months
Size of utility	20 million customers (11.5 GW peak demand)	**Number of customers enrolled in VPP**	100,000
Compensation structure	Residential: » Thermostats: $25 – $50 upfront incentive per thermostat; additional $20 incentive for staying enrolled. » Batteries: 0% Interest 7-Year Loan for battery costs; $275/kW performance incentive. Commercial: » $30 - $200/kW performance incentives depending on the location and number of dispatches per year.		
Grid services	» Electric and natural gas peak shaving, non-wires alternatives		

Utility objectives with VPP program *(not exhaustive)*

- **Meet rising demand** by delivering bulk system-level capacity during peak hours.
- **Reduce cost** by pursuing all cost-effective demand reduction measures[100,clxxxiv] to reduce customer energy bills.
- **Alleviate grid constraints** by using flexible demand as non-wires alternatives to address grid congestion or load limits of grid equipment.

100 The 2016 State of Charge: A Comprehensive Study of Energy Storage in Massachusetts Report found that 40% of each year's electric costs were due to the 10% of hours with the highest electricity demand.

Program summary

National Grid developed and launched its ConnectedSolutions 'bring-your-own-device' (BYOD) VPP in less than four months to provide low-cost, low-emissions peaking capacity in Massachusetts and New York.[101] The program launched fully in 2019. In this configuration, National Grid contracts with EnergyHub, an Edge DERMS vendor that integrates multiple single-brand VPP software systems (e.g., Tesla) into one platform. National Grid sends notices to EnergyHub in advance of peak hours to dispatch demand reductions from the customer-owned DER aggregation that EnergyHub manages on National Grid's behalf. By relying on EnergyHub to manage the customer enrollment and participation experience, and to turn the heterogeneous portfolio of DERs into a utility-scale and utility-grade resource, National Grid required little change to its internal organizational operations.

Delivered outcomes

- ✔ **Reduced costs of peak demand,** providing an estimated $300M in system benefits since the start of all of National Grid's demand response programs by reducing the buildout of power plants, the grid, and reducing energy use at expensive peak times.
- ✔ **Met regulator goals** by earning financial profit for National Grid (specific incentive mechanisms vary by state).
- ✔ **Reduced cost of ownership of DERs** by compensating them for grid benefits delivered.

VPP communication protocols & operations

National Grid works with EnergyHub to operate ConnectedSolutions in the following ways:

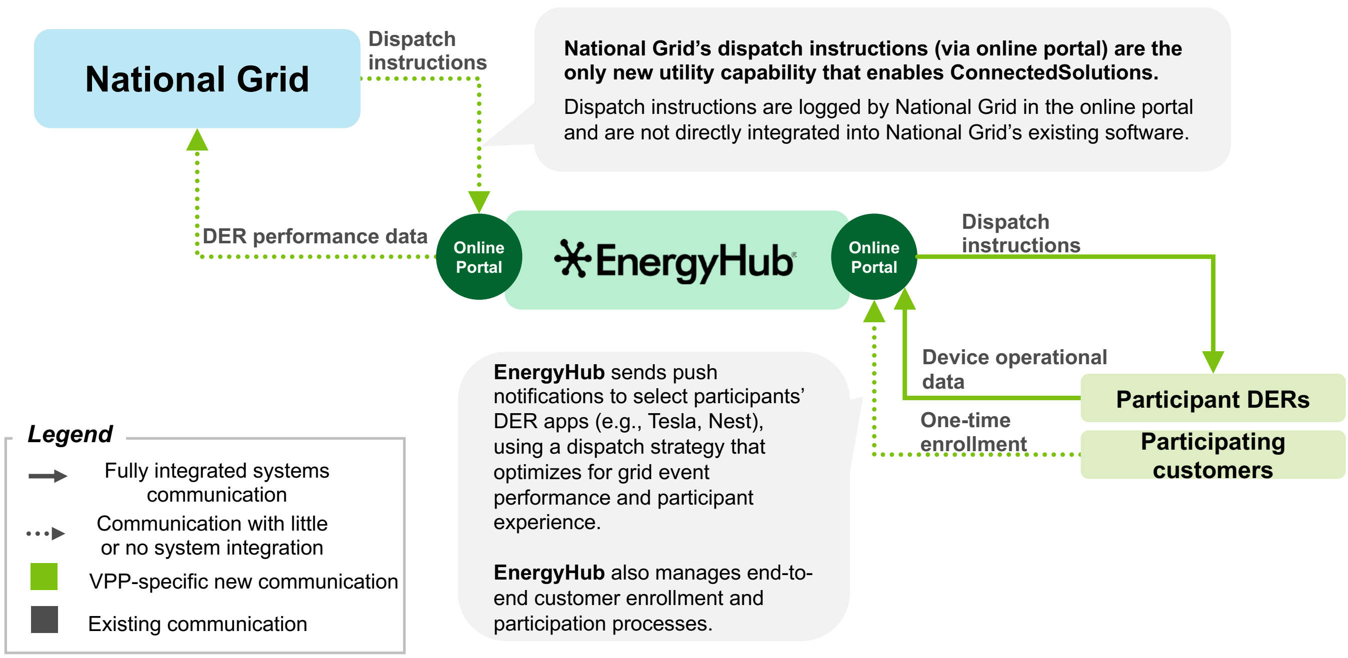
1. National Grid or EnergyHub (depending on the jurisdiction) estimates peak demand and establishes the level at which grid events will be called.
2. National Grid or EnergyHub (depending on the jurisdiction) tees up and then triggers demand response events when loads on the grid are forecasted to exceed the established levels.
3. EnergyHub communicates the demand response event parameters to various DER device manufacturers and providers, curtailment service providers and aggregators. The communication happens through a variety of open protocols and proprietary APIs. Depending on how much grid relief is needed, dispatch happens in three levels:
   a. The first level call is to maximize demand reduction by discharging residential-scale and commercial-scale batteries. Batteries are called on approximately 50 times per summer.
   b. The second level adds (in addition to the first) in HVAC load reduction through smart thermostats to optimize for customer comfort and maximize continued participation in events.[102] HVAC is called on approximately 15 times per summer.
   c. The third level adds (in addition to the first and second) commercial & industrial load reduction. This is a last resort given load size and potential costs of, for example, shutting down an entire assembly line. These assets are called on approximately 5 times per summer.
4. EnergyHub receives DER energy consumption data and meter data through a variety of open protocols and proprietary API connections with DER manufacturers, providers, curtailment service providers, and aggregators.

101 For additional detail on the policy and regulatory context in which ConnectedSolutions was implemented, including the energy and non-energy benefits included in the cost-effectiveness test for the program, see the case study annex (page 66) of NARUC's ADER Resources in 2024: The Fundamentals.

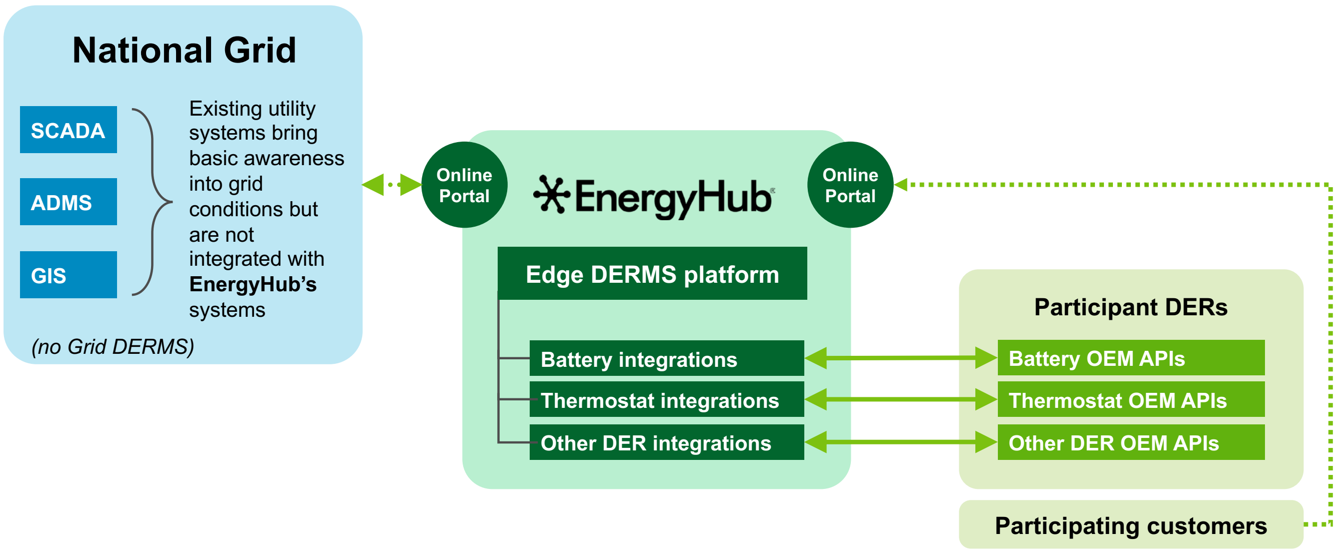
102 Customers can opt out of an event by re-adjusting their smart thermostats.

5. EnergyHub uses the DER telemetry to calculate the performance for each DER and end each event.
6. EnergyHub shares performance data with 15-minute telemetry to National Grid.[103]

VPP communications



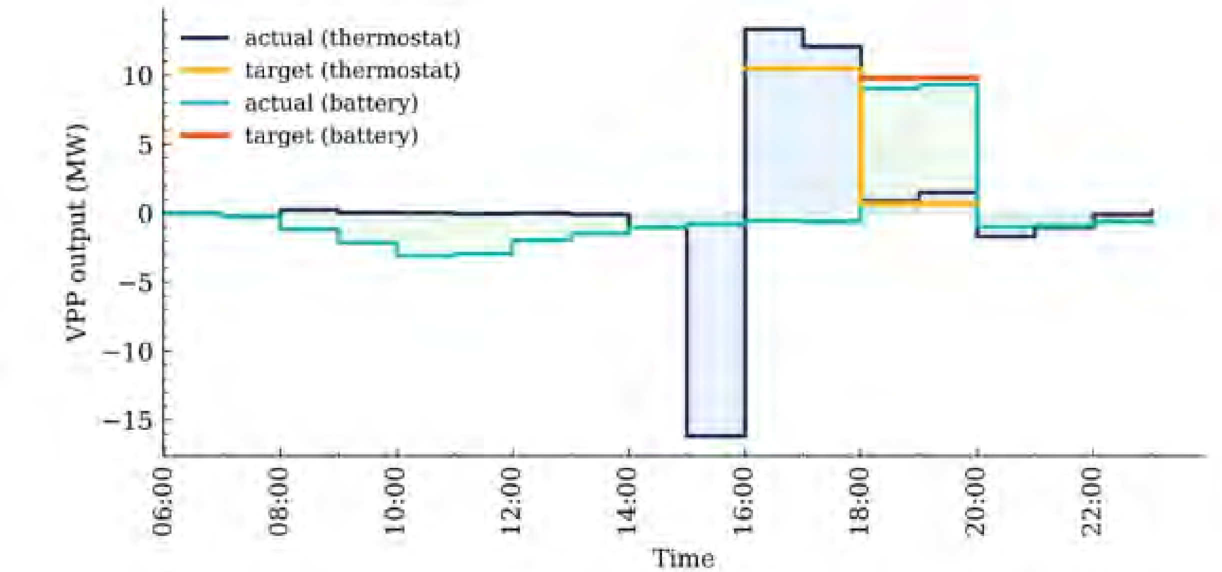
IT and OT components



103 For devices that are not equipped to provide minutely telemetry, EnergyHub conducts modeling to estimate what the capacity would be from those resources on a minute-by-minute basis and provides that to National Grid.

Delivered outcomes

The chart below shows the MW output of the thermostats and batteries enrolled in ConnectedSolutions during a four-hour peak reduction event. As the chart shows, thermostats adjust to pre-cool buildings and homes from 3pm to 4pm, then reduce air conditioning load at 4pm when the event begins. After two hours, thermostats return to normal operations and batteries dispatch to deliver the second two hours of reduced load on the grid.[clxxxv]



Source: EnergyHub

C.ii. Detailed case study #2: Energy Storage System (ESS) Leasing Program

VPP overview

Green Mountain Power's Energy Storage System Leasing Program

Utility-owned and operated battery VPP offers backup power for participants, peaking capacity, emissions reduction, and transmission benefits for the grid, and lower costs for all customers.

VPP summary			
Utility	Green Mountain Power	**VPP size** *(as of 2024)*	36 MW (5% of system peak)
Utility type	Certified B Corp, Investor-owned utility	**Type of DERs**	BTM battery
Market structure	Within organized market (ISO-NE), utility owns generation	**Upfront investment cost**	*Not available*
Location	Vermont	**Time to operationalize**	12-24 months
Size of utility	275,000 customers (663 MW peak demand)	**Number of customers enrolled in VPP**	4,800 customers
Compensation structure	» GMP maintains ownership of batteries and leases them to customers for a 10-year period, either for a one-time payment of $5500 or a $55 monthly fee. Customer continues to get battery backup at no cost after 10 years. » In return, customers are equipped with backup power during outages for a significantly lower price than they would have paid for a non-enrolled battery.		
Grid services	» Peak shaving, frequency regulation		

Utility objectives with VPP program *(not exhaustive)*

- **Reduce costs for all customers** by decreasing GMP's capacity obligation in ISO-New England and GMP's service territory transmission charges, and reducing demand during peak hours. Achieve additional cost savings through energy arbitrage (discharging batteries during peak hours and recharging during off-peak when prices are lower).
- **Improve resilience** by offering seamless backup power for participants to keep customers connected during increasingly severe weather and other events.

Program summary

Green Mountain Power fully launched the Energy Storage System Leasing (ESS) program in 2020, after two successful pilots, to improve system reliability in the face of extreme weather while reducing costs for all customers.[104] GMP operates the program with Tesla technology. Tesla supplies the battery hardware (Powerwalls) and acts as the software platform that aggregates and orchestrates battery dispatch. GMP sends real-time load data (generated by metering integrated with their SCADA system)[105] to Tesla via an API to communicate demands on the distribution grid. Tesla uses that information to strategically dispatch batteries to shave peaks on the distribution system. The program is open to additional battery systems as well and GMP continues to test the latest available battery technology to integrate into the program.

GMP's ESS program is continuously evolving to produce more value. Initially, the utility used the batteries for peak shaving and back up power, but then piloted and now tariffed the use of the same batteries for frequency response, which it sells into the ISO-NE market to generate revenue it can use to directly reduce costs for all GMP customers. Future goals of the program include:

- **Additional grid services:** GMP is working to identify opportunities to use the batteries in targeted locations to alleviate grid constraints at the substation level, which would allow deferrals of costly equipment upgrades.
- **Integration with other resources:** GMP separately operates a bring-your-own-device VPP using a Virtual Peaker platform, as well as a commercial flexible load program using the platform of a Vermont-based software company, Dynamic Organics. The utility is also collaborating with customers to create benefits with other distributed resources such as smart EV chargers.
- **Automation:** With experience and historical data, GMP will be able to automate how a VPP reacts to grid conditions and external conditions (e.g., distributed solar output and weather).

Delivered outcomes

- ✔ **Reduced costs for all customers** by reducing Green Mountain Power's capacity obligation in ISO-New England forward capacity auction by 36+ MW per year (reducing system costs by as much as $3M in some years for all customers – both participants and non-participants).
- ✔ **Generated revenue** of $250,000 from frequency regulation to return to customers.
- ✔ **Improved customer resilience** by enrolling over 4,800 customers in the ESS program, equipping each with backup power to stay connected during extreme weather and other events.

104 For additional detail on the policy and regulatory context in which GMP implemented its VPP, including the monetized and non-monetized benefits of the program, see the case study annex (page 63) of [NARUC's ADER Resources in 2024: The Fundamentals].

105 Supervisory control and data acquisition systems (SCADA) are a collection of systems used to monitor, report on, and remotely operate grid equipment.

VPP communication protocols & operations

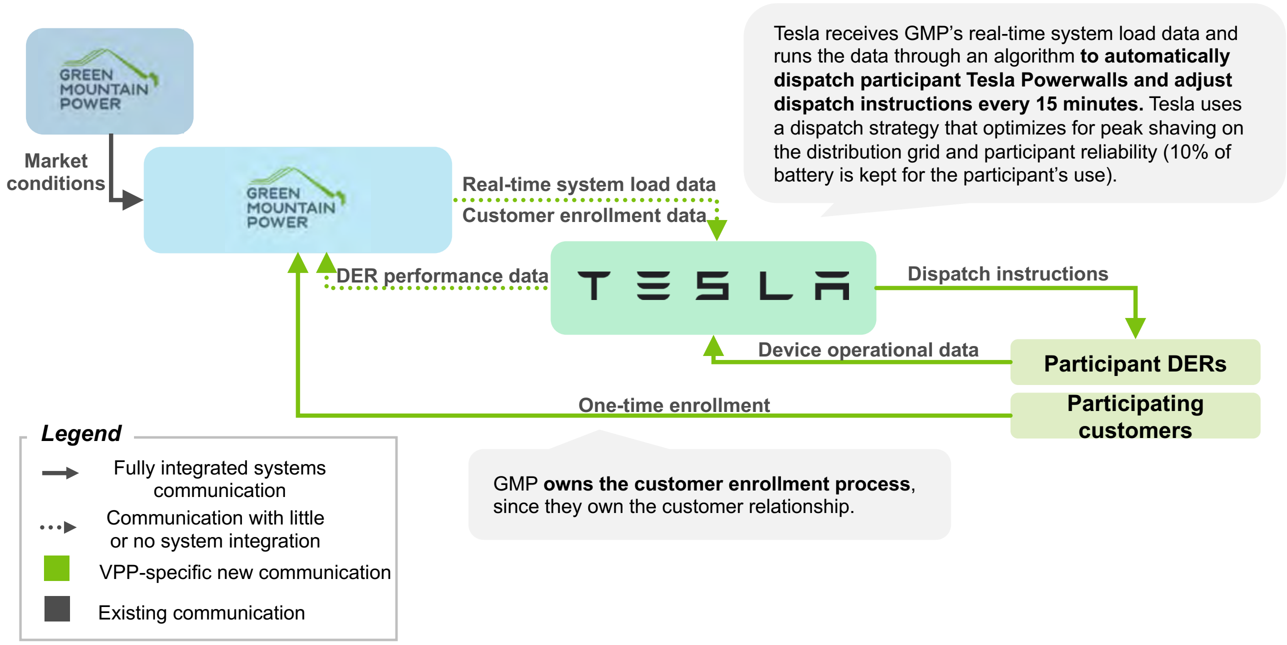
Green Mountain Power works with Tesla to operate ESS in the following way:

1. GMP provides real-time system load data from their SCADA system to Tesla through an API connection.
2. Tesla receives the load data and uses its own algorithm to determine optimal usage of Tesla Powerwalls across the distribution grid, primarily for peak shaving.
3. Tesla manages the Powerwalls through direct integration, adjusting usage of batteries every 15 minutes (or in the case of frequency regulation every four seconds) to respond to system conditions.[106]
4. Tesla receives real-time performance data of batteries and pushes data through the API to GMP in real-time.

Additionally, Green Mountain Power completed a successful pilot and has now tariffed a program to bid their fleet of Tesla batteries into ISO-NE for fast frequency response services (ancillary services market), using the same technology architecture *(excluded from communications protocols and IT / OT components diagrams)*:

5. Tesla receives real-time market signals and pricing information through an API connection with ISO-NE.[107]
6. Tesla's updated algorithm manages GMP's batteries to optimize for load, while bidding into ISO-NE for fast frequency response services, adjusting usage of batteries every four seconds.[108]

VPP communications

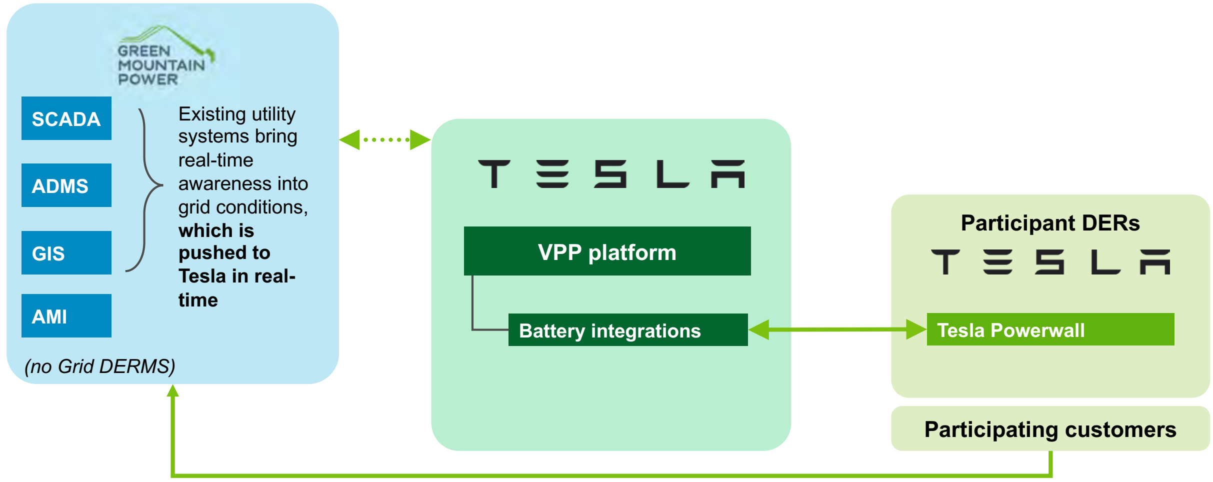


106 Tesla's algorithm continuously monitors Vermont and ISO-NE load and dispatches the batteries accordingly to maximize peak shaving. Customer backup is always prioritized, however, which means weather events override peak shaving.

107 GMP provides the bids for frequency regulation on a weekly basis (i.e., hour-by-hour MW availability for the week) to a third-party who bids them into ISO-NE. During hours the batteries clear the market and are performing regulation, Tesla receives the signals every four seconds from ISO-NE via API and adjusts the batteries charge / discharge to match the signal.

108 The response time for data communicated from GMP to the battery (over the internet), then to the market (also over the internet) is two seconds.

IT and OT Components



C.iii. Detailed case study #3: Wattsmart

VPP overview

Rocky Mountain Power's Wattsmart

Battery VPP that integrates directly into utility's grid operations system enables many grid services.

VPP summary			
Utility	Rocky Mountain Power	**VPP size** *(as of November 2024)*	28 MW (0.5% of system peak)
Utility type	Investor-owned utility	**Type of DERs**	BTM battery
Market structure	Not in organized market, utility owns generation	**Upfront investment cost**	$5 million
Location	Utah	**Time to operationalize**	3 years
Size of utility	1.2 million customers (5.58 GW peak demand)	**Number of customers enrolled in VPP**	4,200
Compensation structure	» Upfront cash enrollment incentive based on battery capacity available for discharge. As of 2023, up to $600 per kW, with the highest incentive offered to customers who are "firming" existing distributed solar. » Ongoing participation incentive in the form of an annual bill credit of $15 per kW, starting in the second year of participation.		
Grid services	» Fast frequency response, daily load cycling		

Utility objectives with VPP program (not exhaustive)

- **Keep costs low** (some of the lowest energy prices in the nation) by procuring bulk grid and distribution grid services including energy, capacity, and fast frequency response to cost-effectively transition to a decarbonized power supply.
- **Improve resilience** and reduce severity of weather-related outages by providing backup power from BTM batteries to customers.
- **Decarbonize power supply** by maximizing usage of cheap solar and reduce reliance on peaker plants by charging batteries during the day and discharging batteries during peak periods (supporting decarbonization goals of cutting greenhouse gas emissions by 70% by 2030 and 100% by 2050[clxxxvi]).

Program summary

Rocky Mountain Power developed its Wattsmart battery VPP to deliver high-value grid services cost-effectively and increase battery adoption among customers. By obtaining a "full stack" of valuable grid services from the batteries, RMP creates significant value for the grid and in turn pays participants both an upfront and an ongoing performance incentive that helps offset the purchase price of the battery. Wattsmart is among the most advanced VPPs in the U.S. due to its degree of integration into the utility's overall system operations and the wide array of uses (grid services) of the battery aggregation. Unlike VPPs used only during peak hours or peak seasons (summer, winter), RMP may use its batteries 365 days of the year, 24 hours per day.

RMP directly dispatches the batteries using a distributed battery grid management system (DGBMS) that integrates into the utility's energy management system without any intermediate layer of an edge-DERMS.

The network of batteries can respond to dispatch signals in as little as three seconds (sonnen and Core+ batteries) and no slower than 50 seconds (other brands). The system is programmed to dispatch targeted clusters of batteries daily to support peak periods and as needed in response to real-time grid conditions and solar output, which are monitored and communicated via RMP's Energy Management System. The VPP delivers eight grid services:

- System-level demand response and peak shaving
- Firm dispatchable capacity for system requirements
- Storage of renewable energy for dispatch to meet grid load requirements
- Secondary frequency response to load and inject power to rebalance system frequency
- Daily load cycling to charge batteries during low-cost off-peak periods and discharge batteries during peak hours
- Backup power for resiliency
- Non-wires alternative for local load pocket decongestion
- Spinning and non-spinning reserve capacity to provide emergency stabilization power

RMP worked closely with battery manufacturer and software provider sonnen to ensure the battery chemistries and controls would allow for multiple battery dispatches per day in addition to a high degree of visibility and control.[109] The Wattsmart VPP is growing rapidly, with a near-term goal of reaching 100 MW by recruiting customers with solar arrays (>80,000 in Utah) and offering battery incentives to motivate customers to 'firm' their renewable power.

109 Sonnen underwent rigorous certification and testing to ensure the program met all necessary cybersecurity requirements.

Delivered outcomes

- **Reduced costs for all customers** by storing excess renewable energy during low-cost off-peak periods (<3 cents kWh) and dispatches that energy during high-cost peak periods (costs as much as 10x more) to reduce system peaks.
- **Improved customer resilience without raising rates,** enrolling over 5,000 customers in the program and equipping each with backup power.
- **Achieved high usage for real-time system needs** by calling 153 real-time frequency response events from October 2023-November 2024.
- **Developed standards for battery manufacturers** by establishing a clear roadmap for battery designs that ensures products are able to integrate with utilities systems.
- **Developed an open innovation platform** to continually improve based upon customer feedback and inclusion of new innovation.[110,clxxxvii]

See delivered outcomes section for visualizations of battery dispatch data for peak management operations and distribution circuit congestion event.

VPP communication protocols & operations

Rocky Mountain Power works with sonnen to operate WattSmart in the following way:

1. Rocky Mountain Power's grid operating team can view the real-time grid services available from sonnen's VPP within their existing SCADA system– the team does not need to log into any other system due to API integrations.
2. If services from Wattsmart batteries are required to manage the electric grid, the SCADA system will automatically send a signal to the VPP, or the grid operating team can select an option from their operations screen.
3. Sonnen's VPP software layer receives the dispatch signal in real-time and calls the necessary sonnen batteries and non-sonnen batteries to respond.
    a. Batteries typically respond within 5 seconds and no longer than 50 seconds.
    b. The batteries respond and use the same channels to send operational data back to sonnen's VPP.[111]
4. The VPP provides real-time operational data to Rocky Mountain Power sharing how batteries are performing with 2-3 second precision.
5. The VPP software layer, in combination with Wattsmart program qualified battery, is optimized for all eight primary grid services that benefits both customers and utilities.[clxxxviii]
6. Sonnen's VPP software layer receives the dispatch signal in real-time and calls the necessary sonnen batteries and non-sonnen batteries to respond.
    a. It calls sonnen's batteries through direct dispatch instructions and receives direct operational data from these batteries in real-time.
    b. It calls non-sonnen batteries by sending dispatch instructions using IEEE 2030.5 protocols to an IEEE 2030.5 compliant server in Germany and in the U.S. This server then sends dispatch instructions to the non-sonnen batteries using IEEE 2030.5 protocols, ensuring no concern of

110 For an in-depth, 20-page case study of the program benefits realized by Utah's Wattsmart Battery program across frequency regulation services, peak load management, congestion relief, and backup power, see 'Utah WattSmart Batteries Program: Grid Service Benefits Analysis.'

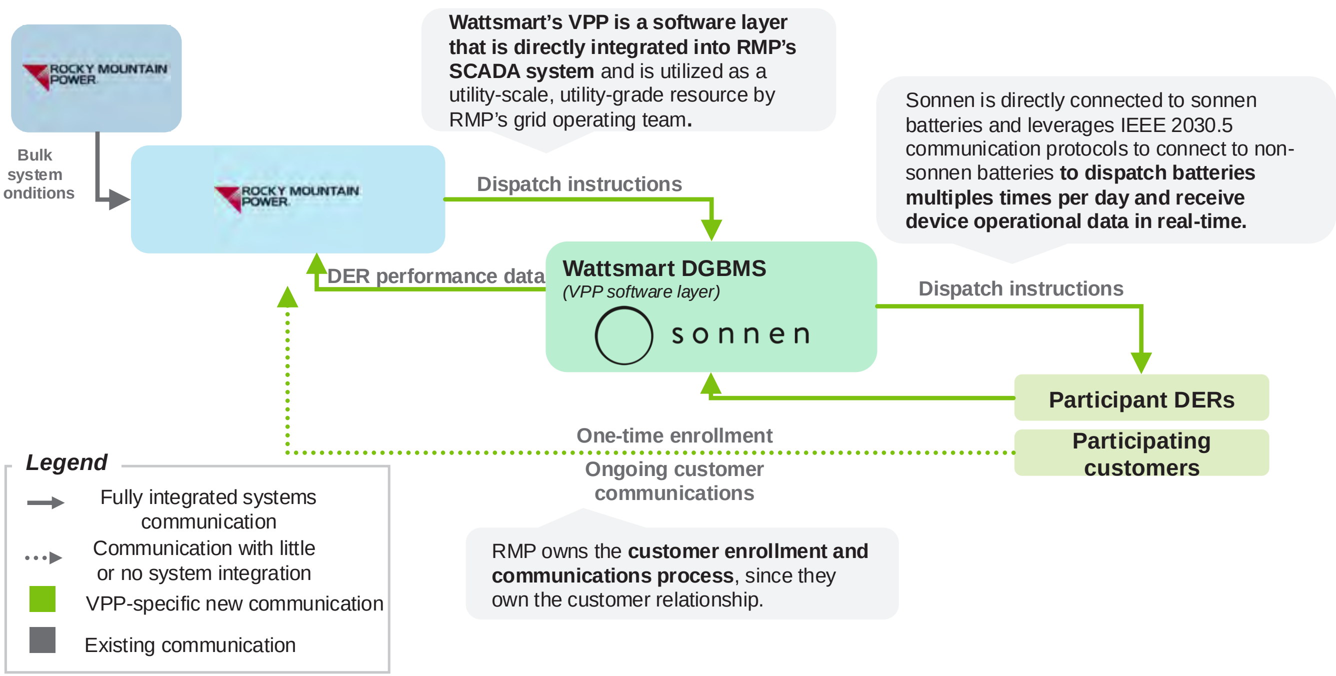
111 The Wattsmart Battery program requires participating batteries to be IEEE 2030.5 protocol compliant, ensuring no intellectual property exchange occurs while utilizing RMP's SCADA system and sonnen's VPP.

intellectual property exchange between battery manufacturers. The batteries respond and use the same channels to send operational data back to sonnen's VPP.

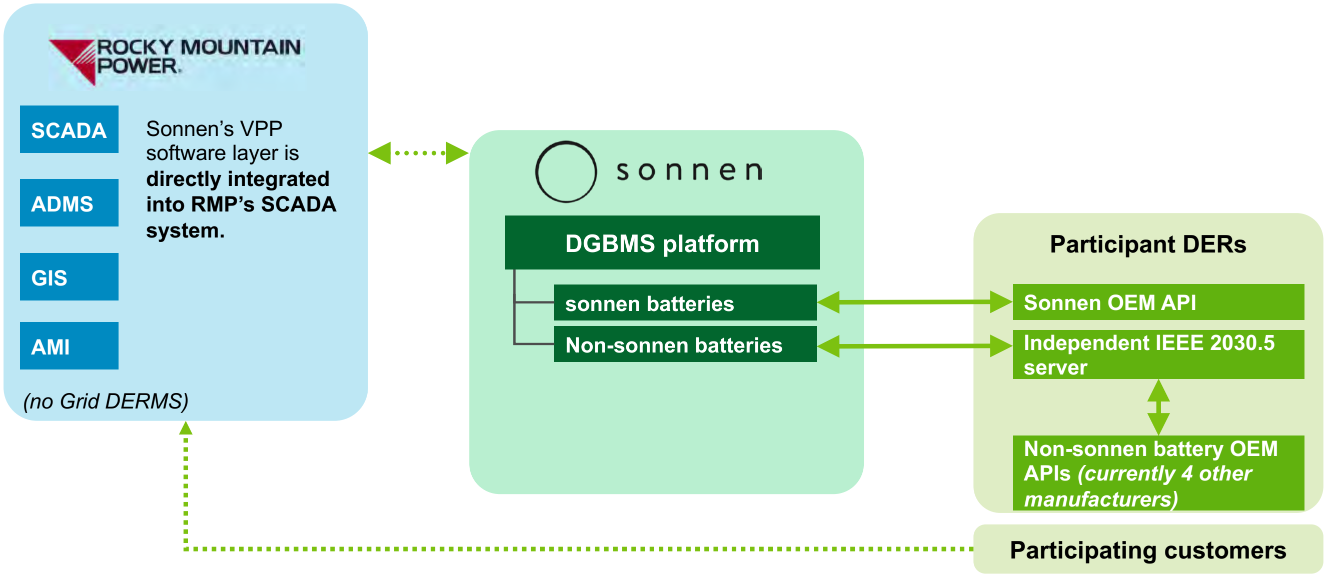
7. After dispatching necessary batteries, sonnen provides real-time operational data to Rocky Mountain Power sharing how batteries are performing with 2-3 second precision.[112]

8. In addition, sonnen's VPP software layer optimizes for daily load cycling, directing batteries to soak up solar when it is cheap during the day and discharge batteries during daily peak hours.

VPP communications



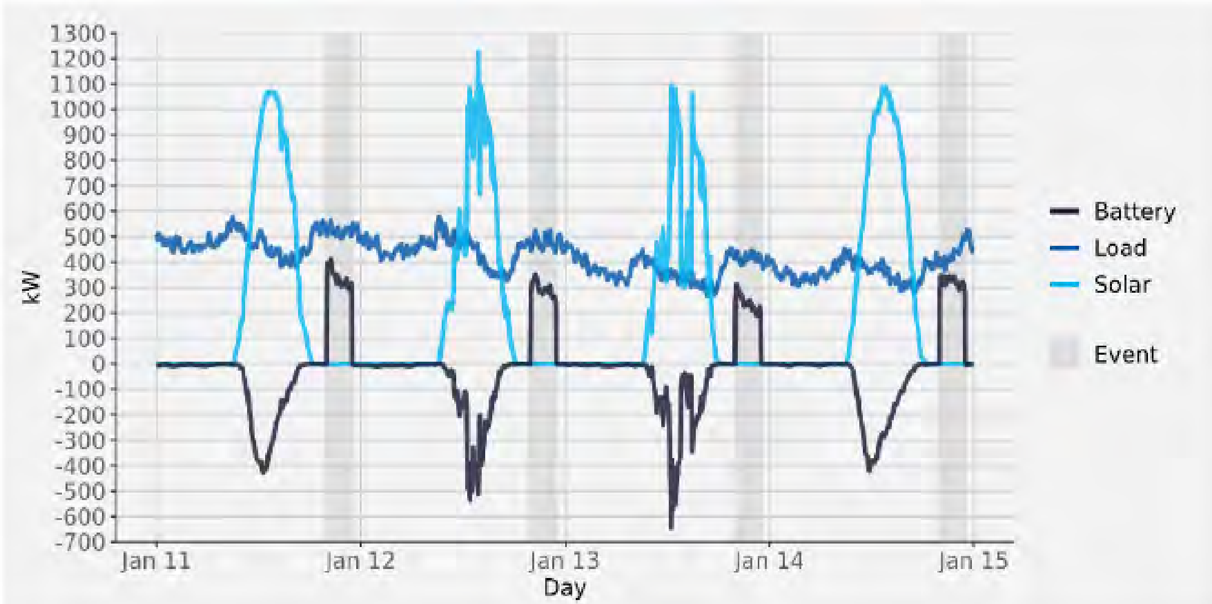
IT and OT components



112 Long term, this operational data helps RMP and sonnen understand the value and performance of the system to improve operations and inform proposed customer incentives.

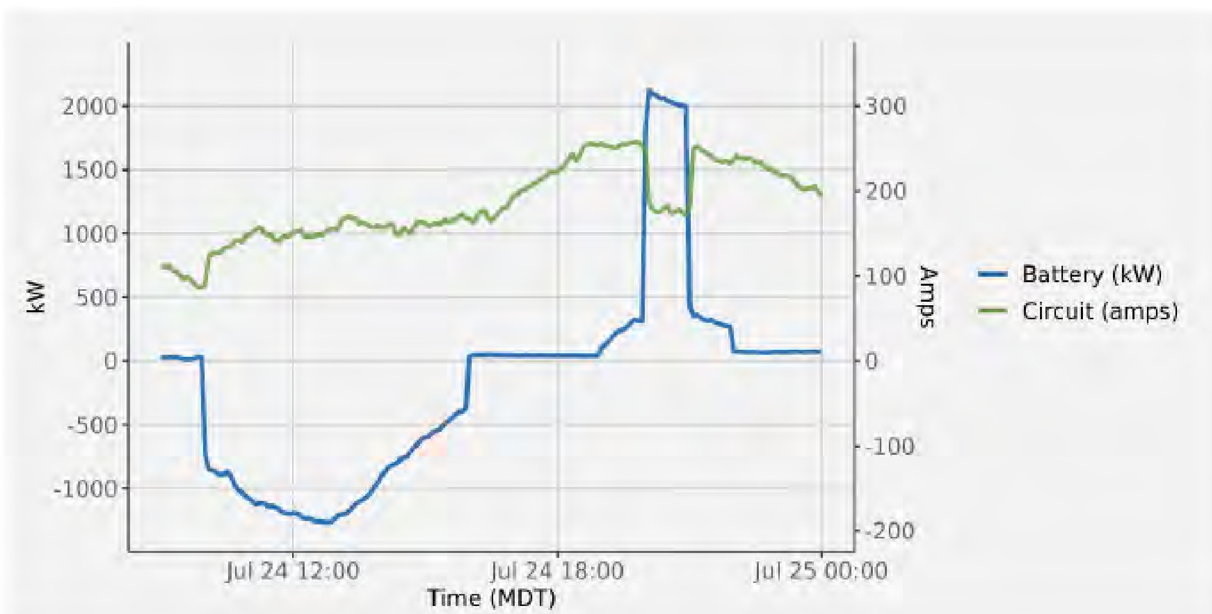
Delivered outcomes

Peak management operations: The chart below shows four days in January 2021 when RMP dispatched battery systems in the evening that had been charged with solar earlier in the day to reduce peak demand during evening peak hours of 8 pm to 11 pm (peak events are depicted by the darker gray bars).



Source: Rocky Mountain Power, Cadmus

Distribution circuit congestion event: The chart below shows the dispatch of battery systems to relieve congestion on a distribution circuit on July 24, 2021. Between 8-9pm, the Wattsmart battery systems were dispatched to reduce load at the circuit and relieve transmission congestion. In aggregate, the batteries delivered approximately 2 MW throughout the event hour during which time load at the circuit was reduced by 30%.



Source: Rocky Mountain Power, Cadmus

C.iv. Key resources for practitioners

- **Stakeholder Perspectives on the Role of Standards in Establishing a Load-Flexible Ecosystem** (August 2024, CalFlexHub) shares qualitative results of 52 stakeholder calls on the role of standards in California.

- **Cybersecurity Considerations for Distributed Energy Resources on the U.S. Electric Grid** (October 2022, DOE) provides an overview of cybersecurity considerations for DERs that can be considered by the electric sector.

C.v. Actions from the Department of Energy

- **Grid Solutions program**, a collection of tech programs, to define coordination and system requirements to enable the utilization of grid services from DERs and VPPs in collaboration with regulators and utilities

- **Distributed Resource Utilization** to support state organizations and utilities in standardizing processes between utilities and third-party DER aggregators, reducing barriers to implementation and enabling more effective operational coordination

- **Aggregator Standard Contract** to define how to govern aggregators using a standard contract for VPP and aggregator services to expedite the approval process while ensuring consumer protections

- **National EV Infrastructure Standards** to ensure federally-funded charging equipment is capable of smart charging

- **Building Energy Codes Program** to support development, adoption, implementation, and enforcement of codes to achieve energy efficiency

- **Distribution system cybersecurity baselines**, as part of the National Cybersecurity Strategy, led by NARUC and the Office of Cybersecurity, Energy Security, and Emergency Response at DOE, to develop a set of cybersecurity baselines for electric distribution systems and the DERs that connect to them

- **Distributed Energy Resource Cybersecurity Framework**, a no-cost interactive web tool, to evaluate a facility's DER cybersecurity health and provide recommendations

- **Cyber-Informed Engineering** to provide tools, case studies, and lessons to support designers, manufacturers, and asset owners in applying cyber-informed engineering principles

- **Energy Threat Analysis Center** to launch cybersecurity threat collaboration between industry and government to enable collective defense

- **VPP-related research, development, and deployment (RD&D) programs** focused on systems integration to address key technical challenges in power system planning and operations

- **EVs@Scale National Laboratory Consortium** to bring together national laboratories and key stakeholders to conduct research and development to address challenges and barriers for high-power EV charging infrastructure to enable greater safety, grid operation reliability, and consumer confidence

- **Connected Communities Program**, focusing on technical measures at the grid edge in buildings, industry, and transportation to prepare the electric grid for these new loads, and improve the resilience of customers and the grid

- **Grid Resilience Utility and Industry Grants** and **Smart Grid Grants**, which are part of the GRIP Program, to fund deployment of comprehensive transformational transmission and distribution technology to increase the flexibility, efficiency, and reliability of the electric power system and modernize the grid to reduce impacts due to extreme weather and natural disasters
- **Interconnection Innovation e-Xchange (i2X)** to provide technical assistance and engage stakeholders to improve interconnection practices and processes for electricity distribution and transmission systems
- **Sustainable and Holistic Integration of Energy Storage and Solar PV (SHINES)** to develop and demonstrate integrated PV and energy storage solutions that are scalable, secure, reliable, and cost-effective
- **Solar Technologies' Rapid Integration and Validation for Energy Systems (STRIVES)** to fund research, development, and demonstration projects to improve power systems simulation software tools and demonstrate new business models for distribution systems operations
- **Operation and Planning Tools for Inverter-Based Resource Management and Availability for Future Power Systems (OPTIMA)** to fund projects that will develop new state-of-the-art planning and operations tools for utilities and bulk system operators. These projects will help address challenges with integrating variable inverter-based renewable generation and distributed energy resources, as well as T&D coordination and co-optimization

Appendix D: Integrating into utility planning and incentives

D.i. Menu of VPP-supportive regulatory and policy options

This menu of options provides a range of choices for state and tribal regulators, policymakers, and utilities to explore alongside examples of regulators and policymakers that are implementing these strategies today. This list aims to capture the breadth of actions available to support VPP deployment but is not an exhaustive list. Two of these case studies, New York's Value of DER (VDER) Program and Massachusetts' Electric Sector Modernization Plans, have a detailed overview provided in Appendix D.ii.

Notes: These levers particularly apply to IOUs that are regulated at the state and federal level. Governing bodies of other utilities (e.g., member boards of co-ops, city councils overseeing public power, tribal utility authorities) can also look to these levers for consideration. These policy and regulatory levers identified are primarily focused on VPP related programs and are not exhaustive of the best practices and policy/regulatory levers to support grid modernization generally.

Utility cost recovery

Regulatory and policy options	Examples
▸ **Use performance-based ratemaking (PBR)**, performance incentive mechanisms, and / or multi-year rate plans ▸ A**llow utilities to include DERs and VPP foundational infrastructure (e.g., DERMS) in rate base**[113]	**Massachusetts Department of Public Utilities (DPU)** has established a performance incentive mechanism for energy efficiency programs, which includes the ConnectedSolutions VPP program; the total incentive is significant with a total of $190M profit potential for all of MA's IOUs over the current 2025-2027 planning period if the goals are met. Utilities must meet at least 80% of efficiency goals to generate any profit, with a maximum profit of up to 125% over the goal.
	Vermont PUC issued an order in 2023 (Case No. 23-1335-TF) that allowed **Green Mountain Power (GMP)** to include customer-leased batteries in its rate base, enabling GMP to earn an approved rate of return on the capital investments for the batteries.
	Michigan PSC, since 2019, has had a performance incentive (Docket U-20164) to allow **Consumers Energy** to earn up to 15% return on operations and maintenance (O&M) costs if it achieves its demand response capacity growth target (and no payment if less than 50% was achieved). In June 2024, the PUC directed Consumers (Order U-21410) to explore alternative financial incentive mechanisms with a focus on shared savings to enhance the cost-effectiveness and maximize the system impact of demand response programs.[114,clxxxix]

113 Allowing utilities to make a financial return on DER and VPP foundational infrastructure investments by including these investments in utilities' approved rate bases can be controversial as it may inequitably distribute costs among all ratepayers and deter market competition. Cost effectiveness tests can measure the net impact for customers to ensure a reduction in energy bills compared to alternate scenarios and confirm that utility-owned DERs and VPPs are the most cost-effective resources.

114 In 2023, Consumers Energy was criticized by MI PSC staff for the high cost of the demand response program (Staff's Initial Brief, U-21410) and staff recommended that the Commission not approve the program for the incentive. This led to the PUC June 2024 action to explore alternative mechanisms to reduce costs.

System planning

Regulatory and policy options	Examples
Clarify benefit-cost assessment frameworks for DERs and VPPs to ensure VPP benefits are comprehensively valued **Require VPPs to be considered in current planning processes** (e.g., IRPs, resource adequacy assessments, asset replacement, distribution system planning) so that VPPs are considered as viable options alongside conventional assets **Require integrated grid system planning** (e.g., integrated distribution system plan, integrated transmission & distribution plan, grid modernization plans) **Require open-source and/or distributed capacity procurement so that VPPs** can compete against conventional assets during capacity procurement process **Require a minimum proportion of resource adequacy procurement to be from VPPs**	**Massachusetts** passed a bill (G.L.c.164, 92B-92C) in 2022 that requires IOUs to submit Electric Sector Modernization Plans (ESMP) to achieve the state's clean energy goals.[cxc] This bill expanded existing grid modernization planning requirements initiated by the **Massachusetts Department of Public Utilities (DPU)** in 2014. The new ESMP requirements enhanced the focus on proactive upgrades to the distribution system and established a Grid Modernization Advisory Council (GMAC) as part of the process. *Detailed case study provided in Appendix D.ii.*
	Since 2018, the **Minnesota PUC** has required utilities to file Integrated Distribution System plans that include DER baseline data, future DER scenario analysis, hosting capacity, multiple time horizons (5- and 10-year), non-wires alternative analysis, and transportation electrification plans.[cxci]
	Georgia PSC approved **Georgia Power's** 2023 Integrated Resource Plan (IRP) only after the utility agreed to several stipulations, including committing to developing a distributed solar and battery storage pilot to provide grid capacity and reliability benefits and including the program in its 2025 IRP analysis.[cxcii]
	In a 2024 State of the State report, the **New York Governor** directed the **NY PSC** to implement a *Grid of the Future* proceeding to "identify smart grid technologies that enable flexible services, like virtual power plants, that can be deployed to achieve New York's clean energy goals at a manageable cost."[cxciii]
	Washington passed a bill (HB 1589) in March 2024 that requires utilities to submit integrated system plans; VPP-enabling features of the legislation include requiring plans to align with state clean energy plans and emission reduction targets and to consolidate multiple existing plans (e.g., transportation electrification plans, muti-year rate plans).

DER deployment

Regulatory and policy options	Examples
• **Provide financial incentives for DER installation** (especially for low-income customers) • **Allow utilities to subsidize DERs** (especially for low-income customers) • **Streamline DER permitting and interconnection processes** (e.g., provide incentives, set maximum review timelines) • **Publish distribution system hosting capacity maps** with clear data standards and regular update requirements • **Modify state and tribal energy codes and standards to support DER deployments** where current standards are a barrier • **Require distribution utilities to deploy a grid orchestration platform** to better manage the distribution grid and DERs	The **South Carolina PUC** is reviewing proposed modifications to **Duke Energy**'s existing On-Site Generation Service and Premier Power Service Programs that allow the utility to own, operate, and maintain backup generation on-site for large non-residential customers that can be dispatched for grid relief only during emergencies. The proposed change involves introducing a cost-sharing mechanism to incentivize customers to install on-site generation that Duke Energy can dispatch more frequently (not just during emergencies). The cost share would be based on the value of the on-site generation to the utility's system.[cxciv]
	Colorado PUC approved a performance incentive mechanism for **Xcel Energy** to speed up interconnection of DERs (Order 23AL-0188E) in October 2023. The PIM requires Xcel to refund customers 4% of the interconnection fee per day delayed beyond Xcel's internal timeline targets (e.g., 50 days). If Xcel interconnects the DER faster than the target timeline, the value would be credited against any penalties accrued for exceeding the target.[cxcv]
	In November 2024, **New Jersey Board of Public Utilities** proposed upfront fixed and ongoing performance-based incentives for front-of-the-meter and behind-the-meter distributed energy storage systems (Docket QO22080540). Distributed systems could receive $150-300/kW in combined upfront and performance payments based on system size, with additional incentives available for "overburdened communities."
	California PUC issued a series of decisions in 2019, 2020, and 2021 to streamline DER interconnection (Electric Rule 21); the decisions include requirements to establish standard interconnection agreements, conduct public hosting capacity analysis, allow DERs to perform within existing grid constraints, and avoid grid upgrades.[cxcvi] Beyond California, fourteen states across the U.S. (from **California** and **Nevada** to **Illinois** and **Minnesota** to **Maine** and **Vermont**) require utilities to publish hosting capacity maps to share data about where DERs can be deployed on the grid.[115,cxcvii] Utilities have published over 70 maps across over 25 states.
	The **New York PSC** launched a Grid of the Future proceeding (Case 24-E-0165) in April 2024 to study near-term actions that could enhance deployment of grid flexibility resources (including VPPs and DERs) and integrate these assets into grid planning and operations. Initial required elements of the plan included an inventory of what resources are needed, how much is needed, and how to procure these resources, with additional requirements being developed with stakeholder input.[cxcviii]

115 See DOE's U.S. Atlas of Electric Distribution System Hosting Capacity Maps for a summary of utilities with published maps; LBNL's Integrated Distribution System Planning map for additional detail on the states requiring hosting capacity maps, including specific docket information; and NREL's Advanced Hosting Capacity Analysis for additional detail on best practices for hosting capacity maps (e.g., development process, data validation, regulatory reviews).

DER aggregation

Regulatory and policy options	Examples
▸ **Authorize default VPP-opt in** enrollment models ▸ **Allow all DER types to participate in VPPs** (e.g., solar, storage, demand response, heat pumps, etc.) ▸ **Align VPP aggregation standards across IOUs** (e.g., data access rules) ▸ **Provide clear methods for VPP capacity accreditation** ▸ **Ensure open participation for multiple aggregators and OEMs** ▸ **Limit DER incentives to smart, connected DERs** (e.g., smart thermostats instead of standard thermostats that cannot be controlled) ▸ **Direct utilities to file VPP program plans to state PUCs** ▸ **Establish interoperability standards and communications protocols**	In response to Winter Storm Uri and related major generation shortfalls as well as industry requests to allow aggregated DERs to register as supply resources in ERCOT, the **Texas PUC** established an Aggregated Distributed Energy Resource (ADER) Pilot and Task Force (Order 53911) in 2022 to develop a VPP program. Within a year of the PUC initiating this pilot, 7.2 MW of VPP capacity was participating in the pilot and providing dispatchable power to the Texas grid.[cxcix,cc] In December 2023, Texas PUC Commissioners affirmed a desire to expand this initial program to scale VPP deployments across the state.[cci]
	In 2023, **Texas** legislators passed a bill (SB 1699) to establish third-party aggregation requirements for DERs and to authorize the TX PUC to establish rules and requirements for DER aggregators.
	Colorado PUC opened a proceeding (23M-0466EG) in September 2023 to explore implementing third-party managed VPP pilots. The resulting studies enabled additional state VPP actions, including the legislature passing a bill in 2024 requiring **Xcel Energy** to submit a VPP program plan to the PUC by 2025.
	Colorado signed into law (SB24-218) in May 2024 legislation that requires the state's largest IOU (**Xcel**) to submit a VPP plan to the PUC. This built on ongoing actions by the Colorado PUC to advance VPP programs as part of an effort to serve rising demand while mitigating costs for ratepayers.
	Maryland passed the Distributed Renewable Integration and Vehicle Electrification (DRIVE) Act (HB 1256) in May 2024 that requires the state PSC to implement regulations that support bidirectional EV charging and that establish VPP pilot programs throughout the state (including incentive mechanisms that compensate EVs and other DER owners and aggregators).

VPP operations

Regulatory and policy options	Examples
▸ **Implement compensation models that compensate VPPs for the full range of grid benefits delivered** (e.g., capacity benefit, infrastructure costs deferred, environmental benefit)	**New York PSC** has implemented a Value of Distributed Energy Resources (VDER) to compensate DERs based on their system value, including a broad range of benefits such as energy value as well as locational system relief value. *Detailed case study provided in Appendix D.ii.*
	Massachusetts DPU established a Distribution Circuit Multiplier that doubles the financial incentives for system load reduction for DERs that are sited on the top 10% most constrained circuits (published annually by the states' distribution IOUs). This enables DER companies to target sales in areas where devices can offer the greatest value to the grid. Eligible DERs include demand response, renewable generation, and storage.[116,ccii]
	CA Public Utilities Commission established the Avoided Cost Calculator (ACC) in 2005 to determine the value of DERs; the methodology is updated every other year. The avoided cost of electricity is determined based on the value of generation energy, generation capacity, ancillary services, transmission and distribution capacity, and decarbonization policy compliance.

116 See the Clean Peak Distribution Circuit Multiplier Guideline for additional information on eligible DERs, distribution circuit selection, and application processes.

D.ii. Detailed case studies

Detailed case study #1: New York: Value of Distributed Energy Resources (VDER)

Valuation model rewards DERs (and VPPs) for the full set of grid services provided.

VPP regulation summary			
Regulator	NY Department of Public Services (DPS)	**Key VPP regulation (order #)**	Order Regarding Value Stack Compensation (Case 15-E-0751)
IOUs	Con Edison, National Grid, NYSEG, Central Hudson, Orange and Rockland	**Year passed**	2017
Market structure	Within organized market (NYISO), utilities typically do not own generation	**Type of DERs**	Solar, storage, combined heat and power (CHP), digesters, wind, hydro, and fuel cells.
Key features	» Created the Value Stack, a valuation methodology used to determine and compensate DERs for a broad range of system benefits » Compensation is delivered to customers through bill credits		

State and regulator grid objectives with VPP program *(not exhaustive)*

- **Decarbonize power sector** to advance NY's state goal of 100% zero-emissions power by 2040.
- **Manage costs for ratepayers** to maximize the value of the existing grid and available cost-effective resources to reduce costs for New York ratepayers while achieving state clean energy goals.

Program summary

The NY DPS (part of the NY Public Service Commission) refined net metering models first established in 1997 to create the Value of Distributed Energy Resources (VDER) framework used today. With input from stakeholder working groups, NY DPS passed the first VDER Order in 2017, implementing two phases: i) VDER Phase One NEM, and ii) VDER Value Stack. The VDER Phase One NEM program compensates customers for any net excess generation (kWh) provided to the grid (provided as a credit to the customer's next monthly bill). The VDER Value Stack compensates customers based on the system value of the distributed generation (e.g., accounting for the hour of day, location on grid, etc).[cciii] In these early orders, NY DPS proactively included an expectation for a Phase Two to continue refining the Value Stack (e.g., modifying to account for other bulk system, distribution system, and societal values).

The VDER Value Stack compensates projects based on when and where they provide electricity to the grid. The Value Stack compensates DERs for the actual benefits delivered and the utility costs they offset, which includes a broader set of system benefits that were not accounted for in original net metering tariffs. Compensation is delivered in the form of bill credits.

Key success factors to integrate VPPs into utility planning and incentives *(not exhaustive)*

- **Assign value of DER compensation to a range of system benefits** to account for energy, capacity, environmental, demand reduction, locational system relief, and community value.
- **Align economic incentives** to compensate DERs based on monetary value delivered to the grid (not just based on volumetric generation) and allow value stacking across multiple grid benefits, including wholesale market value.
- **Provide location-specific compensation** to reward VPPs that have highest impact on alleviating distribution system constraints.

The VDER Value Stack includes six values for DER compensation:

Value name	Description	Eligible DERs
Energy Value (Locational Based Marginal Price, LBMP)	LBMP is the day-ahead wholesale energy price as determined by NYISO. It changes hourly and is different according to geographic zone.	All technologies.
Capacity Value (Installed Capacity, ICAP)	ICAP is the value of how well a project reduces New York State's energy usage during the most energy-intensive days of the year. Developers can choose from three payout alternatives: 1) pay out based on generation (kWh) delivered to the grid during the year, 2) pay out based on generation (kWh) delivered to the grid during peak windows, 3) pay out based on generation (kWh) delivered during the single peak hour of the year. Alternative 1 and 3 rates change monthly; the Alternative 2 rate is set annually.	All technologies. Dispatchable technologies (stand-alone storage, combined heating and power, digesters, and fuel cells) receive Alternative 3.
Environmental Value (E)	This the value of how much environmental benefit a clean kilowatt-hour brings to the grid and society. The E value is locked in for 25 years.*	PV, wind, hydro, and storage charged exclusively from PV or wind energy. Stand-alone storage is not eligible at this time
Demand Reduction Value (DRV)	DRV is determined by how much a project reduces the utility's future needs to make grid upgrades. DRV is locked in for 10 years.*	All technologies.
Locational System Relief Value (LSRV)	LSRV is available in utility-designated locations where DERs can provide additional benefits to the grid. Each location has a limited number of MW of LSRV capacity available. The LSRV is locked in for 10 years.*	All technologies. Project must be on a utility-specified substation.
Community Credit (CC)	CC is available on a limited basis to encourage the development of Community Distributed Generation (CDG) projects. CC is the successor to the Market Transition Credit (MTC) and is similar in structure. The CC is locked in for 25 years.*	Available for CDG projects including PV and digesters. Wind, hydro, and fuel cells receive CC at a derated value.

Table adapted from NYSERDA's Value Stack Fact Sheet (last updated in 2020).

*Projects will set a fixed rate for their E, DRV, LSRV, and CC values when they make their 25% upgrade payment to the utility. If no utility upgrade costs are required, the values are set when the interconnection agreement is fully executed.

In response to FERC Order 2222 (further discussed in *Chapter 5: Integrating into wholesale markets*), New York introduced the Wholesale Value Stack (WVS) in July 2023, which allows qualifying DER customers to receive compensation for energy and capacity from NYISO in addition to still receiving compensation from VDER environmental, demand reduction, locational system relief, and community credit values.[cciv] Value stacking improves VPP economics by allowing the VPP to qualify for multiple revenue streams (rather than capacity value alone, for example), which provides greater revenue certainty to VPP operators.[ccv]

The VDER tariff is intended to be technology agnostic but primarily focuses on distributed generation resources. DPS is currently conducting a Grid Flexibility Study to evaluate and determine appropriate compensation models that better value flexible resources.

Detailed case study #2: Massachusetts Electric Sector Modernization Plans (ESMP)

State policymakers empower PUC and utilities with stronger grid modernization planning requirements.

VPP regulation summary			
Regulator	MA Department of Public Utilities (DPU)	**Key policy and regulations**	*Legislation:* G.L. c. 164, §§ 92B-92C; An Act Driving Clean Energy and Offshore Wind, St. 2022, c. 179, §53 *PUC Order*: ESMP Order (D.P.U. 24-10/D.P.U. 24-11/D.P.U. 24-12)
IOUs in State	National Grid, Eversource, Until	**Year passed**	2022 Order passed 2024 First filings due
Market structure	Within organized market (ISO-NE), utilities do not own generation	**Type of DERs**	Distributed generation, energy storage, flexible load and demand response solutions
Key features	» Each IOU must develop an electric-sector modernization plan (ESMP) to proactively upgrade the distribution network to support the State's clean energy goals » Explicitly included goals to promote DER adoption and minimize costs to ratepayers		

State and regulator grid objectives (not exhaustive)

- **Enhance decarbonization** by enable integration of renewable energy and distributed energy resources and promoting energy storage and electrification technologies.
- **Enhance grid resilience** by improving overall grid reliability and resilience to climate driven impacts.
- **Minimize impacts to ratepayers** by prioritizing solutions to protect ratepayers while enabling decarbonization goals.

Program summary

In 2012, the MA DPU first opened a gird modernization proceeding to encourage IOUs to invest in distribution system modernization that would enhance reliability, reduce electricity costs, and empower customers.[ccvi] In 2015, the DPU approved the IOUs' first Grid Modernization Plans, preauthorizing certain grid modernization investments through 2021, including DERMS and other foundational communications infrastructure (effectively proactively deeming these as prudent investments that can be included in a utility's rate base).

Building on this work, in 2022, MA policymakers passed legislation as part of the Driving Clean Energy and Offshore Wind Act that requires investor-owned distribution companies to submit an Electric Sector Modernization Plan (ESMP) to the DPU every five years. The ESMP plans should consider nine factors, from extreme weather resilience measures to DER adoption forecasts.[117]

The MA legislature provided explicit direction and authority to the state PUC, empowering regulators to review utility investment plans in the context of broader state goals (e.g., reliability, decarbonization and electrification, affordability). The requirements established in the ESMP process, such as deploying energy storage technologies and advanced metering and telemetry, provide the necessary environment to accelerate DER adoption, establish VPP-enabling infrastructure, and deploy VPPs at scale in Massachusetts.

117 See Section 92 of the MA ESMP legislation for the full list of nine factors that must be considered in utility plans (e.g., describing the availability and suitability of new technologies (e.g., smart inverters, advanced metering and telemetry and energy storage technology) to meet forecasted reliability and resiliency needs; describing alternatives to proposed investments, including changes in rate design, load management and other methods for reducing demand, enabling flexible demand and supporting dispatchable demand response).

Key success factors for utility planning and incentives *(not exhaustive)*

- **Provide explicit direction to the PUC and utilities,** leveraging state policymakers to strengthen the regulatory authority and helped speed up action to promote cost-effective grid modernization.
- **Establish common statewide approaches** for all state IOUs to use (e.g., data access, DER monitoring and verification processes, foundational infrastructure expectations) to help standardize VPP operations and support faster deployment.
- **Adopt best practices for distribution planning** by linking planning requirements to specific grid objectives (listed below), including multiple planning horizons (5-year, 10-year, 2050), and requiring consideration of DERs.
- **Establish diverse stakeholder group,** leveraging the Grid Modernization Advisory Council (GMAC)[118] to provide input on the plans to the utilities ahead of submission to the PUC, helping keep IOUs accountable to ensure system-optimal set of solutions were considered (e.g., VPPs).

D.iii. Key resources for practitioners

VPP Resources

- **Aggregated Distributed Energy Resources in 2024: The Fundamentals** (July 2024, NARUC and NASEO) is an accessible guidebook specifically geared for state regulators and policymakers to understand the fundamentals of VPP grid services, valuation options, and approaches to compensation. **The report includes detailed case studies on MA, HI, and VT VPP programs—including context on the impetus and process that states followed to develop these programs.**
- **VPP Policy Principles** (Feb 2024, RMI and VP3) outlines simple foundational principles to support policymakers in enabling VPPs. *Policy Principles for Enabling Virtual Power Plants (VPPs)* presentation (May 2024) includes specific examples of states and utilities where these principles have been done well. See Appendix D.v. for a summary of the policy principles.
- **Distributed Power Plant Model Tariff** (June 2024, Solar United Neighbors) includes model tariff and model legislation to support state regulators, policymakers, and utilities in implementing VPP-supportive regulatory mechanisms. Solar United Neighbors developed these resources to address the gap identified by the 2023 VPP Liftoff report of a lack of model tariff language that PUCs can adapt for their state.
- **VPP Flipbook** (July 2024, RMI and VP3) includes discussion on effective VPP program design and implementation, including specific examples and resources that could support regulators and policymakers (pages 64-66).

General Grid Planning and Modernization Resources

- **50 States of Grid Modernization** (DSIRE, operated by the N.C. Clean Energy Technology Center) provides a quarterly and annual summary of state policy and regulatory actions supporting grid modernization, including VPP related proceedings. Reports include a summary of specific actions, docket and bill numbers, and broad themes.
- **Integrated Distribution System Planning** (Lawrence Berkeley National Laboratory, DOE): Includes an interactive framework, a catalog of existing state regulatory requirements and policy actions, and additional training materials and best practice information.

118 The Grid Modernization Advisory Council is a stakeholder group that reviews and advises on Massachusetts investor-owned electric distribution utilities' electric-sector modernization plans to promote transparency and engagement in grid planning for Massachusetts.

D.iv. Actions from the Department of Energy

- **Grid Innovation Program**, part of the Grid Resilience and Innovation Partnerships (GRIP) Program, provides financial assistance to states, Tribes, local governments, and public utility commissions to deploy projects that use innovative approaches to T&D and storage infrastructure to enhance grid resilience and reliability
- **Grid Resilience State and Tribal Formula Grant Program**, designed to strengthen and modernize America's power grid against wildfires, extreme weather, and other natural disasters, distributes funding to states, territories, and federally recognized Indian tribes, including Alaska Native Regional Corporations and Alaska Native Village Corporations. The states, territories, and tribes then award these funds to a diverse set of projects
- **Integrated Distribution System Planning** Training and Guidelines to assist regulators in developing requirements for, and in assessing, integrated distribution plans of utilities that consider integrating and utilizing DER services, as well as in understanding needed investments
- **Energy Innovator Fellowship** to fund recent graduates and energy professionals to support public utility commissions, co-ops, Puerto Rican energy associations, Tribes, and other grid operators
- **State Energy Program** to provide funding and technical assistance to enhance energy security, advance state-led initiatives, and increase energy affordability, with a portion of funds allocated to states for energy planning
- **DER Integration and Compensation Initiative** to engage regulators via a cooperative agreement with the National Association of Regulatory Utility Commissioners
- **Grid Modernization Initiative (GMI)** coordinates activities and strategy to create the modern grid of the future
- **State Technical Assistance program** tto provide responsive, on-demand technical assistance to PUCs and state energy offices and match them to subject matter experts at the national labs, as well as a help desk that can address quick, short inquiries
- **EVGrid Assist** to develop best practice guides in collaboration with stakeholders to share learnings, accelerate decision making, and support development of data, tools and analysis to support EV-grid integration

D.v. VPP policy principles from the Virtual Power Plant Partnership

The Virtual Power Plant Partnership (VP3) is a coalition organized by RMI, an independent nonprofit, made up of nonprofit and industry organizations focused on supporting market and policy actions to scale VPP deployment. In February 2024, VP3 released a set of VPP policy principles "to support the fair and efficient growth, integration, valuation, compensation, and advancement of virtual power plants."[ccvii]

The seventeen policy principles identified are:

Category	Principle
DER Asset Base	1. Advance policies to expand beneficial DER adoption by diverse end-users 2. Enable inclusion of all DER technologies in VPPs
VPP Design	3. Utilize best practices in program design 4. Use open communication protocols and standards 5. Enable VPP participation in wholesale and retail markets 6. Regularly update grid service needs to reflect the evolving grid 7. Support comprehensive utility planning and investment decisions
Compensation	8. Fairly compensate VPPs for services delivered 9. Enable value stacking to maximize bene its 10. Support policies that value VPP contributions to resilience, reliability, and sustainability 11. Uphold penalties and liabilities to violations of deployment policies
Customer Experience	12. Maintain customer choice in DER operational control 13. Uphold customer data ownership and simplify enrollment 14. Protect and educate customers 15. Support customer participation in structuring VPP offerings through procedural equity
Utility and System Operator Roles	16. Encourage participation of competitive hardware and service providers 17. Use open-source software and make grid data available

Access additional detail at: https://rmi.org/insight/vpp-policy-principles

D.vi. Summary of existing benefit-cost assessment frameworks from NARUC

NARUC and NASEO's Aggregated Distributed Energy Resources 2024: The Fundamentals report (which was funded by DOE) includes a summary of existing tools for valuing grid services.

Below is the excerpt of Table 13 from the report (page 45) summarizing these tools:

Summary of Existing Tools & Examples of Grid Service Valuation

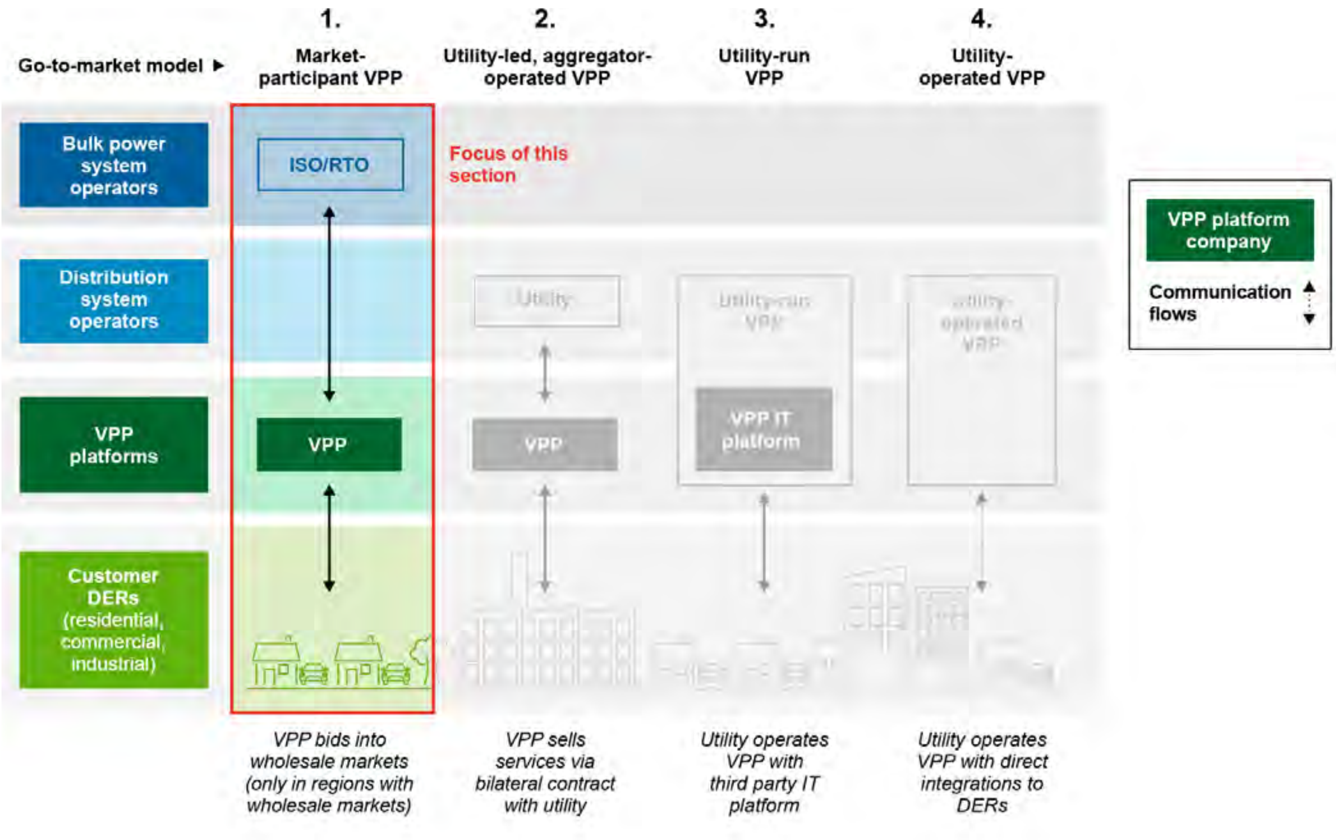
Tool / Methodology Handbook	Description	Energy Benefits Evaluated				Non-Energy Benefits Evaluated	
		Bulk Power Energy & Capacity Grid Services	*Bulk Power Essential Reliability Services*	*Distribution Grid Services*	*Grid Edge Services*	*GHGs*	*Pollutant Emissions or Social Equity*
National Standard Practice Manual (NSPM) for Benefit-Cost Analysis of Distributed Energy Resources	Summarizes the BCA principles for DERs and summarizes cost-effectiveness considerations for multiple DERs.	✔	✔	✔		✔	✔
New England Avoided Energy Supply Costs Report	Forecast of estimated annual electric and gas costs that would be avoided due to reductions in gas and electricity use and methods for estimating avoided costs.	✔	✔	✔		✔	
California Avoided Cost Calculator	Estimates '8,760' benefits by year for a DER in California.	✔	✔			✔	
New York Solar Value Stack Calculator	Calculator used to estimate the value of distributed solar in NY.	✔				✔	
Time-Sensitive Value Calculator	Calculator estimates the hourly value of ADERs.	✔	✔			✔	
LBL Interruption Cost Estimator	Estimates the value of lost load by customer type based on region and current SAIDIs and CAIDIs.			✔	✔		
Central Hudson Benefit Cost Handbook (page 587)	Detailed methodology used by Central Hudson Utility in New York for estimating all of the costs and benefits used to estimate cost-effectiveness of DERs.	✔	✔	✔		✔	

EPA Co-Benefits Risk Assessment Health Impacts Screening and Mapping Tool	Helps state and local governments explore how clean energy policies and programs affect human health and the value of the health benefits that result from these programs.						✔
Distributional Equity Analysis Guidance	Provides guidance on how utility investments in DERs impact specific populations and communities.						✔

Appendix E: Integrating into wholesale markets

E.i. Detailed case studies

The next section provides an explanation of the communication protocols for a demand response program participating in its corresponding market.



Detailed case study #1: Leap's participation in CAISO

VPP overview

Automation capabilities and partnerships with DER technology providers allow VPP scalability in California.

VPP summary			
Program operator	Leap	**VPP size** *(as of 2024)*	500 MW
Market structure	Within organized market (CAISO), utilities own generation	**Type of DERs**	Residential & commercial EV charging, residential & commercial HVAC, residential & commercial batteries, cold storage, water pumping
Location	California ISO	**Time to operationalize**	18 months

Compensation structure	» Capacity payments are based on performance against pre-determined commitments to the ISO, usually via annual contracts. » Energy payments are determined by market prices and clearing results in day-ahead and real-time markets.
Grid services	» Energy (payment from CAISO) and capacity (payment from utilities and Community Choice Aggregators)

Aggregator objectives with VPP program *(not exhaustive)*

- **Monetize DERs** through Resource Adequacy (RA) grid services programs in California.
- **Expand access to VPP participation** beyond large commercial loads, enabling homes and businesses with grid-interactive technologies to easily access these revenue streams.
- **Help reduce upfront costs of DERs** by unlocking new revenue streams for technology providers.
- **Demonstrate the viability of VPPs** as reliable flexible load.

Program summary

Leap partners with technology companies that manufacture and manage DERs to provide energy and capacity services in the CAISO market. Leap contracts with these companies to aggregate residential and commercial DERs, including battery storage systems, electric vehicle charging infrastructure, and smart building technologies.

Leap uses a software solution to integrate with partners' existing systems. Leap connects its partners to the market through API integrations.

Delivered outcomes

- **Provides capacity and energy** services that can competitively bid into CAISO markets.
- **Monetizes 500 MW** of DER capacity for ~40 technology companies.

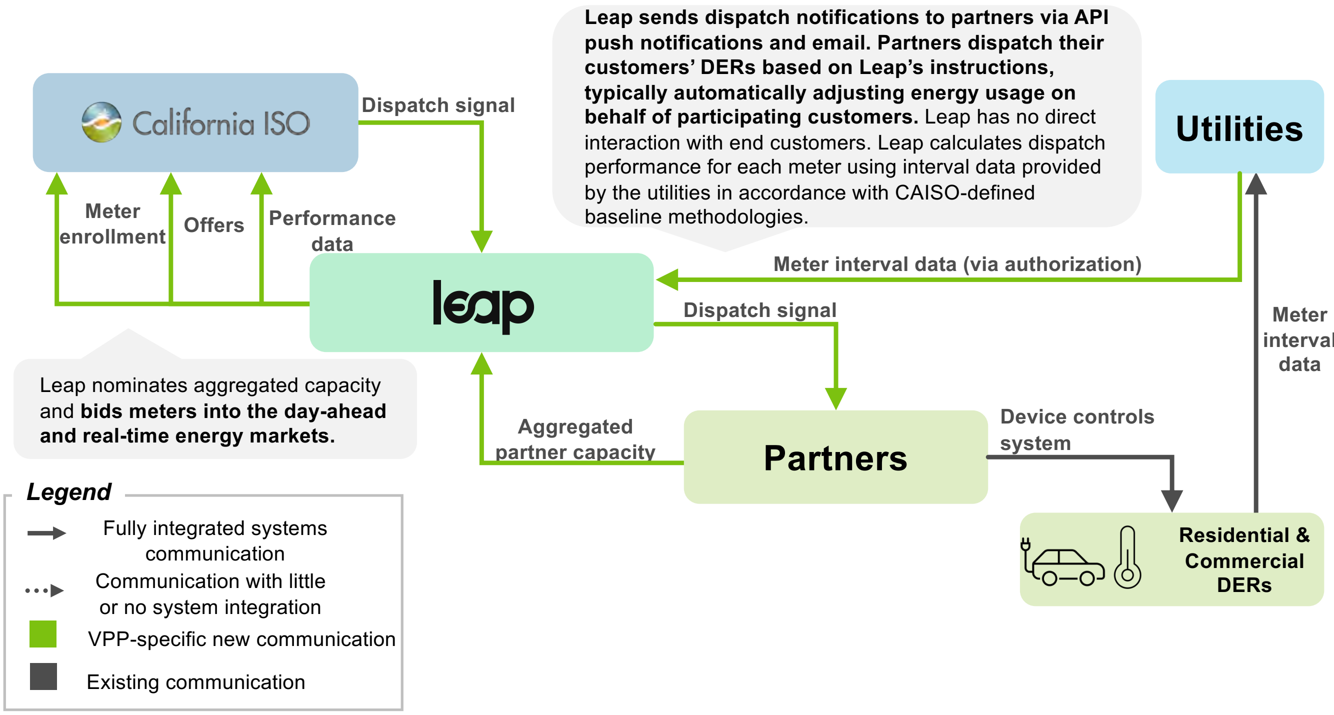
VPP communication protocols & operations

Leap operates in the CAISO energy and capacity markets:

1. Leap's partners start by determining load shed capabilities of their device portfolio, in context with their needs and participation preferences.
2. Partners invite end customers to enroll their DERs for grid services participation through the Leap platform, enabling customers to authorize access to their utility meter interval data for Pacific Gas & Electric, Southern California Edison, and San Diego Gas & Electric through a single interface.
3. Once Leap receives the utility authorization, Leap submits the service account associated with the meter through CAISO's Demand Response Registration System (DRRS) to register for participation in the appropriate programs. Partners use the Leap portal and API to track the status of program enrollment.

4. Leap sets a curtailment capacity for each meter, aggregates meters with similar characteristics, and submits the aggregation through DRRS each month. Additionally, Leap bids aggregations of customer service accounts into the energy market as a resource bid on an hourly and daily basis through CAISO's Scheduling Infrastructure Business Rules (SIBR) based on partners' bidding preferences.
5. Once CAISO chooses Leap's bids, Leap receives a dispatch signal through the CAISO Customer Market Results Interface (CMRI).
6. Leap then sends dispatch notifications to partners via API push notifications and email. Each dispatch notification will include an amount in kW that is expected to be curtailed.
7. Partners dispatch their customers' DERs, typically automatically adjusting energy usage on behalf of participating customers.
8. Leap receives interval data provided by the utilities for each of their customers. This data is used to calculate performance based on CAISO-defined baseline methodologies. Leap provides performance data through CAISO's Market Results Interface-Settlements system (MRI-S) each month.
9. Leap receives compensation for provided capacity from market counterparties such as utilities and Community Choice Aggregators (CCAs) and receives compensation for energy services from CAISO. Leap then disperses payment to partners, providing settlement and performance details through the Leap portal and API.

VPP communications



E.ii. Market operator case studies of common issue areas and potential solutions

This section provides case studies that share potential approaches that market operators can consider to address issue areas outlined in *Chapter 5: Integrating into wholesale markets* – lack of data access, varied metering & telemetry requirements, and different approaches to aggregator participation models.

Data access

Lever	Example
Create a common and standardized DER register with clear rules on data access	In 2020, the Australian Energy Market Operator (AEMO) established a centralized DER register to provide visibility of DER specifications (e.g., type, capabilities, resource ownership) and location to better manage the grid, improve system reliability as the grid becomes more decentralized, and deliver energy at a more affordable price to customers. Utilities are required to provide DER information in accordance with the DER Register Information Guidelines under the National Electricity Rules. The register provides a common, standardized information fact base that the DER industry, customers, AEMO, distribution utilities, and other third parties such as emergency services can request to access.[119,ccviii,ccix,ccx]

Metering and telemetry

Lever	Example
Establish market-wide metering standards	Ontario IESO has established market-wide standards for meter registration across numerous distribution utilities and 5 million smart meters.[ccxi] Market rules require that each metering installation used for settlement purposes is on a list of pre-approved meters established by IESO that meet specific performance standards, including meeting or exceeding 0.2% accuracy, meeting security requirements, and are programmed according to the IESO Conforming Meter Framework.[ccxii] Regulatory amendments expanded IESO's authority to process and manage bi-directional smart metering data through a centralized Meter Data Management / Repository (MDM/R) in July 2023.[ccxiii] Establishing a market-wide approach to metering simplified and standardized data collection while reducing IT costs to develop, manage, and protect the database. This spurred additional engagement with various grid partners to expand third-party access to this database, including for demand response aggregators.[ccxiv,120]
Allow sub-metering (i.e., meters embedded in DERs) for data collection	SPP, CAISO, NYISO, and MISO allow submetering as the basis for measuring DER performance and compensation for grid services provided. Submetering involves using meters embedded in DERs (e.g., inverters in batteries, meters in solar arrays) for data collection. Allowing submetering in all ISO/RTOs could increase DER participation, since nearly all generation and storage DERs already include device-level meters. The benefits of allowing sub-metering need to be determined against the potential burden of validating and verifying device-level meter data against customer metering data for settlement.
Match telemetry requirements to provided service	CAISO only requires telemetry for resources that provide ancillary services or resources above 10 MW. Rather than requiring these same strict telemetry standards across all services (e.g., 2-6 second telemetry for all DERs and all services), CAISO matches telemetry required to the services offered. This flexible approach allows assets that may not be able to provide sub-hourly telemetry to still participate in wholesale markets and all assets to benefit from reduced participation costs, particularly smaller DERs for which requiring high-frequency telemetry could be a costly barrier.[ccxv]
Allow calculated readings based on a sampling	CAISO, NYISO, PJM, and SPP allow participants to use calculated telemetry readings based on sampling rather than requiring direct telemetry for each DER to participate. This allows a greater number of DERs to participate given relaxed telemetry requirements and reduced participation costs.

119 The Australian Energy Market Commission made a rule obligating AEMO to establish this register in the National Electricity Market in September 2018. AEMO engaged with a wide range of partners, including utilities and industry groups, to design the register and align on the corresponding data sets and data collection processes.

120 Another example is ConnectedSolutions, which has metering authority across multiple utilities in Massachusetts. Common program design across utilities enables standardization of data access, dispatch, monitoring and verification, and DERMS while providing economies of scale for enrollment.

Participation models

Lever	Example
Allow DER aggregations to choose from existing participation models or a new set of participation rules for DER aggregations	NYISO and ISO-NE have adopted a hybrid approach to aggregator participation models to address concerns that existing models may limit participation from DER aggregations. This allows DER aggregators to choose to participate using the model that is most economical for them – either existing models (e.g., storage DER aggregation participating through storage participation models) or a new participation model that is specific to DER aggregations.

E.iii. Key resources for practitioners

- **DER Participation in Wholesale Markets** (January 2025), Lawrence Berkeley National Lab) provides an overview of the six most complex challenges in FERC Order 2222 compliance, various ISO/RTO approaches to address these challenges, and the roles of state energy regulators in the implementation and success of these programs.
- **FERC Order 2222 Implementation** (September 2024, Office of Electricity) shares updates on FERC Order 2222 implementation through bi-monthly reports and webinars. The website includes a DER policy tracker and a library of resources from DOE, NARUC, and NERC.
- **FERC Order 2222 Explainer** (FERC) provides a high-level overview of FERC Order 2222, how it addresses current barriers to DER participation in markets, anticipated timelines for implementation, and additional resources.
- **Grid Investments to Support FERC Order 2222** (January 2024, GridWise Alliance) discusses technologies and corresponding investments that may be required to support FERC Order 2222 implementation.
- **NARUC DER Integration and Compensation Initiative** (March 2023, NARUC) includes a summary of state actions, considerations, and enabling policies related to FERC Order 2222 implementation for state energy decision makers such as PUCs and State Energy Offices.
- **DER Integration into Wholesale Markets and Operations** (January 2022, August 2022, August 2022, ESIG) includes a series of three reports on changes required to integrate DERs into wholesale markets and operations, an assessment of DER initiatives in the UK and Australia, and a proposal for technical foundations, least-regrets strategies, and dialogue to resolve challenges in the U.S.

E.iv. Actions from the Department of Energy

- **Aggregator Code of Conduct** to address the roles and responsibilities of all participants (DER owners, VPPs, distribution system operators, bulk system operators, and regulators) to support DER integration and scale use of DER services
- **Technical assistance** for the use and applications of DERs to support distribution and bulk power system operations for ISO/RTOs, regulators, states, and communities
- **Market and Retail-rate Know-how for the Energy Transition (MARKET)**, led by the National Renewable Energy Lab and Lawrence Berkeley National Lab, to study how existing wholesale markets and retail rates may need to evolve to continue operating the electricity system without compromising reliability and cost. The portfolio of projects includes retail rates, VPPs, wholesale electricity markets, and reliability

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Building Certainty into the Electric Transition: Tools to Resist Ideological Instability

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I. Abstract: Two Propositions on Vehicle Regulation in Uncertain Times

I hope to convince you of two claims in this brief essay.

First: The Republican-appointed majority of the Supreme Court's attacks on the administrative state have destabilized environmental law,[1] and this legal breakdown has happened when the vehicle sector most needs coordination and certainty during the complex transition to electric vehicles. Accordingly, the traditional pas-de-deux in the courts between industry and the regulatory agencies, in which litigation has modified or delayed but not stopped down-the-middle regulation, is no longer a reliable dance routine. Especially in view of the death of the *Chevron* deference doctrine in June 2024,[2] a lawsuit on an emissions rule may now produce a surprise opinion from one of the ideologues on the bench ruling multiple decades of clean air rules somehow unconstitutional. The lingering prospect of a second Trump administration only heightens these risks.[3] This breakdown is bad for public health and the climate, as well as, from a narrow but important business perspective, investment certainty.

Second: Lawyers in the field would serve their clients best by abandoning the usual industry reflexive litigation position, given its likelihood of causing destructive instability and instead working towards strategies, including contractual instruments, that can insulate the zero emissions transition from legal politics. With billions on the line, an entire new infrastructure to build, novel connections between the transportation and electric and building sectors, and a shifting global trade web, the *last* thing industry needs is to find out what Samuel Alito thinks James Madison might have thought about batteries. Electoral uncertainty in the 2024 general election only heightens the need for clarity of direction. We need to find ways to empower less erratic government actors and to create new mechanisms for certainty.

II. Introduction: Shared Public and Private Interests in Decarbonization

The vehicle industry hangs between two counterposed trends. The first trend is dire: The Supreme Court's right-wing majority is dismantling environmental laws that the industry relies on for certainty. The second is positive: Zero emission vehicles (ZEVs) are more popular and economic than they have ever been, and a global transition is underway. The question I seek to address in this essay is how to ensure that transition in the United States continues sensibly, equitably, and at pace despite the ongoing legal and political uncertainty. After surveying the landscape and recent history, I propose a range of extra-regulatory measures to secure stability (as well as possible). These measures—including contractual commitments pioneered in response to Trump-era rollbacks—are urgently needed as we confront growing legal and electoral uncertainty.

To underline the key negative trend: The environmental regulatory structure that is meant to drive forward cuts to vehicle pollution, and hence to manage the transition to zero emission vehicles, is under direct and increasing political and legal attack. As Donald Trump and state-level Republicans inveigh against electric vehicles, a judicial assault is ongoing. Fossil fuel companies have captured the politics of the Republican party,[4] and that capture is reflected in the votes of the Supreme Court Justices appointed by that party. The Justices constituting the core of the Court majority, appointed by Donald Trump and George W. Bush (both presidents who lost the popular vote)[5] accurately reflect the more extreme views of their party. Over the last few terms, they have offered a poorly grounded "major question" doctrine[6] that fossil fuel interests are deploying to destabilize the ambitious regulations the Clean Air Act and similar statutes in fact require.[7] The Court's baffling "clear statement" rule invalidates statutes that offer environmental protections if those statutes are not clear enough to a Republican Justice.[8]

The most recent term has substantially accelerated instability. It included the overruling of the landmark *Chevron* deference doctrine[9] and a surprise stay of a well-established EPA rulemaking.[10] As a result of the first case, right-wing appointees now have a much clearer path to question the technical and legal judgments of vehicle regulators, substituting their own judgments of what the Clean Air Act and other relevant laws require.[11] The second case further erodes a long-standing presumption against Supreme Court stays in ordinary environmental litigation—increasing the risk that judicial preferences may be substituted for expert agency analyses at early phases of vehicle rulemaking disputes. The combined effect is a high risk of judicial caprice in place of careful design.

In worse news for the vehicle sector specifically, given this unsettling legal context, cases regarding vehicle electrification and the core California federal vehicle regulatory scheme, argued this term before the D.C. Circuit, may well reach the Supreme Court next year.[12] The first of these cases to be decided at the appellate level, for instance, upheld the California waiver program but left open the possibility of cert grants on the legality of that program next term[13] to a Court that has rapidly been cutting back the reach of settled environmental law doctrines. In sum, even as auto companies strive to compete in a global transition to electric vehicles, the basic building blocks of regulatory compliance are in ever-growing doubt.

But the second global trend towards zero emission vehicles provides tools and incentives to press on. After all, we are midway into a wholesale transition away from internal combustion engines across both cars and trucks, with zero emission vehicle sales climbing dramatically year-on-year.[14] Because zero emission vehicles are a genuinely superior technology to internal combustion engines in respect to both cost and performance[15] and the only technology fully consistent with global climate goals,[16] multiple global regions are moving forward with zero emission vehicles. Retrenchment of key standards in the United States cannot reverse the transition globally.

Indeed, the bulk of global automakers and truck engine manufacturers are committed to zero emissions futures, and plummeting battery and renewable energy prices have led the head of the International Energy Agency to deem the transition inevitable.[17] Though there has never been a viable private economic interest in continuing to cook the planet, balance sheets are now bearing this out—with the billions of the Inflation Reduction Act (IRA) pushing corporate interests to align with public ones.[18]

In light of these competing pressures and opportunities, we need not sit around and wait for the Court to do damage. It is the weakest branch of the government, and the least democratically legitimate.[19] Other actors, from the executive and Congress to state and local governments, have statutory and Constitutional duties that require supporting environmental protections and public welfare. They have tools to carry forward their own obligations despite the Court's see-sawing opinions. Indeed, state governments have previously moved the transition forward even when *both* the Court and the executive branch have been hostile,[20] and they may need to do so again. They should find support from both industry and the public in doing so, both on the merits and as a matter of normative policy.

A clear model that local and state governments can follow to protect progress in reducing greenhouse gas emissions and driving investments in zero emission vehicles (ZEVs) exists. In recent years, California and its regulatory Air Resources Board have twice concluded quasi-contractual arrangements with industry to maintain public health protections regardless of litigation outcomes—first, the "Framework Agreements on Clean Cars,"[21] and this year, the

"Clean Truck Partnership."[22] These deals, important in their own right, are also models for future efforts to align the public good with rational private interests.

These contractual mechanisms are among several potential stability-promoting tools that the Supreme Court's radical rewrite of core statutory and environmental law suggest as least-regrets approaches to supplement ongoing efforts at regulatory and statutory ambition. The emergence of these tools, as a partial response to the right-wing attack on environmental law, is a striking feature of our emerging green industrial policy at this pivotal moment—both as a practical matter in the politically pivotal autumn of 2024 and as a subject of ongoing academic study.

III. Learning from Instability: Failures of Litigation and Successes of Collaboration

This story is best told, first, historically, as the way in which these new mechanisms have emerged is instructive. It is a story about how industry and ideological right-wing pressure on a settled regulatory regime first destabilized a more typical regulatory pathway and then required creative legal efforts to reconstruct certainty.

The past several years of regulatory history show that the best approach to ideological attacks on the regulatory structure is to find ways to keep driving change forward via tools outside litigation.

A. Utilizing Multiple Regulators Provides Opportunities for Ambition.

The divided structure of vehicle regulation has historically created multiple avenues to maintain and increase ZEV momentum by deploying their combined authorities. Three separate regulators, the Environmental Protection Agency (EPA), the California Air Resources Board (CARB), and the National Highway Transportation Safety Administration (NHTSA), operate in an overlapping statutory scheme. That structure, which includes an independent and federally-protected role for California, has been particularly important during the recent Trump-era retrenchments, and can continue to secure ambition.

Under that structure, car and truck emissions are regulated under the Clean Air Act by the first two regulators, Environmental Protection Agency (EPA) and the California Air Resources Board (CARB). The joint arrangement, which Congress has repeatedly preserved, arises from

California's historical role as a pre-EPA vehicle regulator as a result of serious air quality challenges.[23] The arrangement has proven fertile, with California generally regulating more ambitiously than EPA, providing a basis for later catch-up EPA standards in an "iterative federalism" arrangement.[24] Innovations, indeed, regularly spread through large networks as Congress authorized other states with air quality issues to follow California standards at their discretion and as other international jurisdictions regularly adopted California (or EPA) programs and technologies,[25] including the now-familiar catalytic converter.[26] Given these decades of success, it is unsurprising that Congress, in the IRA, reaffirmed CARB and EPA's role in regulating emissions, including for greenhouse gas emissions and to promote ZEVs—while also providing funding to support broader adoption of standards by a network of interested states.[27]

The third regulator, the National Highway Transportation Safety Administration (NHTSA), sets on-road fuel economy standards (the corporate average fuel economy or "CAFE" standards for light-duty vehicles and heavy-duty pickup and van or "HDPUV" standards for certain heavier vehicles). The standards originate from the OPEC oil crisis of the 1970s. Congress's response, the Energy Policy and Conservation Act, charged NHTSA with reducing petroleum dependence via fuel economy.[28]

Notably, since CAFE standards preempt state fuel economy standards, the oil and auto industries have periodically tried to argue that *emissions* standards under the Clean Air Act programs run by EPA and CARB are preempted. Those arguments have repeatedly been rejected by the courts,[29] and the Supreme Court notably observed that the regimes were to be harmonized in its landmark *Massachusetts v. EPA* opinion in 2007 (albeit without discussion of CARB's specific role).[30]

Thus, the core legal structure affords multiple practical opportunities for the three agencies to push each other, to create coordinated approaches, and, in the event of retrenchments or legal setbacks in parts of the system, to maintain momentum elsewhere. When industry has seized these opportunities for mutual reinforcement via collaborative "deals," the system has helped promote a steady and beneficial transition to ZEVs. But industry has repeatedly had to learn that trying to break the system comes with disruptive costs.

B. Pre-History—The Obama "Auto Deal."

The first of these deals emerged from an initial round of fossil-fuel-backed industry-led disruption. In keeping with its usual lead role, California moved to regulate vehicle greenhouse gas emissions in the early 2000s[31] and joined with other states to petition EPA to do the same. This petition culminated in the Supreme Court's *Massachusetts* decision noted above when the George W. Bush administration, bowing to oil and auto industry pressure, declined to regulate or to grant California a waiver to do so itself. Alternatively, the tripartite regulatory structure functioned well as CARB's rules offered a different path and a constituency for progress despite retrenchment. The new Obama administration was able to use this pressure, to force a deal that unified the practical compliance requirements for all three programs and secured industry agreement, in part by functionally tying industry acceptance of that package to the bailout funds.[32] The result was a harmonized CARB/EPA/NHTSA program that significantly cut emissions and was renewed in Obama's second term.

C. The Auto Industry Unwisely Asks Trump to Intervene—And Hates the Consequences.

Unfortunately, industry opted to disrupt the program after the Trump election, renewing the regulatory pas-de-deux without a reliable dance partner. CARB and the Obama EPA had already concluded the review without incident and determined all was well,[33] but auto industry trade groups lobbied for what they appear to have conceived as limited regulatory relief (minor adjustments to timing and stringency, essentially) and initially cheered EPA's decision to make changes after a hastily redone mid-term review.[34] Applause turned to regret as the industry discovered that the Trump Administration intended to flatline progress on both carbon pollution and fuel economy standards, breaking the national program that provided investment certainty. The industry also faced sudden real planning complexities as California took defensive measures to maintain progress by severing itself from the weakened national standards.[35]

Faced with the consequences of their actions, the automakers told the administration that the rollbacks were "untenable" and profoundly disruptive; the Trump team finalized its plans anyway, undercutting company electrification plans globally.[36] Making matters even worse, Trump then pulled the waiver for California's ongoing greenhouse gas program for light-duty vehicles years after it had been issued, destabilizing billions in investment and putting California in jeopardy of violating state and federal clean air and climate mandates.[37]

D. The Framework Agreements.

Confronting years of see-sawing litigation over the waiver recission and regulatory rollbacks as well as substantial jeopardy to long-term planning, the core of the industry changed course. Five auto companies—Ford, Honda, VW, BMW, and Volvo—opened negotiations with California and the states that follow its rules (which collectively comprise almost half of the U.S. market) to maintain greenhouse gas reductions in the face of an unstable regulatory regime.[38]

The companies and CARB developed final settlement agreement contracts, distinct for each company, under CARB's contract and enforcement settlement authority. The contracts established that those companies would maintain compliance under CARB's program by reducing greenhouse gas pollution across their entire fleets in a way broadly consistent with the disrupted national program regardless of litigation outcomes (and because these agreements were much more stringent than the finalized Trump EPA and NHTSA rules, they guaranteed national compliance as well).[39] The companies got real benefits from these deals—principally, authorization to comply on a *fleet-wide basis*, thereby enabling national-scale rather than state-by-state product planning, which they ordinarily would not have been able to do under CARB's California-specific rules (or under parallel rules in states following those standards) without state-level enforcement consequences. Thus, CARB and its supporting states traded some degree of state-by-state rigor and certainty in exchange for clear progress nationally. The companies gained regulatory relief and flexibility. In essence, the deals helped knit back together the nationally harmonized program that Trump had disrupted. The deals continued through model year 2026, thereby providing for certainty on investment and product deployment regardless of the continuing legal churn over the waiver and federal program.

Other automakers were less prescient. GM maintained support, sometimes tacit and sometimes explicit, for the Trump administration until after the 2020 election.[40] Stellantis and Toyota likewise took another year or two to recognize CARB's decades-old authority—Toyota via a letter to CARB and a change in its litigation position and Stellantis ultimately via a separate agreement.[41] Meanwhile, the companies were exposed to compliance risk, a lesson they later learned at their cost.[42] Stellantis's own Framework deal with CARB responds to the product planning challenges the company created by failing to reach a deal sooner, and secures certainty by committing to follow CARB rules through 2030 regardless of litigation outcomes.[43] Toyota and GM remain uncommitted to any formal contractual arrangements.

E. Biden's Restoration, New Rules, and New Threats.

The rest of the regulatory story is quickly told. The Biden administration eventually restored the relevant waiver[44] and imposed newly stringent federal standards for the model years leading up to the mid-2020s through both EPA and NHTSA.[45] More recently, it has proposed a new round of greenhouse standards for cars[46] and trucks[47] and a new set of fuel economy standards.[48] CARB resumed its historic role as the leading regulator. Acting more ambitiously to address the climate crisis and California's persistent air quality problems, it finalized a set of zero emission vehicle standards for new cars that will effectively end internal combustion engine vehicle sales in 2035,[49] and a parallel set of rules for trucks ends heavy-duty combustion vehicle sales in 2036.[50] These rules awaited EPA waivers at the time of writing.

But the cycle threatens to begin again. Republican attorneys general and their fossil fuel allies quickly sued over the restored waiver and new federal rules, and the D.C. Circuit heard that argument in September 2023.[51] The auto companies, having learned wisdom, did not sue and generally supported the regulators. The red states instead re-raised the implausible argument that 1970s era efforts to reduce oil dependency somehow preempt CARB rules that cut combustion emissions (and so also reduce oil dependency).[52] They also have raised new challenges, asserting that EPA, for instance, violated the Republican Justices' newly created "major question doctrine" by regulating vehicles in its usual matter.[53] Ohio further posited that the standards California set for itself under the decades-old waiver provision of the Clean Air Act somehow violate its "equal sovereignty."[54] The D.C. Circuit ultimately threw out most of the claims on standing grounds, while deciding the equal sovereignty arguments were inapplicable.[55] However, cert petitions are a certainty. Even if such petitions are not granted, the same arguments are likely to be raised (doubtless with strengthened standing affidavits) on future CARB programs and EPA waiver grants, potentially along with shadow docket stay motions requests.

F. Meanwhile, Truck Engine Manufacturers (But Not the Trucking Industry) Learn from Auto Examples.

Heavy-duty vehicle manufacturers only recently found their way into the shadow of legal uncertainty cast by the Court. However, it appears they have more quickly understood the need to avoid the chaos that litigation can cause because they dropped pending litigation over California programs.

CARB recently promulgated emissions standards setting a path to 100% zero emission truck sales by 2036, along with stringent standards for remaining combustion engines.[56] Last year, the Engine Manufacturers Association (EMA) filed suit against CARB over its combustion standards[57] and signaled a coming suit against EPA should it approve the electrification rules, but those suits did not persist.[58] Facing a public outcry,[59] and potentially years of back-and-forth in the courts, EMA and its members voluntarily dismissed the suit. Instead, less than a year later, EMA followed the Framework example and formed the "Clean Truck Partnership" with CARB. The agreement committed EMA to 100% zero emission truck sales in California regardless of litigation in exchange for CARB's commitment to propose partial alignment of its combustion rules with EPA's, and a few other proposed regulatory flexibilities.[60]

G. Reflections.

A different history was possible here. In a more rational system, we could have expected the well-functioning troika of vehicle regulators to finalize rules for light- and heavy-duty vehicles to speed the zero emission vehicle transition—even under the Trump administration given the clarity of the relevant statutory commands—and issue the necessary waivers and authorizations to put the most aggressive of these rules, passed in California, into action. Then, as new on-road vehicles shifted steadily to electric, we might expect continued public and private funding of infrastructure while regulatory efforts moved on to address other aspects of the transportation system.

But that, of course, is not what happened. Instead, industry actors sought unwise (but relatively modest) rollbacks and were met with ideological radicalism from the executive branch—a radicalism that has since infected the Supreme Court as well. The result was a careening set of switchbacks on policy and law that ultimately was so costly and complex that key manufacturers instead had to seek certainty by new means in a series of non-regulatory agreements with California. In essence, because of the breakdown in the Republican-led executive branch and Court, the old industry/environmentalist dance moves around regulation instead turned into chaos that required repair.

The problem now is that, going forward, the Court (and perhaps the next President if Trump is reelected) is more likely to chaotically attack core Clean Air Act and administrative law structures than to speed the necessary transition. Litigation intended to give the Court a path to bar or limit regulatory moves away from fossil fuels in this sector is currently at the appellate level (as I noted above) and may be heard by the Court in the next year, and there is a real chance of a Trump restoration. Claims may also swiftly be brought against new waivers issued to California for its recent, and even more ambitious, round of vehicle rules. These claims will re-raise the risks of systemic legal disruption each time they are brought and create a risk of requests for immediate stays from the Supreme Court, which it is now more commonly granted.[61] Without defensive measures, another round of chaos may await what would otherwise be a rational and necessary agenda.

It is heartening that, despite these threats, anti-regulatory efforts intended to hold back the rise of ZEVs have largely turned to ashes as a practical matter. Deals to promote clear paths to ZEVs have succeeded on both public health and investment certainty metrics. That makes sense: The internal combustion engine is an inferior technology to ZEVs because ZEVs last longer, are cheaper to fuel and own, are absolutely necessary in the face of the climate crisis, and are equally necessary for states to comply with federal air quality laws.[62] Strategies that prolong investments are ultimately unstable and uneconomic. Alternate contractual mechanisms were, and are, available to maintain progress—as are a broader array of policies that can buffer against the potential disfunction we are now facing. Those mechanisms are critically important as a matter of domestic public policy, as the pace of change is at stake, and the role of American industry in a major global economic transition. Litigation challenging the laws backing that transition does not just produce costly inefficiencies and unwise investment in stranded combustion assets; it threatens to overturn core regulatory systems. Thus, what was always a poor moral and economic strategy increasingly threatens wholesale damage to all involved, including the broader American public.

IV. New Tools for Policy Coherence Despite Legal Incoherence

We will all shortly have the chance to demonstrate what we have learned. The Clean Air Act and related law should, in principle, produce a measured regulatory progression over the coming years as the three regulators conclude or soon complete what should be among the last major combustion and carbon pollution rules for each vehicle class as the sector decarbonizes and internal combustion engines become historical artifacts. But the political and legal possibilities of major system disruption are real.

Now, in a more rational polity, one might simply argue for new federal statutes to guarantee stability. After all, states blue and red have a strong interest in the transition as facilities and investments spread nationally, just as they all share an interest in a stable climate and good air quality. Indeed, a national ZEV transition statute, setting out clear timelines for each vehicle class, coordinating IRA and other federal funds, setting standards, and integrating charging infrastructure with the grid, would be helpful. But in the face of hyper-partisanship on climate, as well as the filibuster, we will likely need to manage with current law for the time being.

Attorneys interested in safeguarding certainty and the climate, should therefore learn from recent history and work to build coordination and clarity mechanisms to safeguard the transition while attending to relevant client interests. And, more broadly, state and federal policymakers and corporate actors should actively work to ensure stability in this transition, as it is both consistent with law and wholly consistent with the public interest.

A. Contractual and Public Commitments

First, given recent history, both the bar and relevant policymakers should take a serious look at non-regulatory mechanisms that can support continued progress. After all, contractual instruments with regulators in California and recognized in states following CARB rules now cover both light- and heavy-duty vehicle makers and a substantial portion of the overall market. As a result, the regulatory regime is able to rely on a measure of certainty from these agreements, private investments can be made with some protection from the Court, and both economic value and public health are protected. Given continuing risks, the expiration of some of these agreements in the near future, and their limited coverage, it is time to seriously consider what sorts of extra-regulatory arrangements can define a clear path out of combustion for both sectors.

The light-duty side is ripe to revisit this question, as current agreements soon expire. Automakers with market share sufficient to weigh strongly towards ZEVs are committed to reductions through 2026 (and Stellantis through 2030), regardless of regulatory and litigation outcomes, and now have an opportunity to negotiate towards 100% ZEV sales in the 2030s, as CARB regulations require. As cases come closer to the Court, and as EPA and NHTSA finalize their regimes, the time is ripe for companies to consider *contractually* committing to the finalized three-regulator regime. Such commitments could come in the form of renewed Framework agreements with CARB, agreements or MOUs with all three regulators, or even contracts with third parties, such as investors, environmental institutions, or others with an interest in defining the course of the ZEV trajectory.

The same equities that motivated dealmaking previously are now amply present. Ongoing and likely future litigation creates the same questions about enforcement and compliance with the potentially shifting regimes that warranted the enforcement settlements that underwrote the prior light-duty agreements. Indeed, with the IRA underwriting even larger investments now, companies, if anything, have a stronger interest in stability. State and federal policymakers, who continue to need to fulfill binding federal public health and state climate law mandates regardless of the fate of any particular regulatory regime and who seek to deliver a safe climate and efficient transportation system to their constituents, have a similar interest in stability.

Though not the only mechanism available, contractual settlements remain of considerable utility. Such contracts would provide clarity and certainty to investors and corporate boards and could also maintain the value of the "credits" for ZEVs, pollution reduction, or fuel economy (used as currency in the regulatory regimes even in the face of a litigation-driven collapse).

The heavy-duty market also has paths toward stability. Truck manufacturers have already committed to CARB for 100% ZEV sales by 2036, but that instrument is laxer with regard to states following CARB standards and offers other opportunities for clarification with regard to the national market as a whole. There is ample room to strengthen those commitments, for instance, with a recent federal strategy that helps guarantee necessary infrastructure build-out in tandem with growing truck electrification.[63]

To be sure, contracts are not simple and are not a substitute for thoughtful publicly-developed regulation. All else equal, the regulatory notice and comment process provides a greater opportunity to balance equities, seek feedback, and deliver public benefits. But the trouble is that the Court (and a potential Trump presidency) disfavor these mechanisms. Indeed, one of the ironies of the recent wave of Supreme Court opinions unsettling settled law is that though they are rhetorically couched in language about the role of the Court in preventing unexpected or sweeping regulatory overreaches and in producing predictable results, those opinions are actually sufficiently radical and unexpected as they have functionally required decision makers to seek somewhat less transparent mechanisms to respond. In essence, the Court is rhetorically calling for reasoned public decision making even as it is actually forcing the development of novel "kludges" like the enforcement settlements that are the least-bad substitute to superior regulatory solutions.

But there is room to pair regulatory approaches and new mechanisms that are in the public interest—and ways to build some of the public equities inherent to regulation into new deals. For instance, any deals must carefully account for considerations ranging from antitrust to the particularized authorities of government counterparties to contract and can also account for public feedback and comment on the equities to date and on paths forward on electrification. Public counter parties should consider how best to secure additional certainty while maintaining public transparency in this novel context. But difficulty is not a good reason to abandon the mechanism. Companies have real obligations to investors and to society to protect certainty and accelerate the ZEV transition; regulators have obligations to the public to protect public health. Both sides need durable hedge strategies that can protect progress in the face of retrenchment, and these instruments, already productive, are worth revisiting.

B. Mobilizing Alternative Public Actors with Alternate Tools

We should also consider solutions that help re-balance the destabilized government regime we face by creating other centers of policy and power that are less subject to ideological disruption by the federal judiciary or a potentially captured federal executive. We may need multiple tools to restore institutional stability. The core problem is one of political minority rule—essentially of right-wing ideological capture of the Court after a multi-decade campaign financed substantially by fossil fuel interests. Just as state agencies and corporate executives responded in the framework agreement context by building new tools to reflect the actual interest of the majority, other actors in our larger system, from governors to state legislators to members of civil society, will need to continue to find new approaches to vindicate the majority interest in environmental regulation that is repeatedly expressed in our core environmental statutes. Put plainly: The public has, for decades, voted for environmental protection and Congress has legislated accordingly. The Court is not the only Constitutional actor in this system, and it is the least democratically responsive one; other actors may need to step in to reflect the public interest.

Thus, there is a real need, now, to safeguard the ZEV transition via policy anchored by other centers of power that are relatively resilient to federal churn—especially governors and state legislatures who have a wide range of tools available to support electrification, including but extending beyond the contractual mechanisms just discussed. For example, the Clean Air Act includes broad planning and regulatory obligations extending beyond new vehicle standards; because electrification is needed to meet the Act's public health standards, states can and should continue to use all tools available to promote it. The options for policy are ample. Land-use prohibitions on internal combustion engines in certain spaces, so-called "feebates" that help fund ZEVs and disfavor internal combustion via a fee on internal combustion engines that is automatically transferred as a rebate to ZEV purchasers,[64] toxics or fuels rules requiring no further use of dangerous gasoline or diesel fuel by a certain date, liability provisions that impose substantial liability on internal combustion engine manufacturers over time, road charges that strongly favor ZEVs, fleet or indirect source rules that engage building owners and utilities in electrification, ratemaking proceedings that extend charging infrastructure … the field is open.

V. Conclusion

We are collectively deciding, now, the trajectory of planetary climate and of our civilization. We are out of time for the usual games of cat and mouse played by industry litigators, and we certainly no longer have time for the Court's ongoing ideological deregulatory project. The adults in the room have, at this point, demonstrated that progress is possible even at times of real instability. It is time to learn that lesson by pairing an ongoing regulatory push with a wider array of tools to drive forward the necessary economic and environmental transition and vindicate the public interest and the core intent of our foundational environmental statutes.

We should all hope for ambitious regulations from EPA and NHTSA, full implementation of CARB's leading program, continued equitable and deep investment from IRA programs, and legal progress on the system as a whole. Nothing in this piece is intended to suggest that these regulatory and legal mechanisms are anything other than legally necessary, scientifically essential, and morally pressing. But we also need not be sitting ducks for the latest Federalist Society pet legal theory about what eighteenth century framers might think about the power grid or Republican ideological attack on the administrative state. It is time to complement regulatory efforts with substantial additional measures to protect progress.

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expanded with the ABA's permission. I thank the editorial staff of ELQ Currents for their help in improving this article.

[1]. *See generally* Mark A. Lemley, *The Imperial Supreme Court*, 136 Harv. L. Rev. F. 97 (2022).

[2]. *Loper Bright Enter. v. Raimondo*, 144 S. Ct. 2244, 2273 (2024).

[3]. *See* Shane Goldmacher, *Trump Leads in 5 Critical States as Voters Blast Biden, Times/Siena Poll Finds*, N.Y. Times (Nov. 6, 2023), https://www.nytimes.com/live/2023/11/06/us/trump-biden-times-siena-poll-updates.

[4]. Consider, for instance, the antediluvian views of the new House Speaker, which foreshadow Republican policy efforts to come. Lisa Friedman, *New House Speaker Champions Fossil Fuels and Dismisses Climate Concerns*, N.Y. Times (Oct. 26, 2023), https://www.nytimes.com/2023/10/26/climate/mike-johnson-climate-policies.html.

[5]. *See* Ron Elving, *How the Supreme Court's Conservative Majority Came to Be*, Nat'l. Pub. Radio (July 1, 2023), https://www.npr.org/2023/07/13/1185496055/supreme-court-conservative-majority-thomas-trump-bush.

[6]. For a prescient early critique, *see, e.g., Major Question Objections*, 129 Harv. L. Rev. 2191, 2196-203 (2016).

[7]. *See generally West Virginia v. EPA*, 597 U.S. 697 (2022) (invalidating EPA carbon rules for power plants and articulating a "major questions doctrine" of uncertain reach).

[8]. *See* Richard J. Lazarus, *Judicial Destruction of the Clean Water Act: Sackett v. EPA*, U. Chicago. L. Rev. Online (2023), https://lawreview.uchicago.edu/judicial-destruction-clean-water-act-sackett-v-epa; David Owen, *Sackett v. Environmental Protection Agency and the Rules of Statutory Misinterpretation*, 48 Harvard Env. L. Rev. 333, 361 (2024), https://journals.law.harvard.edu/elr/wp-content/uploads/sites/79/2024/08/01_HLE_48_2_Owen.pdf.

[9]. *See generally Loper Bright*, 144 S. Ct. 2244 (invalidating the long-standing *Chevron* deference doctrine).

[10]. *See generally Ohio v. U.S. Env't Prot. Agency*, 144 S. Ct. 2040 (2024) (imposing a highly unusual stay of EPA clean air rules over the dissent of all three liberals and Justice Barrett).

[11]. Long-time environmental litigator Kevin Poloncarz offers a thoughtful explication of this point in an essay reposted by his firm at *How Will EPA Regulate in Loper Bright's Uncertain Wake?,* Covington (April 2024), https://www.cov.com/en/news-and-insights/insights/2024/04/how-will-epa-regulate-in-loper-brights-uncertain-wake#layout=card&numberOfResults=12.

[12]. *See* Dan Farber, *Vehicle Regulations on Trial,* Legal Planet (Sept. 13, 2023), https://legal-planet.org/2023/09/13/vehicle-regulations-on-trial/.

[13]. *Ohio v. U.S. Env't Prot. Agency*, 98 F.4th 288, 294 (D.C. Cir., 2024), *cert. docketed,* No. 24-13 (July 9, 2024).

[14]. *See* International Energy Agency, *Outlook for Electric Mobility* (April 2024), https://www.iea.org/reports/global-ev-outlook-2024/outlook-for-electric-mobility.

[15]. *See, e.g.*, Tom Randall, *Long-Range EVs Now Cost Less Than the Average New Car in the US*, Bloomberg (June 7, 2024), https://www.bloomberg.com/news/articles/2024-06-07/long-range-evs-now-cost-less-than-the-average-us-new-car (discussing for a general audience the many advantages of the technology).

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[30]. *See Massachusetts v. EPA*, 549 U.S. 497 (2007).

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[48]. Corporate Average Fuel Economy Standards for Passenger Cars and Light Trucks for Model Years 2027-2032, 88 Fed. Reg. 56128 (Aug. 17, 2023).

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[53]. *See* briefs cited *supra* note 52.

[54]. *See* briefs cited *supra* note 52.

[55]. *Ohio v. EPA*, 98 F.4th at 307-08; 314.

[56]. *See California approves groundbreaking regulation, supra* note 50.

[57]. *See Advanced Clean Cars Program, supra* note 49.

[58]. *See* Eric Miller, *EMA Drops Lawsuit Challenging CARB Rule*, Transport Topics (Aug. 25, 2022), https://www.ttnews.com/articles/ema-drops-lawsuit-challenging-carb-rule-lead-time (describing the brief life and swift death of EMA's lawsuit).

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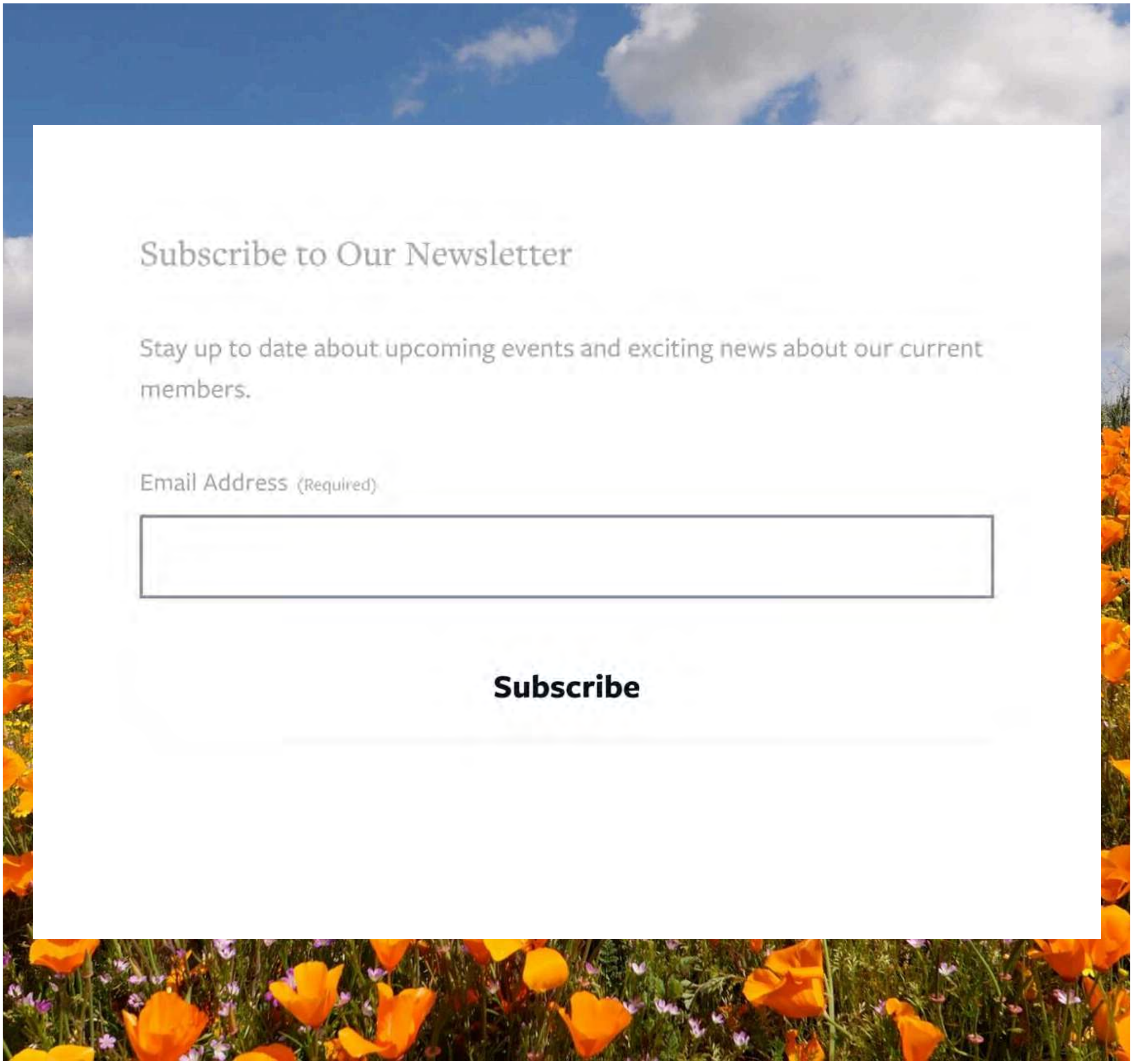

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Framework Agreements on Clean Cars

PRINT

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While California is engaging in litigation to restore its authority to protect the public health of its residents, it has finalized with six participating automakers individual bilateral agreements based upon the Framework unveiled last year.

Automakers who voluntarily agreed to the framework agreements are BMW of North America (including Rolls Royce for purposes of the agreement), Ford, Honda, Volkswagen Group of America (including VW and Audi), and Volvo.

The framework agreements are voluntary commitments that support continued annual reductions of vehicle greenhouse gas emissions through the 2026 model year, encourage innovation to accelerate the transition to electric vehicles, provide industry the certainty needed to make investments and create jobs, and save consumers money.

The auto companies party to the voluntary agreements will stay on course to make cleaner cars consistent with their individual production plans to substantially electrify their respective fleets and cut greenhouse gas emissions. The other states that have previously adopted California's cleaner vehicle standards have notified each of the Framework automakers by letters that they will also support the Framework agreements.

Each of the automobile manufacturers that have finalized Framework agreements have made additional and individual commitments to expedite the transition to zero-emission vehicles. These agreements, designed to further advance innovation and investment, are memorialized in a separate appendix for each company, and are designated as Confidential Business Information because they relate to specific model production plans and similar matters. Generally they promote enhanced distribution of zero-emission vehicles.

Under the framework agreements, gasoline and diesel cars and light trucks will get cleaner through 2026 at about the same rate as the former Obama-era program, preventing hundreds of millions of tons of greenhouse gas emissions over the lifetime of the agreements.

Final signed agreements

Timeline on agreements and related issues

CARB's mission is to promote and protect public health, welfare, and ecological resources through effective reduction of air pollutants while recognizing and considering effects on the economy. CARB is the lead agency for climate change programs and oversees all air pollution control efforts in California to attain and maintain health-based air quality standards.

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CARB and truck and engine manufacturers announce unprecedented partnership to meet clean air goals

The new Clean Truck Partnership agreement offers flexibility to address public health of Californians and the needs of fleet manufacturers that build the technology required for the transition to zero-emissions

PRINT

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CATEGORIES

Topics Freight & Goods Movement

Programs Advanced Clean Trucks, Advanced Clean Fleets, Heavy-Duty Low NOx

SACRAMENTO – The California Air Resources Board announced a Clean Truck Partnership today with the nation's leading truck manufacturers and the Truck and Engine Manufacturers Association that advances the development of zero-emission vehicles (ZEVs) for the commercial trucking industry, which includes flexibility for manufacturers to meet emissions requirements while still reaching the state's climate and emission reduction goals.

The Clean Truck Partnership, which includes Cummins, Inc., Daimler Truck North America, Ford Motor Company, General Motors Company, Hino Motors Limited, Inc., Isuzu Technical Center of America, Inc., Navistar, Inc., PACCAR Inc., Stellantis N.V., Truck and Engine Manufacturers Association, and Volvo Group North America, marks a commitment from the companies to meet California's vehicle standards that will require the sale and adoption of zero-emissions technology in the state, regardless of whether any other entity challenges California's authority to set more stringent emissions standards under the federal Clean Air Act. In turn, CARB has agreed to work collaboratively with manufacturers to provide reasonable lead time to meet CARB's requirements and before imposing new regulations and to support the development of necessary ZEV infrastructure.

"The unprecedented collaboration between California regulators and truck manufacturers marks a new era in our zero-emission future, where we work together to address the needs of both the trucking industry and the Californians who deserve to breathe clean air," said **CARB Chair Liane Randolph**. "This agreement makes it clear that we have shared goals to tackle pollution and climate change and to ensure the success of the truck owners and operators who provide critical services to California's economy."

EMA President Jed Mandel said, "This agreement reaffirms EMA's and its members' longstanding commitment to reducing emissions and to a zero-emissions commercial vehicle future and it demonstrates how EMA and CARB can work together to achieve shared clean air goals. Through this agreement, we have aligned on a single nationwide nitrogen oxide emissions standard, secured needed lead time and stability for manufacturers, and agreed on regulatory changes that will ensure continued availability of commercial vehicles. We look forward to continuing to work constructively with CARB on future regulatory and infrastructure efforts designed to support a successful transition to ZEVs."

The terms of the Clean Truck Partnership include:

- CARB will align with EPA's 2027 regulations for nitrogen oxide emissions. CARB also will modify elements of the 2024 NOx emission regulations for which manufacturers will provide offsets as necessary to maintain California's emission targets.
- CARB commits to providing no less than four years lead time and at least three years of regulatory stability before imposing new requirements.
- Truck manufacturers commit to meeting CARB's zero-emission and criteria pollutant regulations in the state regardless of any attempts by other entities to challenge California's authority.

The Clean Truck Partnership comes as California prepares for implementation of its landmark rules that put in place a phased-in transition toward 100% sale and use of zero-emissions technology for medium- and-heavy duty vehicles under CARB's Advanced Clean Trucks and Advanced Clean Fleets rule by 2045. In March, the Biden administration approved California's waiver under the federal Clean Air Act that allows the state to become the first in the world to require zero-emissions technology for trucks. By working together, California air quality regulators and truck manufacturers will ensure that the technology, infrastructure and supply will be available to meet the state's ambitious clean air goals.

View Agreement

Below are quotes from participating manufacturers on the Clean Truck Partnership:

"Cummins continues to be committed to working collaboratively with CARB toward a zero emissions future. We appreciate CARB's commitment to providing flexibilities as we transition to zero emissions, and for their efforts to align with EPA's 2027 standards. We also welcome CARB's commitment to collaborate in the further development of ZEV infrastructure needed for our customers to adopt these technologies. These actions will enable Cummins to improve product availability for our customers, while delivering significant emissions reductions," said Shelley A. Knust, Vice President of Product Compliance and Regulatory Affairs for **Cummins Inc**.

"At Daimler Truck we continue working towards achieving our goal of offering only carbon-neutral vehicles by 2039. For the overall industry transformation to become a reality, we believe the key to success is a close collaboration with all our stakeholders," said Sean Waters, Vice President of Product Compliance and Regulatory Affairs for **Daimler Truck**.

"Ford remains committed to working collaboratively with the California Air Resources Board and the Truck and Engine Manufacturers Association. During this extraordinary period of transition in the automotive industry, automakers need harmonization between programs to help meet our shared goal of lowering emissions from transportation to improve air quality, human health and the environment. This alignment between California and the Environmental Protection Agency's national standards for model year 2027 and beyond will help us get more clean trucks on the road across the country," said Cynthia Williams, Global Director Sustainability, Homologation and Compliance at **Ford Motor Company**.

"Navistar is committed to offering our customers products and services which support a sustainable future. This agreement enables the regulatory certainty we all need to prepare for a future which will include ever increasing volumes of low and zero-emissions technologies," said Michael Noonan, Director Product Certification and Compliance for **Navistar**.

“PACCAR is committed to supporting the environmental goals of California and the nation as a whole and welcome the harmonization of future emissions regulation. This agreement provides regulatory certainty and supports a balanced transition to zero emissions by ensuring continued supply of product into California and opt-in states,” said John Rich, Chief Technology Officer for **PACCAR**.

“The Volvo Group is pleased to support this joint agreement between the California Air Resources Board and the Truck and Engine Manufacturers Association. We believe this lays the foundation for our customers to have the greatest possible product availability consistent with California’s climate change and air quality goals. Through cooperative efforts such as this, the Volvo Group believes we can achieve the quickest and least disruptive transition to a commercial zero-emission vehicle future,” said Dawn Fenton, Vice President, Government Relations & Public Affairs for **Volvo Group North America.**

CARB's mission is to promote and protect public health, welfare, and ecological resources through effective reduction of air pollutants while recognizing and considering effects on the economy. CARB is the lead agency for climate change programs and oversees all air pollution control efforts in California to attain and maintain health-based air quality standards.

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Vehicle Make and Model	Parent Company	Vehicle Weight Class	Body Type	In Production / Delivered to Customer	Accepting Orders	Pre-Production Demonstration	Notes
ARBOC Equess Charge	NFI Group	Class 8	Transit Bus	-	X	-	-
Arrival Van	Arrival	Class 2b	Cargo Van	-	X	-	-
Blue Bird All-American RE Electric	Blue Bird	Class 8	School Bus	X	X	-	-
Blue Bird Vision Electric	Blue Bird	Class 7	School Bus	X	X	-	-
Workhorse C650	Workhorse	Class 3	Cargo Van	-	X	-	Production scheduled to start late 2022 - 2023
BYD 6F	BYD Motors	Class 6	Box Truck	X	X	-	-
BYD 6R	BYD Motors	Class 6	Refuse truck	X	X	-	-
BYD 8R	BYD Motors	Class 8	Refuse truck	X	X	-	-
BYD 8TT	BYD Motors	Class 8	Tractor Truck	X	X	-	-
BYD 8Y	BYD Motors	Class 8	Terminal Tractor	X	X	-	-
BYD C10M 45 All-Battery Electric Coach Bus	BYD Motors	Class 8	Coach Bus	X	X	-	-
BYD C10MS 45 All-Battery Electric Double-Decker Coach Bus	BYD Motors	Class 8	Double Decker Bus	X	X	-	-
BYD C6M 23 All-Battery Electric Coach Bus	BYD Motors	Class 6	Coach Bus	X	X	-	-
BYD C8M 35 All-Battery Electric Coach Bus	BYD Motors	Class 7 - 8	Coach Bus	X	X	-	-
BYD C8MS All-Battery Electric Double-Decker Coach Bus	BYD Motors	Class 7 - 8	Double Decker Bus	X	X	-	-
BYD C9M 40 All-Battery Electric Coach Bus	BYD Motors	Class 7 - 8	Coach Bus	X	X	-	-
BYD K11M 60 Articulated All-Battery Electric Transit Bus	BYD Motors	Class 8	Transit Bus	X	X	-	-
BYD K7M 30 All-Battery Electric Transit Bus	BYD Motors	Class 7 - 8	Transit Bus	X	X	-	-
BYD K7M-ER 30 All-Battery Electric Transit Bus	BYD Motors	Class 7 - 8	Transit Bus	X	X	-	-
BYD K8M All-Battery Electric Transit Bus	BYD Motors	Class 7 - 8	Transit Bus	X	X	-	-
BYD K9M 40 All-Battery Electric Transit Bus	BYD Motors	Class 7 - 8	Transit Bus	X	X	-	-
BYD K9MD	BYD Motors	Class 8	Transit Bus	X	X	-	-
BYD Type D School Bus	BYD Motors	Class 7 - 8	School Bus	X	X	-	-
Canoo MPDV1	Canoo	Class 2b	Passenger Van	-	X	-	-
Canoo Pickup Truck	Canoo	Class 2b - 3	Pickup Truck	-	X	-	-
CCW ZEPS Bus Conversion	Complete Coach Works	Class 7 - 8	Coach Bus	X	X	-	-
Collins Bus Magellan	REV-Collins Bus	Class 8	Coach Bus	X	X	-	-
Proterra ZX5 35 ft	Proterra	Class 8	Transit Bus	X	X	-	Catalyst model replaced by "ZX5" model
Proterra ZX5 40 ft	Proterra	Class 8	Transit Bus	X	X	-	Catalyst model replaced by "ZX5" model
ElDorado National AXESS Battery Electric Transit Bus	REV-ENC	Class 8	Transit bus	-	X	-	Axess model replaced by "BRT" model
ElDorado National AXESS Fuel Cell Hybrid Transit Bus	REV-ENC	Class 8	Transit Bus	-	X	-	Axess model replaced by "BRT" model
Lightning Electric Zero Emission E-450 Box Truck	Lightning eMotors	Class 4	Box Truck	X	X	-	-
Tesla CyberTruck Single Motor RWD	Tesla	Class 2b	Pickup Truck	-		X	Expected to start production late 2022
EVT 2020 Urban Truck	EVTV	Class 3	Cab and Chassis	X	X	-	-
Ford E-Transit	Ford	Class 2b	Cargo Van	X	X	-	-
Freightliner eCascadia	Daimler Trucks	Class 8	Tractor Truck	X	X	-	-
Freightliner eM2	Daimler Trucks	Class 7	Cab and Chassis	-	X	-	-
GreenPower EV Star CC	GreenPower Motor	Class 4	Cab and Chassis	X	X	-	-
GILLIG 29;35;40 Low Floor Battery Electric Bus	GILLIG	Class 8	Transit Bus	X	X	-	-
Lightning Electric Zero Emission Transit Cargo Van	Lightning eMotors	Class 3	Cargo Van	X	X	-	-
Brightdrop EV600	GM	Class 2b	Delivery Van	X	X	-	-
GreenPower BEAST	GreenPower Motor	Class 8	School Bus	X	X	-	-

GreenPower EV Star	GreenPower Motor	Class 5 - 6	Shuttle Bus	X	X	-	-
GreenPower EV Star ADA	GreenPower Motor	Class 5 - 6	Shuttle Bus	X	X	-	-
GreenPower EV Star Cargo Plus	GreenPower Motor	Class 4	Cab and Chassis	X	X	-	-
GreenPower EV Star Plus	GreenPower Motor	Class 4	Shuttle Bus	X	X	-	-
GreenPower EV250	GreenPower Motor	Class 8	Transit Bus	X	X	-	-
GreenPower EV350	GreenPower Motor	Class 8	Transit Bus	X	X	-	-
GreenPower EV550	GreenPower Motor	Class 8	Transit Bus	X	X	-	-
GreenPower SYNAPSE Shuttle Bus	GreenPower Motor	Class 8	Shuttle Bus	X	X	-	-
Optimal E1	Vicinity Motor Corp.	Class 4	Cab and Chassis	-	X	-	-
Phoenix Zeus 500 Trucks	Phoenix Motorcars	Class 4	Cab and Chassis	X	X	-	-
GreenPower SYNAPSE 72 School Bus	GreenPower Motor	Class 8	School Bus	X	X	-	-
Hyundai Xcient Tractor	Hyundai	Class 8	Tractor Truck	-	-	X	-
Hyundai Xcient Straight Truck	Hyundai	Class 8	Cab and Chassis	-	-	X	-
IC Bus Electric CE Series	Navistar	Class 7	School Bus	X	X	-	-
Kalmar Ottawa T2E Terminal Tractor	Kalmar	Class 8	Terminal Tractor	X	X	-	-
Kenworth K270E	PACCAR	Class 6	Cab and Chassis	X	X	-	-
Kenworth K370E	PACCAR	Class 7	Cab and Chassis	X		-	-
Kenworth T680 FCEV	PACCAR	Class 8	Tractor Truck	-	-	X	-
Kenworth T680E	PACCAR	Class 8	Tractor Truck	X	X	-	-
Lightning Electric City Transit Bus Repower	Lightning eMotors	Class 8	Transit Bus	X	X	-	-
Lightning Electric Zero Emission Transit Passenger Van	Lightning eMotors	Class 3	Passenger Van	X	X	-	-
Lightning Electric Isuzu FTR / Chevrolet 6500XD	Lightning eMotors	Class 6	Cab and Chassis	X	X	-	-
SEA 4500 EV (on GMC 4500 with SEA-DRIVE Power System)	SEA Electric	Class 4 - 5	Cab and Chassis	X	X	-	-
Lightning Electric Zero Emission E-450 Shuttle Bus	Lightning eMotors	Class 4	Shuttle Bus	X	X	-	-
SEA 5500 EV (on GMC 5500 with SEA-DRIVE Power System)	SEA Electric	Class 4 - 5	Cab and Chassis	X	X	-	-
Lightning Electric Zero Emission F-550 Bus	Lightning eMotors	Class 5	Shuttle Bus	X	X	-	-
Rivian Van	Rivian	Class 2b - 3	Passenger Van	X	X	-	-
Ford F-150 Lightning (Standard)	Ford	Class 2a - 2b	Pickup Truck	X	X	-	-
Lion A Mini School Bus	Lion	Class 6	School Bus	X	X	-	-
Lion C School Bus	Lion	Class 6 - 7	School Bus	X	X	-	-
Lion D School Bus	Lion	Class 7	School Bus	X	X	-	-
Lion M Shuttle Bus	Lion	Class 6 - 7	Shuttle Bus	X	X	-	-
Lion 6	Lion	Class 6	Cab and Chassis	X	X	-	-
Lion 8-Refuse Truck	Lion	Class 8	Refuse Truck	X	X	-	-
Lion 8-Straight Truck	Lion	Class 8	Cab and Chassis	X	X	-	-
Lion 8-Tractor	Lion	Class 8	Tractor Truck	X	X	-	-
Lonestar SV S12/T12	Lonestar SV	Class 8	Terminal Tractor	X	X	-	-
Lonestar SV S22/T22	Lonestar SV	Class 8	Terminal Tractor	X	X	-	-
Mack LR Electric	Volvo	Class 8	Tractor Truck	X	X	-	-
MCI D45 CRT LE CHARGE	NFI Group	Class 8	Coach Bus	X	X	-	-
MCI J4500 CHARGE	NFI Group	Class 8	Coach Bus	X	X	-	-
Micro Bird D-Series Electric Shuttle Bus (on E450 Platform)	Blue Bird	Class 4	Shuttle Bus	X	X	-	-
Micro Bird G5 Elecric (on E450 Platform)	Blue Bird	Class 4 - 5	School Bus	X	X	-	-
Motiv EPIC F-53	Motiv Power Systems	Class 6	Cab and Chassis	X	X	-	-
Motiv on F-53 Platform Hometown Trolley	Motiv Power Systems	Class 6	Trolley	X	X	-	-
Motiv on Ford E-450 Platform School Bus	Motiv Power Systems	Class 4	School Bus	X	X	-	-
Motiv on Ford E-450 Platform Shuttle Bus	Motiv Power Systems	Class 4	Shuttle Bus	X	X	-	-
New Flyer XCELSIOR CHARGE H2 40	NFI Group	Class 8	Tranist Bus	X	X	-	-
New Flyer XCELSIOR CHARGE H2 60	NFI Group	Class 8	Transit Bus	X	X	-	-
New Flyer XCELSIOR CHARGE NG 35	NFI Group	Class 8	Tranist Bus	X	X	-	-
New Flyer XCELSIOR CHARGE NG 40	NFI Group	Class 8	Transit Bus	X	X	-	-
New Flyer XCELSIOR CHARGE NG 60	NFI Group	Class 8	Tranist Bus	X	X	-	-

Nikola TRE BEV	Nikola Motors	Class 8	Tractor Truck	X	X	-	-
Nikola TRE FCEV	Nikola Motors	Class 8	Tractor Truck	-	X	-	-
Nikola TWO FCEV	Nikola Motors	Class 8	Tractor Truck	-	X	-	-
Nova Bus LFSe	Volvo-Nova Bus	Class 8	Transit Bus	X	X	-	-
Nova Bus LFSe Plus	Volvo-Nova Bus	Class 8	Tranist Bus	-	X	-	-
SEA F-450 EV (on FORD F-450 with SEA-DRIVE Power System)	SEA Electric	Class 4 - 5	Cab and Chassis	X	X	-	-
Optimal S1LF	Vicinity Motor Corp.	Class 4	Shuttle Bus	-	X	-	-
OrangeEV T-Series	OrangeEV	Class 8	Terminal Tractor	X	X	-	-
Peterbilt 220 EV	PACCAR	Class 7	Cab and Chassis	X	X	-	-
Peterbilt 520 EV	PACCAR	Class 8	Refuse Truck	X	X	-	-
Peterbilt 579 EV	PACCAR	Class 8	Tractor Truck	X	X	-	-
Phoenix ZEUS 300 Passenger Shuttle	Phoenix Motorcars	Class 4	Shuttle Bus	X	X	-	-
Phoenix ZEUS 400 Shuttle Bus	Phoenix Motorcars	Class 4	Shuttle Bus	X	X	-	-
SEA F53 EV (on FORD F-53 with SEA-DRIVE Power System)	SEA Electric	Class 4 - 5	Cab and Chassis	X	X	-	-
SEA F-550 EV (on FORD F-550 with SEA-DRIVE Power System)	SEA Electric	Class 4 - 5	Cab and Chassis	X	X	-	-
Phoenix ZEUS 600 School Bus Type A	Phoenix Motorcars	Class 4	School Bus	X	X	-	-
Proterra ZX5 35 ft	Proterra	Class 8	Transit Bus	X	X	-	-
Proterra ZX5 40 ft	Proterra	Class 8	Transit Bus	X	X	-	-
GMC Hummer EV Pickup	GM	Class 2b - 3	Pickup Truck	X	X	-	-
Rivian R1T	Rivian	Class 2b	Pickup Truck	X	X	-	-
ROUSH CleanTech Ford F-650 Battery Electric Vehicle	ROUSH CleanTech	Class 6	Cab and Chassis	-	X	-	-
SEA M4 EV (on HINO M4 with SEA-DRIVE Power System)	SEA Electric	Class 4 - 5	Cab and Chassis	X	X	-	-
SEA M5 EV (on HINO M5 with SEA-DRIVE Power System)	SEA Electric	Class 4 - 5	Cab and Chassis	X	X	-	-
SEA 6500 EV (on GMC 6500 with SEA-DRIVE Power System)	SEA Electric	Class 6 - 7	Cab and Chassis	X	X	-	-
SEA Cascadia EV (on Freightliner Cascadia with SEA-DRIVE Power System)	SEA Electric	Class 8	Tractor Truck	X	X	-	-
SEA Econic EV (on Freightliner Econic with SEA-Drive Power-System)	SEA Electric	Class 8	Cab and Chassis	X	X	-	-
SEA NPR EV (on ISUZU NPR with SEA-DRIVE Power System)	SEA Electric	Class 4 - 5	Cab and Chassis	X	X	-	-
SEA NQR EV (on ISUZU NQR with SEA-DRIVE Power System)	SEA Electric	Class 4 - 5	Cab and Chassis	X	X	-	-
SEA F53 EV (on FORD F-53 with SEA-DRIVE Power System)	SEA Electric	Class 6 - 7	Cab and Chassis	X	X	-	-
EVT 2020 Logistics Van	EVTV	Class 4	Cargo Van	X	X	-	-
GreenPower EV Star Cargo	GreenPower Motor	Class 4	Cargo Van	X	X	-	-
SEA F59 EV (on FORD F-59 with SEA-DRIVE Power System)	SEA Electric	Class 6 - 7	Step Van	X	X	-	-
SEA F-650 EV (on FORD F-650 with SEA-DRIVE Power System)	SEA Electric	Class 6 - 7	Cab and Chassis	X	X	-	-
SEA F-750 EV (on FORD F-750 with SEA-DRIVE Power System)	SEA Electric	Class 6 - 7	Cab and Chassis	X	X	-	-
SEA FSR EV (on Isuzu FSR with SEA-Drive Power-System)	SEA Electric	Class 6 - 7	Cab and Chassis	X	X	-	-
SEA L6 EV (on HINO L6 with SEA-DRIVE Power System)	SEA Electric	Class 6 - 7	Cab and Chassis	X	X	-	-
SEA L7 EV (on HINO L7 with SEA-DRIVE Power System)	SEA Electric	Class 6 - 7	Cab and Chassis	X	X	-	-
SEA M2 106 EV (on Freightliner M2 106 with SEA-DRIVE Power System)	SEA Electric	Class 8	Cab and Chassis	X	X	-	-
Freightliner MT50e	Daimler Trucks	Class 5	Step Van	X	X	-	-

Lightning Electric Zero Emission F-53/F-59 Van	Lightning eMotors	Class 4 - 5	Step Van	X	X	-	-
SEA MB65 EV (on Freightliner MB65 with SEA-Drive Power-System)	SEA Electric	Class 6 - 7	Transit Bus	X	X	-	-
SEA F59 EV (on FORD F-59 with SEA-DRIVE Power System)	SEA Electric	Class 4 - 5	Step Van	X	X	-	-
SEA MT55 EV (on Freightliner MT55 with SEA-DRIVE Power System)	SEA Electric	Class 6 - 7	Step Van	X	X	-	-
SEA MT45 EV (on Freightliner MT45 with SEA-DRIVE Power System)	SEA Electric	Class 4 - 5	Step Van	X	X	-	-
Phoenix ZEUS 400 Transit Bus	Phoenix Motorcars	Class 4	Transit Bus	X	X	-	-
SEA NRR EV (on ISUZU NRR with SEA-DRIVE Power System)	SEA Electric	Class 6 - 7	Cab and Chassis	X	X	-	-
SEA S2 C EV (on Freightliner S2 C with SEA-Drive Power-System)	SEA Electric	Class 6 - 7	Cab and Chassis	X	X	-	-
SEA S2 EV (on Freightliner S2 with SEA-Drive Power-System)	SEA Electric	Class 6 - 7	Cab and Chassis	X	X	-	-
Workhorse C1000	Workhorse	Class 3	Step Van	X	X	-	Production started but the model will be retired after ~250 units
Tesla Semi	Tesla	Class 8	Tractor Truck	-		X	Expected to start production 2023
Thomas Built eC2 Jouley School Bus	Daimler Trucks	Class 7	School Bus	X	X	-	-
Van Hool CX45E	Van Hool NV / ABC Companies	Class 8	Coach Bus	X	X	-	-
Volvo VNR 4x2 Straight	Volvo	Class 7	Cab and Chassis	X	X	-	Production scheduled to start in Q2 2022
Volvo VNR 4x2 Tractor	Volvo	Class 8	Tractor Truck	X	X	-	Production scheduled to start in Q2 2022
Volvo VNR 6x2 Tractor	Volvo	Class 8	Tractor Truck	X	X	-	Production scheduled to start in Q2 2022
Global M3 / M4 Street Sweeper (BEV & Hydrogen)	Global Environemental Products	Class 3 - 4	Street Sweeper	X	X	-	Pilot program in NYC
GMC Hummer EV SUV	GM	Class 2b - 3	SUV	X	X	-	-
XOS Et-One	XOS Trucks	Class 8	Tractor Truck	-	X	-	-
XOS SV01	XOS Trucks	Class 6	Step Van	X	X	-	First delivery to Canada
Lightning Electric Ford Transit LEV60/120	Lightning eMotors	Class 2b - 3	Transit Bus	X	X	-	-